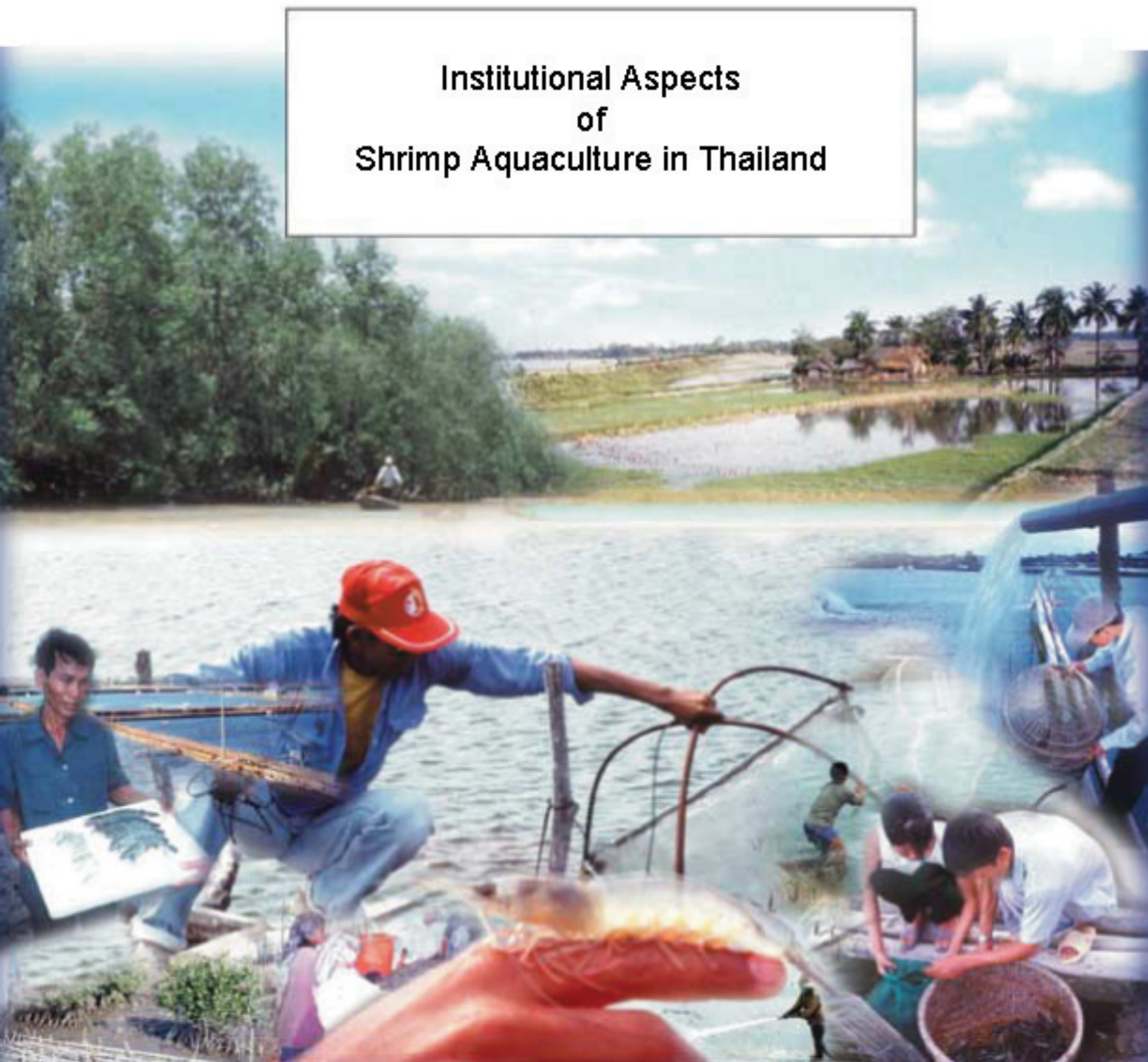


# Shrimp Farming and the Environment

## Institutional Aspects of Shrimp Aquaculture in Thailand



A Consortium Program of:



A CASE STUDY ON  
INSTITUTIONAL ASPECTS  
OF SHRIMP AQUACULTURE  
IN THAILAND

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A Report Prepared for the  
World Bank, Network of Aquaculture Centres in Asia-Pacific,  
World Wildlife Fund and Food and Agriculture Organization of the United Nations  
Consortium Program on Shrimp Farming and the Environment

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### Preparation of this document

The research reported in this paper was prepared under the World Bank/NACA/WWF/FAO Consortium Program on Shrimp Farming and the Environment. Due to the strong interest globally in shrimp farming and issues that have arisen from its development, the consortium program was initiated to analyze and share experiences on the better management of shrimp aquaculture in coastal areas. It is based on the recommendations of the FAO Bangkok Technical Consultation on Policies for Sustainable Shrimp Culture<sup>1</sup>, a World Bank review on Shrimp Farming and the Environment<sup>2</sup>, and an April 1999 meeting on shrimp management practices hosted by NACA and WWF in Bangkok, Thailand. The objectives of the consortium program are: (a) Generate a better understanding of key issues involved in sustainable shrimp aquaculture; (b) Encourage a debate and discussion around these issues that leads to consensus among stakeholders regarding key issues; (c) Identify better management strategies for sustainable shrimp aquaculture; (d) Evaluate the cost for adoption of such strategies as well as other potential barriers to their adoption; (e) Create a framework to review and evaluate successes and failures in sustainable shrimp aquaculture which can inform policy debate on management strategies for sustainable shrimp aquaculture; and (f) Identify future development activities and assistance required for the implementation of better management strategies that would support the development of a more sustainable shrimp culture industry. This paper represents one of the case studies from the Consortium Program.

The program was initiated in August 1999 and comprises complementary case studies on different aspects of shrimp aquaculture. The case studies provide wide geographical coverage of major shrimp producing countries in Asia and Latin America, as well as Africa, and studies and reviews of a global nature. The subject matter is broad, from farm level management practice, poverty issues, integration of shrimp aquaculture into coastal area management, shrimp health management and policy and legal issues. The case studies together provide an unique and important insight into the global status of shrimp aquaculture and management practices. The reports from the Consortium Program are available as web versions (<http://www.enaca.org/shrimp>) or in a limited number of hard copies.

The funding for the Consortium Program is provided by the World Bank-Netherlands Partnership Program, World Wildlife Fund (WWF), the Network of Aquaculture Centres in Asia-Pacific (NACA) and Food and Agriculture Organization of the United Nations (FAO). The financial assistance of the Netherlands Government, MacArthur and AVINA Foundations in supporting the work are also gratefully acknowledged.

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### Reference:

Nissapa, A. and S. Boromthanasarat 2002. A Case Study on Institutional Aspects of Shrimp Aquaculture in Thailand. Report prepared under the World Bank, NACA, WWF and FAO Consortium Program on Shrimp Farming and the Environment. Work in Progress for Public Discussion. Published by the Consortium. 72 pages.

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<sup>1</sup> FAO. 1998. Report of the Bangkok FAO Technical Consultation on Policies for Sustainable Shrimp Culture. Bangkok, Thailand, 8-11 December 1997. FAO Fisheries Report No. 572. Rome. 31 p.

<sup>2</sup> World Bank. 1998. Report on Shrimp Farming and the Environment – Can Shrimp Farming be Undertaken Sustainably? A Discussion Paper designed to assist in the development of Sustainable Shrimp Aquaculture. World Bank. Draft.

## **Abstract**

There are several examples in Thailand where (formal and non-formal) farmers associations and local government have worked together to facilitate the development and adoption of better management practices. The Coastal Resources Institute (CORIN) has been particularly active in working on participatory solutions to local environmental problems caused by shrimp farming. This case study documents the success and lesson's learnt from such local co-management approaches involving farmers associations and local government. The case study also shows the linkages and relationships of institutions operating at different levels of administration from farm to national levels and their effect on management.

The case study is divided into sections that presents several shrimp farming issues; an analysis of institutional supports and mechanism needs for successful shrimp farming management using two different case studies; a synthesis of type of information and delivery systems for sustainable shrimp farming; a synthesis of human skills needed for management of shrimp farming as an option for coastal zone management; and a final section that concludes the study and presents future prospects and adaptive adjustments in the long term.

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## Abbreviations and Acronymes

BOD	Biological Oxygen Demand
CCADC	Chantaburi Coastal Aquaculture Development Center
CORIN	Coastal Resources Institute
CP	Charoen Pokphang
DOF	Department of Fisheries
FAO	Food and Agriculture Organization of the United Nations
FCR	Feed Conversion Ratio
ICZDA	Integrated Coastal Zone Development Analysis
ICZM	Integrated Coastal Zone Management
KKRDC	Kung Krabaen Royal Development Study Center
Mg/l	Milligram per liter
MLS	Multi Level Stakeholders
MSL	Multi Stakeholder Level
NACA	Network of Aquaculture Centres in Asia-Pacific
NICA	National Institute of Coastal Aquaculture
Or-Bor-To	Sub-district Administration Organization
RTG	Royal Thai Government
SFG	Shrimp Farming Group
SPWDPC	Shrimp Waste Development Planning Committee
TSA	Thai Marine Shrimp Farmers Association
WB	World Bank
WWF	World Wildlife Fund

# Introduction

## Background

Agriculture has played an important role in the Thai economy and its way of life. The agricultural development approach taken by Thailand from import substitution to export industry orientation has been supported by the national policies and plans (First to present National Economic and Social Development Plans, 1961 – present). The role of agriculture – the decline of rice; agricultural trade protectionism; stiff competition; and the decline of comparative advantages – has encouraged the growth of agribusiness including shrimp farming.

**Key issues for sustainable shrimp farming taken in this study are:**

Efficiency  
Equity  
Sustainability

The development of shrimp farming has been one of the recent success stories of Thai rural diversification. But like other aspects of modernisation in this country, this development has been a two-edged sword, with enormous increase in foreign revenue earned from this source off-set by environment and social costs. As a consequence, negligence of the social and environmental issues has affected the shrimp farming industry as a whole by firstly forcing some small and poorly managed farms to cease their operations, to

be followed by bigger and better equipped farms. The reasons for such changes have not been clearly stated and proven but the consequences have been obvious that there is not just a question of efficiency (technical management) and equity (distribution of benefits), but also an involvement of sustainability.

There have been many studies on shrimp farming development in Thailand with many possible aspects ranging from purely technical to a vast and diverse discipline of social and environmental issues. This study intends to synthesize existing foundation of the shrimp farming knowledge in combination with some selected case studies, which will provide the readers with some more elaborated and practical outcomes in handling the shrimp farming with respect to its economic viability, environmental and social impact, institutional involvement and conflict minimization.

**Objectives of the Study**

With the stated four reasons and problem statement, objectives of this study are developed as follows:

- To apply ICZM concept for the development of strategic management approach to compromise conflicts arising from shrimp farming
- To systematically analyse shrimp farming situations using a Hierarchical Multi-level Stakeholder Approach
- To synthesis two shrimp farming case studies for the development of sustainable models
- To propose management solutions for further development of Thailand's shrimp farming industry



The study intends to focus on four following reasons:

First and foremost, potentially shrimp farming is a highly desirable development, providing employment, rural diversification and export earnings which fit neatly within the Thai philosophy of commercial development not only within the industrial sphere, but also in the rural sector, through the promotion of agribusiness.

Second, typical of many new boom enterprises exhibiting unusually rapid growth, the shrimp farming has produced some undesirable development of farming practices, as well as some potentially successful ones possibly capable of replication elsewhere.

Third, Thailand is one of the countries most advanced in the development of shrimp farming, and already some Thai farming practices are poised to be introduced into other countries.

Fourth, the spatial management of shrimp farming in combination with individually technical development models through a well-defined role of institutional arrangements are gateways for the potential success.

### **A Brief History of Shrimp Farm Development in Thailand**

Shrimp farming in Thailand was accidentally discovered as a by-product from salt fields along the seacoast of the Inner Gulf of Thailand. The conversion on salt fields into shrimp ponds was convenient as these fields are well linked with the sea through a network of canals facilitating shrimp farming operations. Only in the 1970s that shrimp farming became popular among few groups of investors who had financial opportunities. After a decade, the shrimp farming started to take off, concentrating on coastal lands in the upper Gulf of Thailand provinces close to Bangkok (i.e., Samut Sakorn, Samut Songkram and Samut Prakarn). The main stimulus for this growth was the rapidly increasing export price for shrimp particularly into the Japanese market. The farm operation intensity and the species cultured changed from an extensive and banana prawn (*Penaeus merguensis*) to semi-intensive or intensive and tiger prawn (*P. monodon*) aiming the export to fit well with the Japanese taste and requirements.

<b>Significant Historical Periods of Shrimp Farming in Thailand</b>	
<b>1960s</b>	Traditional aquaculture
<b>1970s</b>	Beginning to take shape
<b>1980s</b>	Boom
<b>1990s</b>	Problems
<b>2000s</b>	Better practices

Several factors contributing to the boom of the shrimp farming are a regional decline in the shrimp catch from wild source, a massive decline in Taiwanese production, and the gradual willingness of the Taiwanese to share some of the technology and expertise that they have developed over time. By 1989, Thailand had some 80,000 hectares of shrimp farms, with an output of 90,000 tons, and held 16 percent of the world market.

Thailand was the world's third largest producer of tiger shrimps after China and Indonesia, and its position moved to the second largest tiger shrimp producer in 1990, only after China. In 1992, foreign exchange earning from shrimp export represented Thailand's ninth largest sub-sector. At the stage, much of the land converted to intensive shrimp farming was in former areas used for extensive and semi-intensive operation, mangrove forests, nipa palm forests and coconut groves.

Undercapitalized former farmers, fisherfolks, government and non-government employees and small-scale business investors/ speculators with little knowledge of or expertise in shrimp farming marched for position in poorly protected public lands. There was no planning of shrimp farm lay-out, some critical mangrove forests were encroached and some farms discharged their effluents into public canals or directly into the sea. Overstocking of ponds and poor feeding efficiency added to the nutrient level of discharge water, and the concentration of farms showed the recycling of contaminated waters back into ponds. The combined effects of these actions saw the tiger shrimp farming in the Upper Gulf Provinces show signs of

environmental degradation as the expansion was without proper controls coupled with government encouragement. Shrimp mortalities and lower shrimp prices forced many farmers to leave the industry. The shrimp farming in the Upper Gulf Provinces of Thailand was over.

Shrimp farming then started in the eastern provinces toward the Cambodian border (Chantaburi, Rayong, Trat and Chonburi), and southern provinces along the Gulf of Thailand (Nakhon Si Thammarat, Surat Thani and Songkhla). Public mangrove forests and extensive areas of lowlying poor paddy land along the coast were available and local land owners (farmers, fisherfolks and local business people) entered the industry. Some small commercial investors began to buy up land, and larger companies (national and transnational) either bought up land or entered into agreements with local farmers to develop contract or cooperative shrimp farms. In 1991 it was estimated by the Department of Fisheries that nearly three quarters of Thai shrimp production came from the south. The development of the shrimp industry was strongly promoted by the national government and by provincial governors. For example in Surat Thani province, the policy became one of making Surat Thani the biggest shrimp producer in the south, and authorities organized a “Shrimp Day” as an annual celebration.

As had occurred in the Upper Gulf Provinces, the expansion exceeded carrying capacity, and poorly managed farms led to a decline of the industry. However, some of the farmers and larger private companies continued to experiment with new alternative practices and some new shrimp farming models (closed, semi-closed, alternate closed systems) were developed. But on a larger scale, shrimp farming in the eastern and southern provinces was almost over at this time.

Shrimp farming shifted to other areas to Upper Southern Provinces (Chumphon, Phang-nga and Phuket). Because of favorable environmental and weather conditions, and open-access space, these areas became the new investor hub of shrimp farming industry.

While the traditional shrimp farming practices continued in the eastern and southern parts of Thailand, inland or freshwater shrimp farming has been developed in the central plains around Bangkok (i.e., Suphan Buri, Ratchaburi, Nakhon Pathom, Ayutthaya). These areas are thought of as the rice bowl of Thailand. There were calls to put off the inland freshwater shrimp farmers for fear of ecosystem and crop farming damages, the Thai government (after several debates, studies and protests by parties affected), announced the Cabinet Resolution dated on July 7, 1998 to ban the practices. The inland shrimp farming and the imposition of ban had generated conflicts not only between shrimp farmers and rice farmers, but also institutional conflicts among government departments. Fishery officials as well as interior officials had declined to enforce the ban because they had promoted the aquaculture business (fishery officials) or they fear confrontation with the shrimp farmers. There have been arguments for the ban’s flexibility and some shrimp farms refused to comply with the ban.

Meanwhile there have been attempts to develop new culturing techniques, modern disease control methods and new substituting species in the areas that the operation was ceased. Some farmers and private

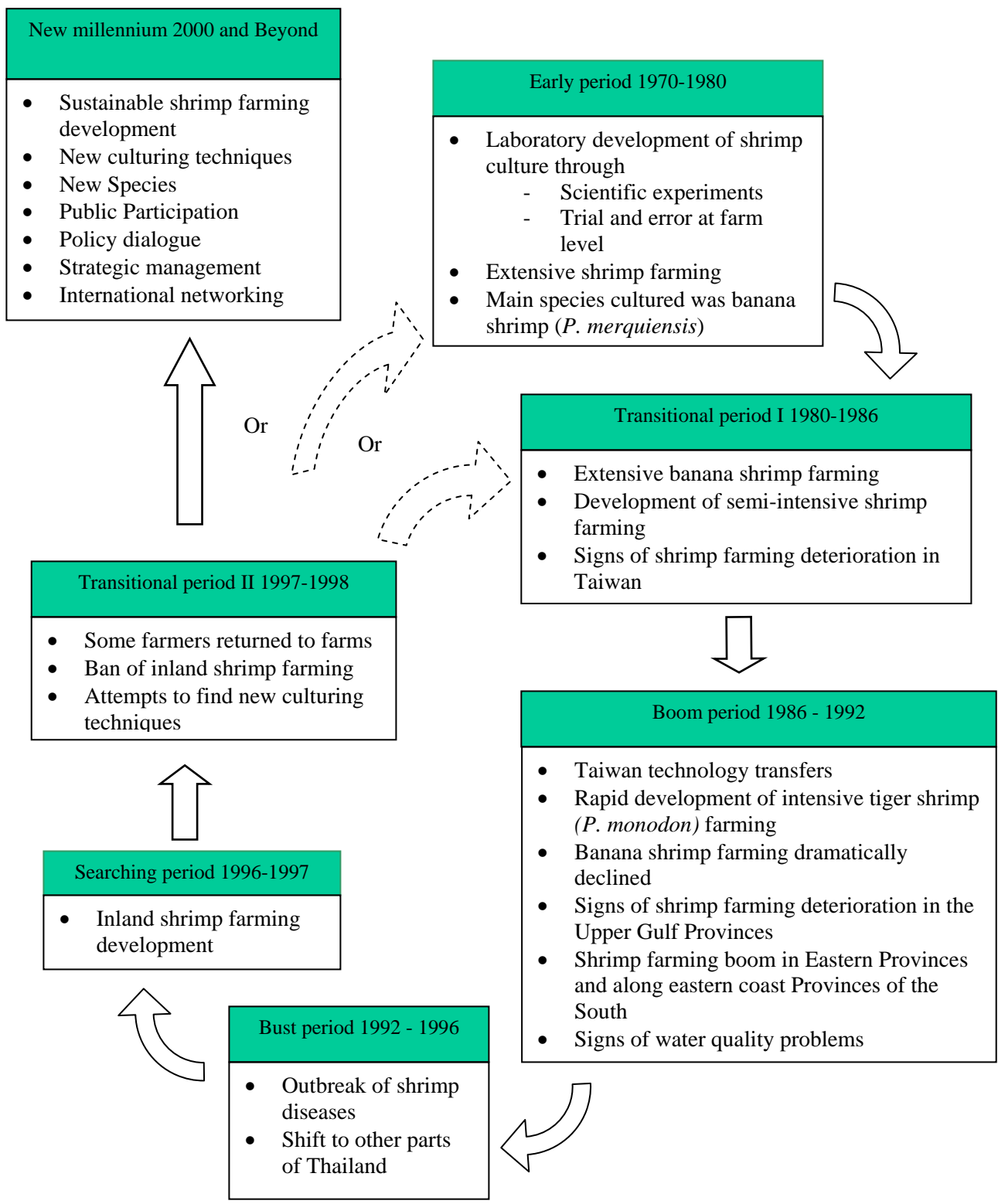
To avoid conflicts of good intention among institutions responsible for shrimp farming development, an application of ICZM concept is highly recommended.

companies have learnt from their experiences about their failure and attempted to correct it by several means such as lower stocking density, careful screening of incoming water, constructing water storage and treatment facilities, and closed/semi-closed culturing systems. Many old shrimp ponds are presently under operations with increasing intensive management (or extensive in some aspects). There has shown some satisfactory degree of achievement, and in 2000 Thailand’s production reached record highs.

It is obvious that shrimp farming development in Thailand has gone through several stages of learning. This indicates extraordinary characteristics of Thai farmers and their strong wills to find solutions for their

agricultural problems. On an optimistic note, it is believed that Thai shrimp farming will continue to survive and adjust adaptively to fit with all kinds of problems. Positive attitude has contributed a great deal to the survival.

An analysis of the historical shrimp farming development in Thailand can be best represented by a boom and bust cycle as shown in Figure 1.



**Figure 1:** “Boom and Bust” cycle of shrimp farming development in Thailand

## **Present Status of Shrimp Farming**

Since 1972-1994, cultured shrimp production had enjoyed an increasing trend with a steep slope shown during 1987/1988 to 1994/1995. Only during the period of 1995-1997 that the production slumped, and started to grow again in 1998. The estimated figure of 1999 was estimated at about 220,000 tons of 1998. With respect to the area of production, it gradually increased from 56,602 rai in 1972 to 500,000 rai in 1996 with slight fluctuations in between, and declined to around 450,000–460,000 rai, thereafter. At present southern Thailand has about 40 percent of the area under shrimp farming on the east coast of the Gulf of Thailand and the west coast of the Andaman Sea. The number of farmers also followed a similar trend reaching a maximum number of 22,197 farmers in 1994. After this year, the number of farmers reduced to around 15,000–16,000 farmers with more than 134,000 shrimp farm employees. This employment figure does not include people employed in the related industries such as feed, shrimp frozen and processing industries. About 80 percent of all shrimp farmers has developed an intensive operation, the rest are mainly semi-intensive.

Despite the disease outbreak during 1995 – 1997, Thailand's shrimp production still maintains its number one position since 1991 even with some drops in production between years. White spot disease and yellow head disease are the two most important problems having a big impact on the decreased production. Early harvest to avoid flooding and mass mortality in the south, shrimp prices drop, and trade policy of importing countries are other factors determining shrimp production in Thailand. By the second half of 1997, high prices of shrimp attracting several farmers to return to their previously abandoned farms and new venture to raise shrimp inland in the freshwater areas helped maintain the shrimp production level.

## **Shrimp Farming Potentials in Thailand**

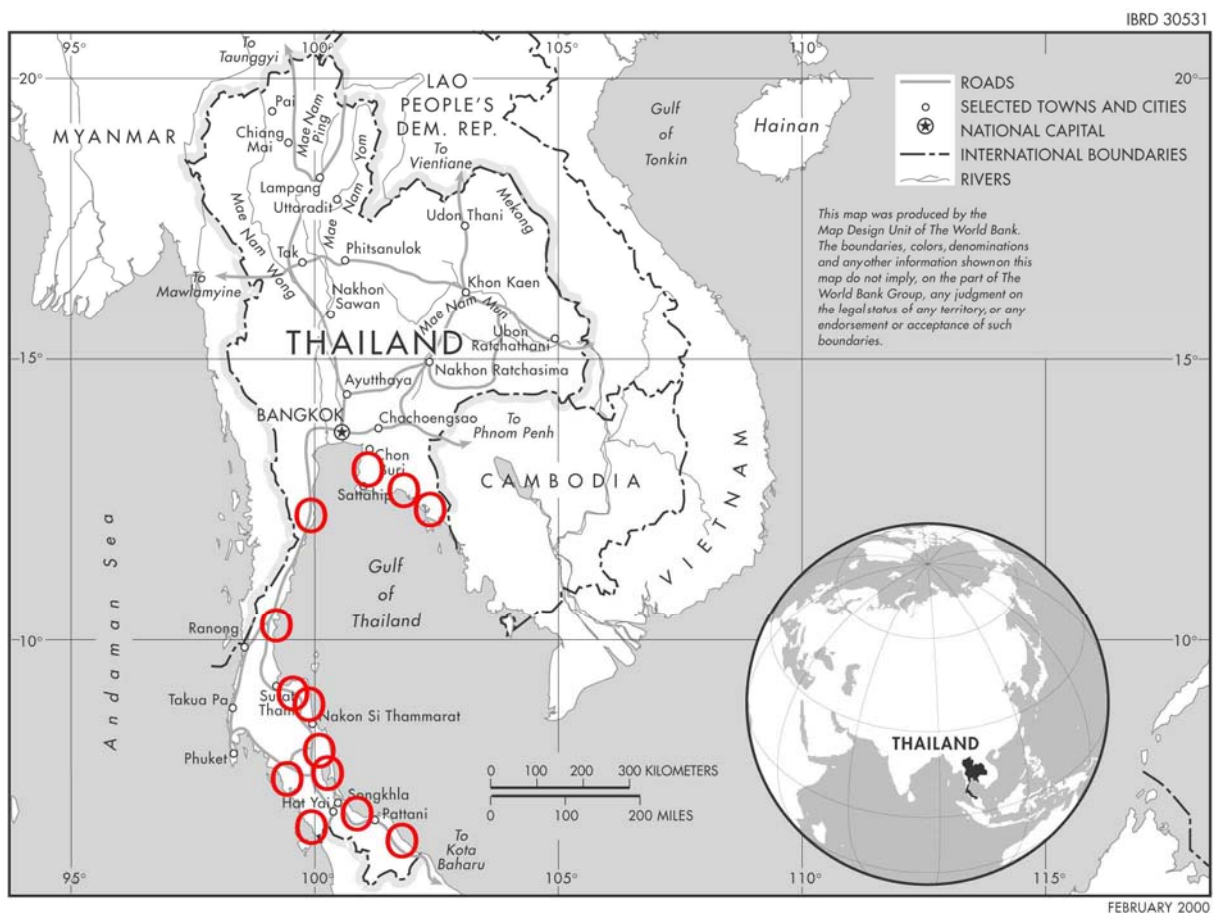
With the coastal line of 2,614 kilometers, Thailand has a high potential for coastal aquaculture development, which needs high quality saline water and easy access to it. It has been estimated and made a national policy that the areas suitable for shrimp farming should not exceed 500,000 rai (80,000 hectares). In 1996, this area limit was reached, while in the later years area under shrimp farming has declined due mainly to farmers leaving the industry because of disease infestation and low shrimp prices. It can be said that at present there is limited potential for area expansion. The only potential left is to develop the old and disused shrimp ponds for reuse. However, this reuse potential depends highly on the locations of the farms and ownership status attached to them. The coastal areas where water circulation is in a closed system usually are not suitable for coastal aquaculture as effluents from shrimp farms, industries and households are circulated in a closed proximity. The areas around the Upper Gulf of Thailand are example of this characteristic, which is one of the reason that shrimp ponds in these provinces have not been extensively reused for shrimp farming. On the contrary, the coastal areas along the Lower Gulf and the Andaman sea are facing open seas enabling high flushing rates and good water circulation. This is one of the reason that many shrimp farmers are now returning to operate their farms again in these areas. In addition to the geographical location, the ownership nature of the shrimp farms is an important factor.

With regard to farming techniques potential, Thailand has developed its own culturing technologies based mainly on the Taiwanese's but greatly adapted to suit Thai conditions. It can be said that Thailand is leading the world in shrimp farming practices. The government has continued its support to research and development in cooperation with the private sector. There have been several events for technology and information exchange among farmers, government officials, private sector employees, non-governmental organization workers, and members of shrimp farmers groups and associations. These have been crucial for shrimp farming development of techniques.

In terms of economic and investment potentials, it is believed that there is limited opportunity for new investment by new entrepreneurs in either newly open areas or old ponds. The government has restricted loan provision to shrimp farmers as a result from increasingly environmental protection awareness, and

economic and financial meltdown in 1997. Any new investment on shrimp farming has to be carefully monitored, as this industry has experienced the consequences from the hit-and-run farming practices. In line with the limited economic and investment potentials, the government policies and institutional potentials are also constrained by occupational conflicts and trade-offs between environmental degradation and increased foreign exchange earnings. The government has uncertain policies with respect to the heavily argued freshwater shrimp farming, and the implementation of Article 9 of the Enhancement and Conservation of National Environmental Quality Act (1992).

Despite some promoting and limiting potentials, shrimp farming trend in Thailand is foreseen to grow. The highest boom and worst bust may be just a history not to be imitated. Optimistically, the trend is thought to gradually rise with some few fluctuations. However, shrimp farming is a risky industry that some unexpected factors may create devastating impacts again. On Figure 2 below main shrimp farming areas in Thailand can be seen.



**Figure 2.** Maps showing main shrimp farming areas in Thailand (Rosenberry 2001)

### Summary and Conclusions

Shrimp farming industry in Thailand has passed through the boom and bust cycle, which has revealed how sensitive and risky the industry, can be. However, Thai shrimp farmers have managed to develop this industry to maintain its production level to be consecutively number one in the world. Undoubted there are many factors contributing to this achievement, i.e., technological advancement, expansion of new areas, cooperations among concerned parties and supports from both public and private sectors.

The interest of this research is focused on management issues of shrimp farming for sustainable development. It intends to analyse economic and social interactions that are contributing to the desirable development. Some of the research questions are:

- Are there institutions in place at local, provincial and national levels to support the sustainable shrimp farming practices in an institutional arrangements (rights and rules) context?
- Are co-management principles effectively implemented in the development planning framework (local, provincial and national levels)?
- Is there any coherence among independent, farmers groups and associations and private enterprises in terms of practising environmentally sound coastal aquaculture?
- In what hierarchy level ICZM approach for sustainable shrimp farming development can be implemented in the Thai government administration context?

These research questions will be answered in the contents of the following chapters.

## **Shrimp Farming Issues and Solutions**

### **Background**

Intensive shrimp farming has proliferated in Thailand since 1986 creating much needed foreign exchange earnings. Its economic importance has been widely known alongside with some negative social and environmental consequences. There is obvious evidence of resource-use conflicts among stakeholders with different interests. This calls for an institutional involvement to solve conflicts, manage common property resources, and to plan and set strategies for the industry to grow in a desired and more sustainable way.

In order to perform the tasks for sustainable shrimp farming, the responsible institutions have to develop an appropriate management framework to derive at plans, strategies and activities. The present research proposes an Integrated Coastal Zone Development Analysis as a main framework, together with the classification of shrimp farming components into a Hierarchical Multi-level Stakeholders Analysis. These two management frameworks will be used in the case study analysis and the formation of the desirable model.

Prior to further discussion of these frameworks, understanding of the present shrimp farming issues and their institutional aspects is necessary. These topics are discussed in the following sections.

### **Dominant Shrimp Farming Issues**

There are many important issues but these can be grouped in four key issues as follows.

#### *Economic Issues*

With respect to value of cultured shrimp, the value has been increased from a small amount of 20.50 million baht in 1972 to more than 58,000 million baht in 1998. The export exchange earnings from shrimp have substantially contributed to the Thai economy as the value of export in has been in the top ten list following computer parts, textile, circuit, rice, rubber, jewelry and canned seafood. Income from cultured shrimp export is expected to remain its significance in the national economy in spite of stiff competition from neighboring countries, increasing trade barriers of the importing countries and domestic production problems.

#### *Environmental Issues*

In 1961 Thailand had 3,679 sq. km. of mangrove forests; by 1993, it had about 1,687 square.km. –a decline of more than 50% in about 30 years. The area of mangrove forests had declined along the eastern seaboard,

in the Upper Gulf region and in the south in relation to the movement of shrimp farming development. Although mangrove forests have been under pressure of encroachment from many activities such as charcoal timber concessions, mining, salt ponds, household settlement and even tourism, the development of shrimp farms has certainly contributed to the loss.

It is now recognised that mangrove areas are not ideally suited to shrimp pond development because the tangled mass of mangrove roots are difficult to clear and there is a tendency for ponds to leak where remaining root structures penetrate the impoundment walls. Soils are often acidic requiring extra expenditure to neutralize and the complete drainage of the ponds and drying of the pond bottom is difficult to achieve within the tidal zone. But mangrove forests have been common property resources supporting subsistence livelihood of the local poor; and state's forest reserve boundaries have been unclear, and implementation of the forest reserve principles has not been sufficient. Therefore they have been considered "vacant", and subject to being converted into other uses, including shrimp ponds. Even though the mangrove forest reserves are protected by laws, their protection has in the past been compromised by the Thai authorities' willingness to grant concessions for mining and shrimp farming, as well as the harvesting of the forest for charcoal wood on a supposedly sustained yield basis. Illegal encroachment for all purposes of economic benefits, including shrimp pond development, has in the past occurred. However, the present lift of new mangrove forest concession is an attempt to preserve the remaining forest. The forthcoming community forest law is expected to encourage the local people to help protect their own forest resources.

The growth of shrimp farming has led to generation of solid wastes. From an annual crop of 150,000 tons, based on the Food Conversion Ratio (FCR) of 2:1, 250,000 tons of organic matter, 17,400 tons of nitrogen and 5,600 tons of phosphorous wastes are produced. The waste water in which these materials are to be found with other inorganic matters and antibiotics is normally drained into the sea or public canals without proper sedimentation and treatments, causing water pollution and planktonic eutrophication. This wastewater may be suitable for finfish, molluscs and seaweed culture because of the abundant plankton, organic solids and nutrients. Surprisingly, little research and practical experiments leading to this promising secondary aquaculture system has been conducted to date.

### *Social Issues*

Social issues form a livelihood core of the people benefited and/or affected by the shrimp farming development in terms equity distribution, employment opportunity and social well beings.

Positive social benefits from shrimp farming are employment which creates socio-economic security and opportunity to the farmers and their families. In 1998, there were 15,800 registered shrimp farmers who are directly engaged with this industry. Each farmer had approximately five dependent members in a family, and he/she employed on an average of one hired laborer to help in his/her farm. The shrimp farming, therefore, generated about 32,000 direct jobs with 63,000 dependencies. There were also some related industries such as shrimp processing factories, shrimp export companies, shrimp feed industries, middlemen and others that create an additional employment of more than 200,000 people. In total, there were about 300,000 people who depend on the viability of shrimp farming in Thailand (Sethsirote 1995; Department of Fisheries 1993)

In southern Thailand, a larger proportion of shrimp farms are developed by small business people from towns, government officials, local influential people and big business, either in cooperation with the local rice farmers or fishermen or on their own. In the short term, these investors gain a majority of the benefit from sale of shrimp, but when the farming industry declines, negative consequences are put as a burden on the local who actually have their livelihood there. In addition, increases in road accidents, major and minor



crimes, drugs and unwanted forms of entertainment have entered into the shrimp farming locality and local people are the ones who have to live with the affect of the shrimp boom.

### *Institutional Issues*

Shrimp farming development has generated many kinds of institutional involvement such as institutional arrangements concerning rights and rules, and organization arrangements dealing with management of rights and implementation of rules. It is clearly that the roles of the institutions and its legal tools to solve problems, minimize the conflicts, distribute the benefit equally, as well as well as ensure socially sustainable development society need attention.

Clearly some forms of regulations are required. Initially, the Royal Thai Government (RTG) adopted a benign option by promoting public awareness and advice on environmentally sound farming practices. This approach clearly was having little effect, and in November 1991, the RTG introduced regulations for shrimp farming that the shrimp farmers were to be registered with the Department of Fisheries; farms over 50 rai (8 ha) must be equipped with wastewater treatment or sedimentation pond(s) covering not less than 10 percent of the pond area; water released from shrimp farming areas must contain BOD not more than 10 mg/l (ppm); mud or silt must not be released from the shrimp farming areas into natural water sources or public areas; and salt water must not be drained into public freshwater sources or other farming areas. These regulations were designed to protect local rice farmers and villagers, and shrimp farmers against themselves. It was believed that by reducing the spread of pollutants to the surrounding areas and waters, ideally the problem could be solved. However, unless these direct regulations are enforced, compliance will not be the result.

Further provincial initiatives were therefore taken. For example, the Governor of Songkhla province initiated the way to solve the environmental problems from shrimp farming by calling on several discussions with representatives of the industry, including the Charoen Pokphand (CP) and Aquastar, and fisheries researchers from the Department of Fisheries and National Institute of Coastal Aquaculture (NICA) to draft more specific provincial guidelines which added to the general Thai regulations. The extra requirements that there be no pumping of artesian well water into shrimp ponds; that drainage pipes must extend at least 10 meters into the ocean; that ponds must be no more that two kilometers from the shoreline and no closer than 100 meters from a fresh water canal; and that there be no digging of ponds in the vicinity of Songkhla Lake. In future permits were to be required from the Harbors Department to install intake or drainage pipes in the ocean, and from the Highways Department for pipes to pass under the coastal roadbed. These provincial regulations show an attempt to get involvement from at least three departments for the issuing of permits. But these regulations are unlikely to be enforced rigorously, as evidences of these regulations violations have been obviously seen. As long as these regulations add an extra cost to the shrimp farming investors whose motivation of getting short-term profit is prominent, unless these regulations are enforced rigorously, regulations may be largely ignored. Certainly, large companies will comply, not only because they are more visible, but also because their investments are such that they are more likely to be planning on long occupancy. The problem is more serious in the case of investors who are trying to minimize their costs for the highest short-term profit.

Certainly, these regulations must be effectively enforced. Some forms of subsidized assistance may be necessary to untangle the web of water inlet pipes and drainage channels that have resulted from uncoordinated, unregulated piecemeal and shrimp farms development. The public investment, however, should claim the polluter-pay principle.

## Conflict Resolution in Shrimp Farming

As discussed earlier, shrimp farming has been subject to criticism of its negative impacts more than its positive ones. This direction may be changed in an opposite way if proper conflict resolution is implemented by means of efficient institutional arrangements.

The efficient institutional arrangements involve, (i) clearly defined rights of all stakeholders, and (ii) effective enforcement of rules (laws and regulations). A rational government is able to design strategic management through clear planning and policies with full public participation at an early stage of shrimp farming development.

There are at least 19 government institutions, 3 state enterprises and 7 groups of private organizations in Thailand that are involved in shrimp farming development (Appendix 2). More specifically concerned with shrimp farming, the Department of Fisheries, Office of the National Economic and Social Development Board, Office of Environmental Policy and Planning and Wastewater Control Organization are four major government institutions that have direct responsibility for shrimp farming plans and policies.

In order to achieve these plans and policies, concerned institutions (both government and private organizations) need to possess and acquire the following characteristics.

### *Accurate Data/Information*

It is important for any planning agencies to have the most accurate data/information so that the plans and policies could reflect the reality as much as possible.

Data/information needed are listed as:

- Types of conflicts, whether they are environmental, social, political or institutional.
- Magnitude of conflicts, whether it is limiting or lethal, or whether it is far much exceeding set standards or at some negotiating levels.
- Costs of eradicating/minimizing conflicts, whether they are in whose responsibility or could the costs be shared in an agreeable proportion.
- Types of resources, whether they are public, common, club/state or private properties; and whether the boundaries are clearly defined and supported by legal instruments.
- Issues, whether they are urgent, prominent, clearly seen or the opposite.
- Stakeholders, whether they are active, neutral or passive.
- Pond and farm management techniques, whether it is semi-intensive, intensive, super-intensive or others; and possible types of impacts in response with each pond and farm management intensity.
- Types of sludge disposal and disease controls.
- Attitudes, whether the farmers are having responsible shrimp farming attitudes or otherwise.

### *Clear Understanding of Administrative Structures of All Levels*

A strategic management planner is required to have a clear picture of local, provincial and national lines of public administration with their legal systems. There are some aspects that need further explanation.

- Enforcement of laws and regulations; whether what, when, where and how these legal systems are enforced. These formal rules may be effective in one locality, but may not be the case in the other. Appropriate choice of the formally legal instruments is extremely important.

There are at least 37 laws and regulations regarding fisheries and coastal resources management in Thailand. However, there have been no direct national laws specifically designed for either the management of fisheries and coastal resources or shrimp farming management (Appendix 3).

- Existence of customary rules, whether they exist and are being enforced or not. In some locality, customary rules are more effective than the national and general rules.
- Vertical and horizontal integration, whether the concerned government and private organizations are working in line with both types of integration.

#### *Recognition of International Forces*

Intensification of shrimp farming for high productivity has been an impact from international forces in terms of market demands. These forces have transformed the social and economic structure of coastal life, which is reflected by new forms of political, economic and social organizations.

In turn, the concerted international forces can assert a more socially defined mode of shrimp production. They can also limit their own market demands of shrimp products on the grounds of human rights, health and environmental concerns.

The conflict resolutions existing in shrimp farming are not an easy task. The question may be asked whether these conflicts can be resolved or at least mitigated, given the present institutional capacity of concerned ministries and departments. However, with shrimp farmers', and government's and private organization's commitments to responsible and sustainable forms of shrimp farming development they can exert pressure for more positive structural changes which take into account wider societal goals.

#### **Approach to Sustainable Shrimp Farming Management**

Upon an extensive review of literature on shrimp farming and its related topics, there has been a number of shrimp farming research works done in various aspects ranging from technical, economic, environment to social and institutional perspectives. To name a few of these extensive sources of references, they are Csavas (1990, 1992); DeVoe and Pomeroy (1992); Phillips (1992, 1994); Flaherty and Karnjanakesorn (1995), Prathak (1998); Nissapa et al. (1999); Smith (1999), Asian Shrimp News (Quarterly issues).

The present synthesis is not intended to repeat this research; instead it attempts to extend its analytical framework to incorporate these well-established results alongside with recent management approaches by both individual farmers, and relevant institutions and institutional arrangements. Results from the analysis will eventually come up with a synthesis finding for the management of shrimp farming industry in a desirably sustainable fashion. The knowledge accumulated and experiences learnt from intensive involvement through the periods of shrimp farming development are incorporated. However, a well-defined framework for synthesizing the shrimp farming system has been developed as a guideline to put all issues described in earlier sections in place.

Shrimp farming industry in Thailand and its environmental impacts can be hierarchically connected into five levels based on the scale of the social and environmental impacts.

## *Hierarchical Multi-level Stakeholder Analysis*

### *System Level 1: The coast landscape framework for shrimp pond development*

The coastal landscape is a very complex phenomenon. To deal with the coastal landscape in its full complexity, these institutions have to work together to develop the area included in the Protection, Production or the Development Zones. Shrimp farms are priority in the Production Zone for pond construction and operation.

In this approach, “**Shrimp Farming Development**” is defined as an activity on the ground, using appropriate technologies in the respect multiple use systems. Following the sustainability paradigm, “appropriate” would require that technology follow five major pillars for sustainability, namely:

- (1) Ecological protection
- (2) Socially acceptable
- (3) Economically production
- (4) Economically viable
- (5) Reduce risk

### *System Level 2: The shrimp pond and farm development*

In the shrimp farm development zone comprises of shrimp ponds and other kinds of ponds necessary to run the shrimp farms, i.e., water-intake pond, water settling ponds and sludge storing ponds. These ponds are connected with the management of farms leading to an involvement of economic, trade and social components of the farmers.

### *System Level 3: Community involvement (Provincial and Sub-district).*

This system interconnects all shrimp farms and their environmental impacts with each other, and their impacts to the coastal ecosystem. This system is increasingly more complicated, therefore it involves some more components of the system and multi-stakeholders level. The components enter to play important roles such as institutional, legal, as well as policy components counterbalancing with the biological, environmental, economic, market and social components.

### *System Level 4: National involvement*

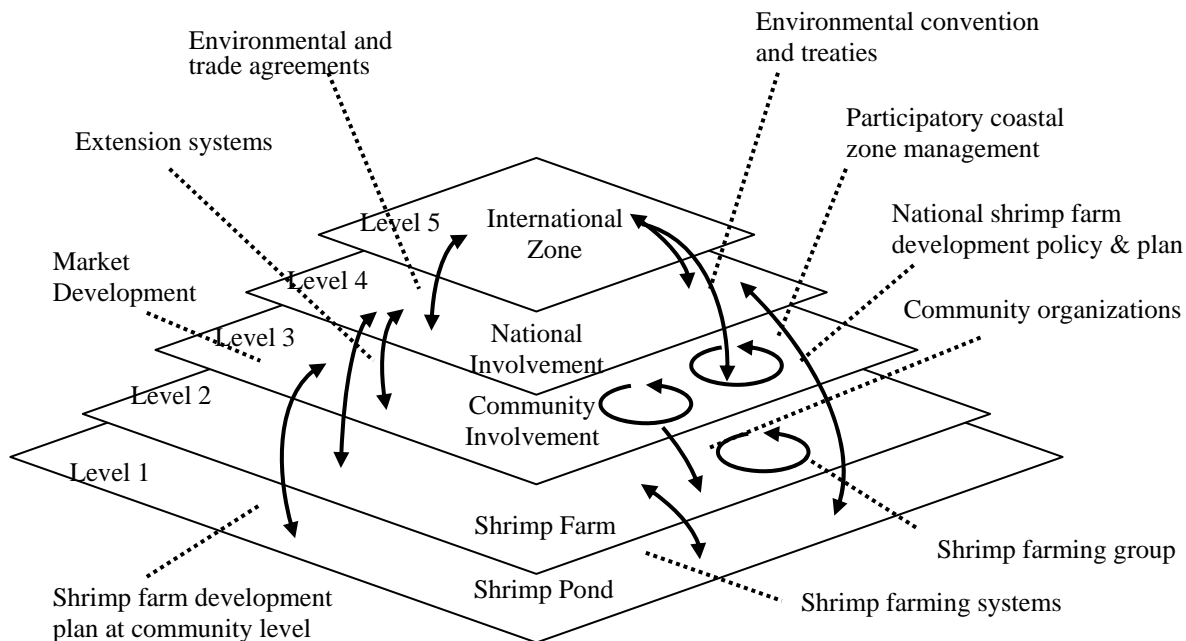
The most complete system among these four systems is this system level 4, the National Development Plan for shrimp farm to mitigate the impacts of shrimp farming to the coastal zone, but also impacts from other sources beyond the system levels 1 to 3 are involved. Impacts from industries, households, tourism, infrastructure development and agriculture are taken into account, which complicate the system in a more spatially and temporally depth. Institutional, legal, policy and planning, and conflict resolutions play a prominent role in paving ways for the desirably sustainable shrimp farming industry. The plan will be carried out by a number of multilevel stakeholder and public groups working to promote sustainable shrimp farm development project.

### *System Level 5: International involvement*

It is inevitable that shrimp farming has to link with international trade and agreements. Competition to increase market shares in a few importing countries, i.e., Japan, United States of America, and European Union has been stiff. Various trade negotiation techniques are forcefully used by both exporting and importing countries to control the shrimp trade in line with the countries' policies. Trade restrictions ranging from product quality control, environmentally sound label, specific trade preferences and issues related to genetically modified products are increasingly implemented.

The need to have access to information on trade movement, its analysis and proper strategic planning is constantly urgent.

A diagrammatic representation of the five system levels is presented in Figure 3.



**Figure 3.** Operation Levels and Activities in a Multi-level Stakeholder Approach to Sustainable Shrimp Farming Development

### The Challenges of Sustainable Development to Shrimp Farming Development

Sustainable development requires due consideration of specific environmental, socio-cultural and economic conditions, and institutional arrangements found in a particular location. Shrimp farm development is particularly challenged because of the social and environmental issues. Increased efforts should be made in order to:

- Invest selectively in areas with a high potential for specialized shrimp production development in order to enhance economic growth in the aquaculture sector
- Support the regeneration of aquaculture in potentially sustainable areas and, where appropriate, use coastal land management technologies to minimize actual degradation
- Introduce coastal land use changes in areas where there are opportunities for nature and bio-diversity conservation or where there is insufficient economic potential for shrimp aquaculture development and regeneration.

However, widespread poverty and lack of development necessitate support strategies in particularly needy regions, even if sustainability is not immediately enhanced by these activities.

Integrated Coastal Zone Development Analysis (ICZDA) is a supportive tool that can be potentially used to achieve sustainable management solutions at community level.

ICZDA is preferably carried out by interdisciplinary teams working with local and external stakeholders in a transdisciplinary manner, i.e., using both scientific and local knowledge to arrive at shared views on needs, options and constraints in order to be able to collaborate in efforts to promote sustainable development.

### *Participatory Assessment and Development Evaluation Process*

An overview of the general process to be taken in analyzing sustainability in a regional context, using integrated coastal zone development analysis (ICZDA):

- Process 1**      Issues and opportunities formulation
- Process 2**      Definition of development visions, and objectives goals
- Process 3**      Spatial typology (conflict use, ownership, resources, etc)
- Process 4**      Actor typology (use groups, wealth strata, institutions, etc)
- Process 5**      Interactions between and among units and actors
- Process 6**      Dynamics of change (population, environmental degradation, improvements, etc)
- Process 7**      Assessment of sustainability (according to selected social, ecological and economic indicators)
- Process 8**      Needs, options and constraints as seen by stakeholders
- Process 9**      Development synthesis
- Process 10**     Strategies for action

### *Application of ICZM via ICZDA in Shrimp Farming*

The ICZM concept has been implemented in Thailand approximately since 1985. With the assistance from the USAID via the Coastal Resources Center of the University of Rhode Island, Coastal Resources Institute (CORIN) of Prince of Songkla University was established in 1989 with the main aim to implement the ICZM concept. Later on this concept was extended to other parts of Thailand. Many coastal communities, with or without recognizing it, have had practical applications similar to parts of the ICZM process. However, formal and full implementation of ICZM process in Thailand is still considered incomplete. One of the main difficulties was difference in interpretation of this concept by different implementing agencies. In addition, Thailand's inherited bureaucratic system succumbs to a single and tremendously strong sector. Coordinating mechanisms are difficult to penetrate into this system, which makes it hard to introduce the integration concept.

A review of some current applications of ICZM concept in Thailand is summarized in Table 1 below.

**Table 1:** Some Current Shrimp Farming Applications of Integrated Coastal Zone Management (ICZM) in Thailand.

Sr No.	Application Model	Institutional Involvement <sup>1</sup>	Common Characteristics	District Characteristics	Prominent Position in the ICZDA process <sup>2</sup>
1	Kung Krabaen Bay Royal Development Study Center	Government-led Model (DOF)	Shrimp farm and mangrove, seawater irrigation system, water recycle and water filters, shrimp disease treatment and shrimp sludge fertilizer	Royal initiatives, selected members only involved	Process 2 Process 6
2	Chantaburi Shrimp Farmers Group	Facilitator-led Model (CORIN) with Provincial government	Shrimp production and habitat restoration	International donor, special area and special topic management,	Process 1 Process 2 Process 3 Process 4 Process 5 Process 6 Process 8 Process 10
3	Suratthani Model	Shrimp farmers group-led Model (TSA)	Shrimp farm and mangrove, environmental conservation and awareness	Prominent roles of intellectuals and private entrepreneurs	Process 1 Process 2 Process 3 Process 4 Process 5 Process 6 Process 7 Process 8 Process 10
4	CP Model	Private company-led Model (CP)	Shrimp farm and water treatments with biotechnology and recycle	Invention of new culturing technology, select members involved, public extension programs	Process 1 Process 2 Process 6 Process 9 Process 10

Note:<sup>1</sup> DOF – Department of Fisheries, CORIN –Coastal Resources Institute, CP - Charoen Pokphang  
TSA - Thai Marine Shrimp Farmers Association

Note<sup>2</sup> Prominent positions of the application model were assessed by examining the common and distinct characteristics using the ICZDA process of Figure 2.

The application of the ICZM process is complicated in nature as it involves many disciplines with intricate interactions among them. There has been no complete case of ICZM applications in Thailand. The dynamism of the ICZM process has been interrupted by many factors such as through understanding of the concept, continuation of government policy and deadlocks in the decentralization process.

### Summary and conclusions

This chapter presents shrimp farming issues that are considered important for sustainable operations. They are economic, environmental, social and institutional issues that need proper identification, if in any cases conflicts are likely to occur. Attempts to solve these conflicts require accurate data/information, clear understanding of administrative structures of all levels and recognition of international forces.

The present study focuses its attention to analyze the existing shrimp farming situations emphasizing on a holistic approach. Such approach is rearranged to represent a hierarchical multi-level stakeholders in five operational levels. These levels are interrelated and they have to be taken into account when analyzing the sustainability concept.

An important analytical tool used in this study is the Integrated Coastal Zone Management (ICZM) via the ICZDA. This tool was applied in the Chantaburi case of wastewater management from shrimp farming. The ICZM process has provided a good opportunity for the Chantaburi shrimp farming communities to help solve their common problems (and conflicts).

## **Institutional Support and Mechanism Needs**

### **Background**

This chapter forms a central core of this research by analyzing two complementary case studies – Chantaburi and Suratthani Models – to come up with a flexible model for sustainable shrimp farming in Thailand with respect to institutional perspectives.

As described in Chapter 2, the Hierarchical Stakeholders Levels Analysis and Integrated Coastal Zone Development Analysis (ICZDA) are adopted jointly to be analytical frameworks for both case studies. The Chantaburi model is a model with a Multi-Stakeholder Level (MSL) structure that focuses its attention on many stakeholders in the same level, which the whole level is later related with other levels in a hierarchical structure. This model portrays a detailed process of developing shrimp farmers and other resource users groups who operate their own initiatives (with initial arrangements by other institutions) within the existing line of formal government administration. It is a model that is initiated and driven by institutions other than their own groups, or in other words, Other-driven Model.

The other model, Suratthani Model is a model with Multi-Level Stakeholders (MLS) structure that all stakeholders in all hierarchical levels are simultaneously inter- and intra-connected. This model is self initiated in all levels of the hierarchical structure. It is therefore the Self-driven Model.

This chapter firstly presents analytical results from the Chantaburi Model, followed by the Suratthani Model. The last section is a synthesis result obtained from the analyses of the above two models to form a sustainable shrimp farming model with respect to the institutional perspectives. This model recommends institutional management practices that are easy to adopt for a better overall management.

The MLS structure or Suratthani Model and MSL structure or Chantaburi Model are expected to offer solutions that complement technological recommendations.

### **Multi-Stakeholder Level (MSL) Structure of Sustainable Shrimp Farming Development – the Chantaburi Model**

Shrimp farming in Chantaburi province can be best described as a MSL structure or Chantaburi Model. The MSL Structure involved sustainable management at pond, farms and communities (Levels 1-3). At these levels, sustainable shrimp farming development can be maintained as far as some other agencies keep managing the level 4 and 5.

#### *Background to the Chantaburi Model*

Chantaburi province has a 68 km of coastline and four coastal districts. Shrimp farming represents an emerging use of important public resources and plays an important role for the provincial and national economy. However, in recent years, shrimp production in Chantaburi has shown a marked decline and many of the ponds have been abandoned. Most farms have suffered from disease problems, and even total crop failures. This is not surprising given the lack of co-operation and enforcement of land and water uses and the lack of understanding between environmental management practices and pathogens.



The Chantaburi model focuses mainly on horizontal integration of components within Level 1, Level 2 and Level 3 with regard to shrimp wastewater management issues. The integrated approach for shrimp wastewater management issues has a multi-sectoral perspective, including identification, collection,

***Two Different Terms***

MSL structure stands for Multi-Stakeholder Level Structure involving sustainable management at any one level with many stakeholders.

MLS structure stands for Multi-Level Stakeholder structure involving sustainable management at many levels with many stakeholders.

compilation and interpretation of data and information. A consensus approach has been applied throughout the process. Sustainable shrimp farming relies on the interaction of integration of the level's components indicating that sustainability exists in each level, and also in all levels. Shrimp farmers in Chantaburi have been discouraged by all the problems mentioned above. They needed some kinds of stimulation to gain those confidence back, and this gave ways for Coastal resources Institute (CORIN), Prince of Songkla University to play a role. CORIN employed Integrated Coastal Zone Development Analysis (ICZDA) process to prepare a participatory, integrated and operational plan for shrimp farming development to guide Chantaburi farmers for an achievement of objectives and goal.

The ICZDA approach is a supportive tool that has been used to achieve participatory shrimp farming management for sustainability at Level 3 (community level). This approach shows much promise and is an alternative process that encourages the local community groups to participate from the beginning, as principal stakeholders, in planning and implementation sessions with local and central government agencies. Consideration should be given to establish a multi-stakeholder team led by a technically knowledgeable third party to prepare the integrated and operational plan. The university and Fisheries Station of the Department of Fisheries should be consulted to advise on team leadership, team structuring and the design process. It is a dynamic, collaborative process involving a number of overlapping steps.

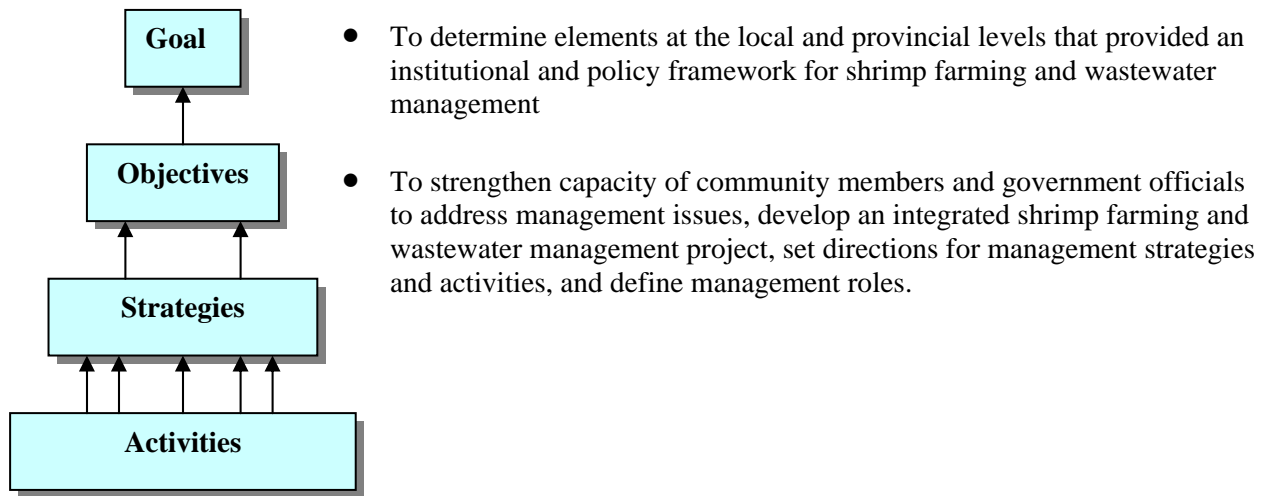
The ICZDA steps for the Chantaburi Model are:

- Clarification of goal and objectives
- Establishment of management team and framework
- Selection of preferred location and its problem and opportunity analysis
- Establishment of specific objectives and their management strategies
- Projects implementation and joint actions
- Budget allocation

*Clarification of Goals and Objectives*

The Chantaburi model was an effort to demonstrate improvement of shrimp production by means of integrated shrimp farming and wastewater management. The ultimate goal of the model was to ensure the sustainable management of shrimp farming in Chantaburi by using the area of Klung district as a case study. This goal was achieved through a demonstration of the structure and execution of a participatory planning process, which resulted in integrated strategies with activities that improved shrimp production as well as wastewater management.

Specifically, some objectives were identified for an achievement of the goal as follows:



#### *Establishment of Management Team and Framework*

The Chantaburi model attempted to apply the integrated approach for shrimp production and wastewater management. Important issues that were relevant for the achievement of the objectives and goal were identified, followed by the identification of stakeholders to form a management team.

There were five groups of team that played roles in planning and implementation of management strategies and activities. They were described as follows:

#### *Facilitator*

A neutral institution, the Coastal Resources Institute (CORIN), Prince of Songkla University was selected as a facilitator to develop an operational plan. The role of CORIN in the process was that of a catalyst to start the process. This was accomplished by providing technical and financial assistance. CORIN coordinates and facilitates the work program with the guidance of a steering committee and Shrimp Farming Groups (SFG).

#### *Steering Group*

For the operational plan developed in this project, the Governor of Chantaburi Province recognized the need for more comprehensive, integrated shrimp farming management and responded by setting up the Shrimp Production and Waste Development Planning Committee (SPWDPC). SPWDPC was a steering committee at the provincial level. This committee was made up of representatives from various government technical and administrative agencies and community groups. The SPWDPC had a project management role, took an overview of the process and advised on the direction of the project. In the transition from strategy preparation to implementation, the SPWDPC continued to be responsible for seeking necessary financial and administration provisions.

#### *Shrimp Farmers Group*

Participation of the local community from the beginning, as principal stakeholders, in planning and implementation was essential for the community to gain a sense of “ownership” of the plan. To achieve this, a local organization was established and named the “Shrimp Farmers Group” (SFG). The group identified and addressed most pressing issues, which led to the development of strategies and recommendations to be acted upon. This approach provided the main incentive for community groups to participate and helps to ensure that the plan could be implemented and continued in the future.

The SFG met frequently for detailed discussion on how to tackle each stage of the work program and submitted proposals to the SPWDPC for their executive decision.

#### *Topic Groups*

Three topics group namely, (1) Water Quality Supply, (2) Shrimp Disease Improvement, (3) Seedstock Quality were set up to feed information into the strategy/project formulation. **Kung Krabaen Royal Development Study Center (KKRDC)** of Department of Fisheries had direct experience related to developing ecologically friendly small-holding shrimp farms. They offered expertise related to organizing and providing technical advice to small-holding farmers, water supply management, shrimp hatchery operation, disease diagnosis and use of mangrove buffers. **Chantaburi Coastal Aquaculture Development Center (CCADC)** of Department of Fisheries undertook research and development for culture of shrimp and other species and monitoring of water quality and health in selected shrimp culture areas. They have recently been studying use of different mangrove species to improve water quality near shrimp culture areas. **Private Sector (PS)** provided advisory services for shrimp farming. They could participate in the project on a non-remunerative basis if members of the SFG met criteria related to design (use reservoirs), operating methods (willing to follow technical guidelines) and financial viability (having sufficient financial resources to continue production for several years).

#### *Strategy Preparation Groups*

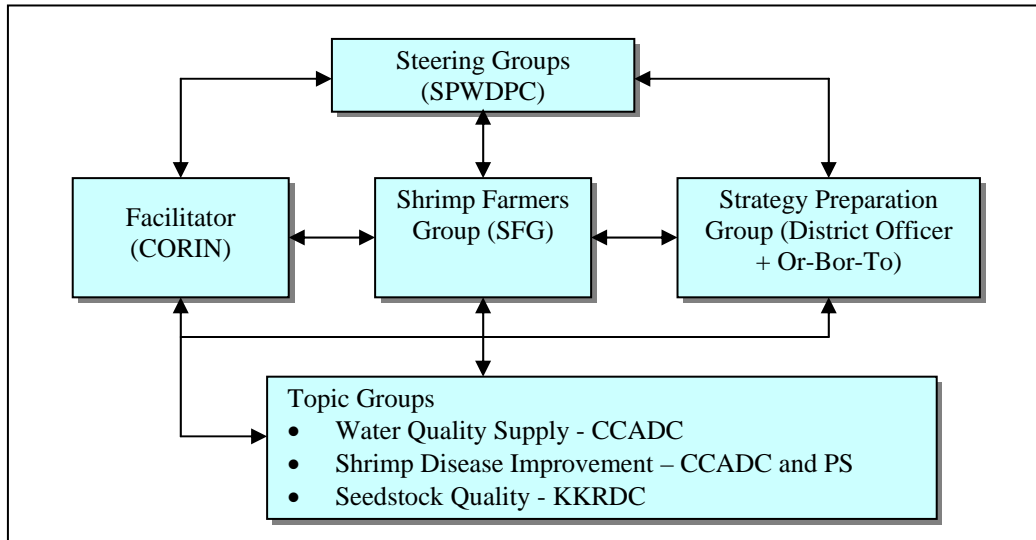
The group was led by district government office, local administration (Or-Bor-To) and the SFG, with additional members from farmers, small scale fishermen and local residences around the estuary. The function of this group was to consider issues and proposals put forward by the Topic Groups. The activities could be carried out in stages and phases by the group to spread costs over five years period. The lower levels of government and community organization played an important role in aiding group organization and logistics.

In the process of the identification of teams, the activities about creation of spiritual to safeguard the shrimp wastewater were conducted by education through regular meetings and organizing the tour and training. These activities had provided an opportunity for community discussions and awareness building. The team set up from organization and individuals was involved in the process of preparing an operational plan. The team was interrelated and its management framework is presented in Figure 3.

#### *Selection of preferred location and problem and opportunity analysis*

Analysis of proposed areas for project implementation was important as the selected location should have all the components contributing to the achievement of the project's goal.

The selected case study area was located near a canal connected with a river. It was an area where mangrove forest had been converted into shrimp farms. The total area of the Chantaburi case study was about 600 ha. The land utilization of the area could be classified into five main categories: shrimp farming 40%, mangrove 36%, paddy fields 14.4%, swamp 3.6%, and paddy household settlement and other uses 6%. The area currently under shrimp farming was developed from land within the mangrove area.



**Figure 4.** Shrimp Production and Wastewater Management Team and its Institutional Management Framework

The area was further analyzed with respect to its water supplies, water quality, topographic properties, and its proximity to likely sources of pollution such as agricultural and urban areas. The relationship between shrimp farming area and the surrounding environment was scrutinized in terms of water exchange, and wastewater discharges from agricultural sites and villages. Shrimp farmers using water from the canal and river had faced with shrimp production and disease problems especially in dry season. The general characteristics of shrimp farming production and wastewater management could be summarized as follows

- (1) Shrimp farms in the area differed greatly in terms of size, investment, management practices and production related problems. Accordingly, recommendations for community solutions must take into consideration substantially sub-area differences regarding needed problem remedies within the area (**Operational Level 1**).
- (2) Farms encountering the greatest difficulty appeared to be small farms, which water pumped from the nearby canal in the northern part of the area. Available information suggested that existing problems in the area were a combination of:
  - Poor soil condition.
  - Lack of sufficient quantities of good quality water.
  - Self-pollution caused by direct water discharge into the same canals used by shrimp farms as water intake.
  - High stocking densities and insufficient farm management.
  - Poor farm design.
  - Inadequate monitoring of water quality and shrimp growth/ survival during production.
  - Insufficient understanding of shrimp health management (**Operational Level 2**).
- (3) Actions to improve the wastewater management practices and improve physical characteristics of water supply canals were partial solutions to the problems being encountered at the moment. To seek for long-term solutions, most individual farms had to make changes to physical features of ponds and to operating practices. In particular stocking levels had to be reduced to levels that were sustainable given prevailing conditions (**Operational Levels 2 and 3**).

Reduced growth and disease problems reported during the dry season were also problems in other shrimp production areas in Thailand and in other countries. Reduced growth had been associated with reduced daytime feed consumption and seasonal differences in the pond's phytoplankton community. These factors, in combination, increased stress of shrimps during dry season, especially during the day. Among other things, feeding during the dry season must be closely monitored and adapted to actual food consumption to prevent overfeeding, increases in concentrations of harmful degradation products and decreases in oxygen.

- (4) From the policy steps of issue identification, the SFG identified five areas where they felt action was needed.
- Sludge removal from the canal.
  - Preparation of group regulations/rules on sediment control to prevent sediment from entering the cleaned canal.
  - Obtaining help to understand causes and effects of shrimp diseases.
  - Improvement of shrimp seed quality by changing the way they currently obtain shrimp seeds.
  - Ways to test feed quality.

Feed testing was ultimately considered by the SFG to be an expensive and technically demanding for the group to undertake this task, so the group indicated that it was not practical. Items other than those listed above were discussed and felt by farmers to be in a lower priority. They were (i) construction of separate intakes/outlets and use of pond area as supply reservoir, (ii) improvement in water quality test and (iii) pond management procedures.

The SFG suggested that sludge in the canal was the main problem associated with poor production and cleaning should be the first priority action.

However, production problems in the area indicated that canal cleaning did little to improve production if other actions were not taken. Several of these were critical factors that the group did not feel their immediate importance, for example, use of reservoirs and separate intakes/outlets; and current water quality and pond management procedures. Many farmers used stocking densities that were not sustainable (greater than 30-40 PL/m<sup>2</sup>), and would make pond management challenging even for farms drawing upon more sophisticated technical resources.

Also, the success of actions such as canal cleaning was influenced by activities of shrimp farmers, or others, who were not members of the SFG (**Operational Level 3**).

#### *Establishment of Specific Objectives and Management Strategies*

Establishment of specific objectives was aimed to direct process design to help minimize the shrimp production and disease problems. As analyzed and described by the SFG, these problems were usually associated with high stress levels in shrimp caused by poor quality growing conditions. These poor growing conditions were commonly a combination of excessive levels of important parameters in water supplies and poor quality soil and water conditions in production ponds.

The overall strategy for community activities placed an emphasis on priority items identified by the SFG especially those activities leading to long term improvement of farm production. Based on items put forward by the SFG and a review of workable solutions, the following objectives were suggested:

- (1) To Improve Water Supply Quality with:
- Emphasis on identification and elimination of existing sources of solid material and sludge entering the canals from SFG farms and other sources.

- Development of SFG regulations (including self-enforcement provisions) and procedures to prevent sludge entry to canals before undertaking other canal improvement activities.
  - Use of mangroves and natural process to aid removal of existing solid material deposited on the canal bottom and reduce concentrations of dissolved nutrients in the future.
  - Farmers seeking innovative ways to make use of reservoirs and separate intake and outlet channels.
- (2) To Improve Shrimp Disease Knowledge with:
- Maximum advantage taken by the SFG's expression of needs for an understanding of disease causes and effects, because items they felt were not a current problem (water quality/pond management), and the belief that cleaning canal sludge would solve their problems, were intimately linked to this topic.
- (3) To Improve Capability for Selecting High Quality Seedstock
- This objective was linked to improve shrimp farm production and understand factors other than water supply quality that impaired production. The procedures should be developed to improve the ability of the group to select/screen and acquire good quality seed stocks; organizational linkages should be developed so that the group was able to make use of existing laboratory disease screening facilities and deal directly with selected hatcheries, cutting out the currently used brokers/middlemen.

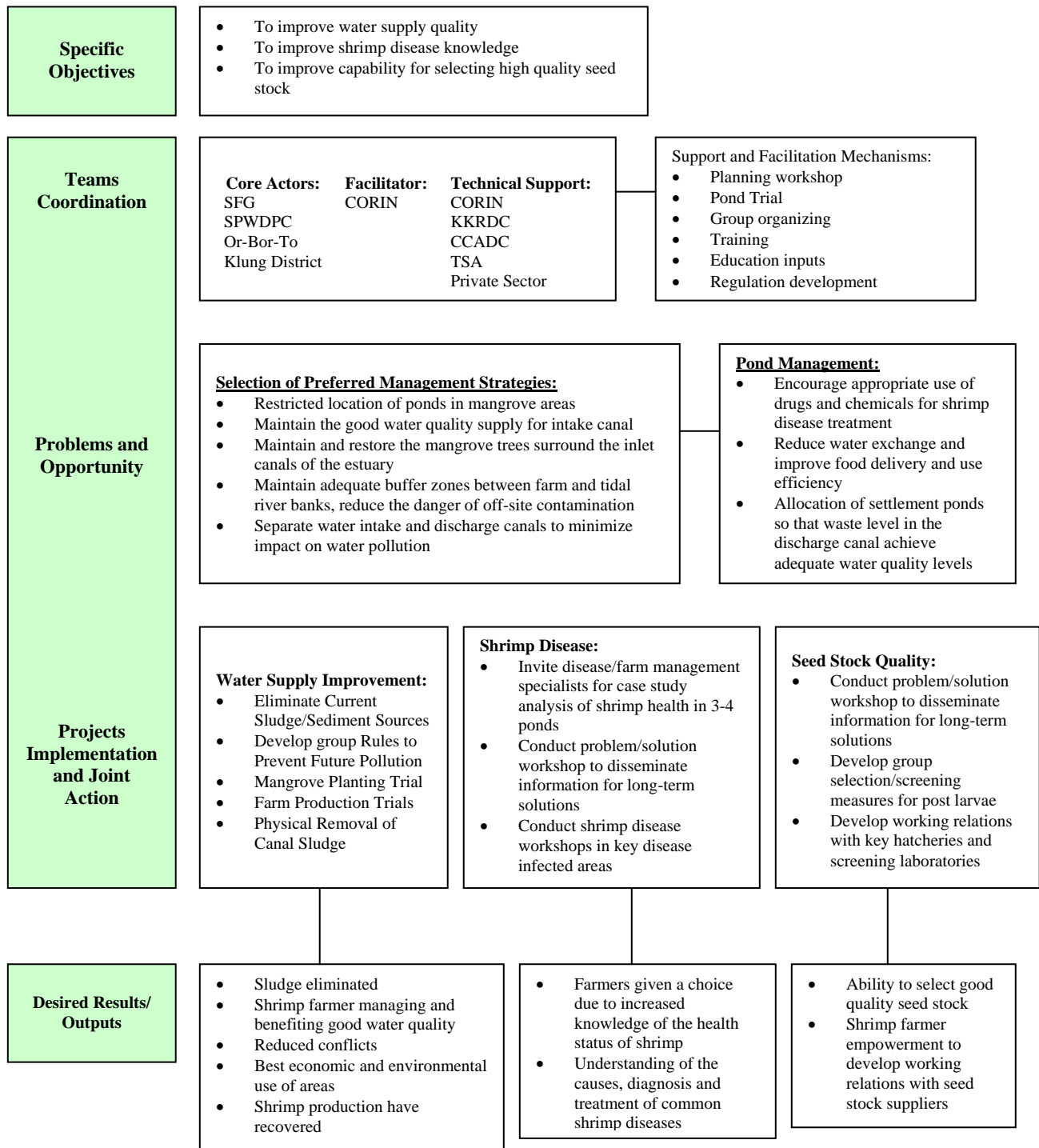
Strategies and actions to achieve the first objective were directed largely at efforts to control and minimize the effects of self-pollution. Strategies and actions to achieve the second objective were directed at increasing the basic level of understanding related to disease transmission mechanisms and factors causing disease outbreaks. Strategies and actions for the third objective were directed at improving the quality of post larvae used by the shrimp farmers. The concepts outlined above formed the basis of community programs directed mainly at long-term solutions to current problems. An important limitation on achieving desired objectives would be willingness of group members to participate in programs that were intended to improve current water and pond management practices.

#### *Project Implementation and Joint Action*

Based on the three objectives, project activities were described in this section to provide opportunities for the SFG to improve farm production through minimization of self-pollution problems and other factors causing poor production, including disease outbreaks. These activities were directed at the SFG members in the project area but were as well applicable to members located outside the project area. Activities were recommended for implementation following the ICZDA process and operational levels described in Figure 5.

#### *Budget Allocation*

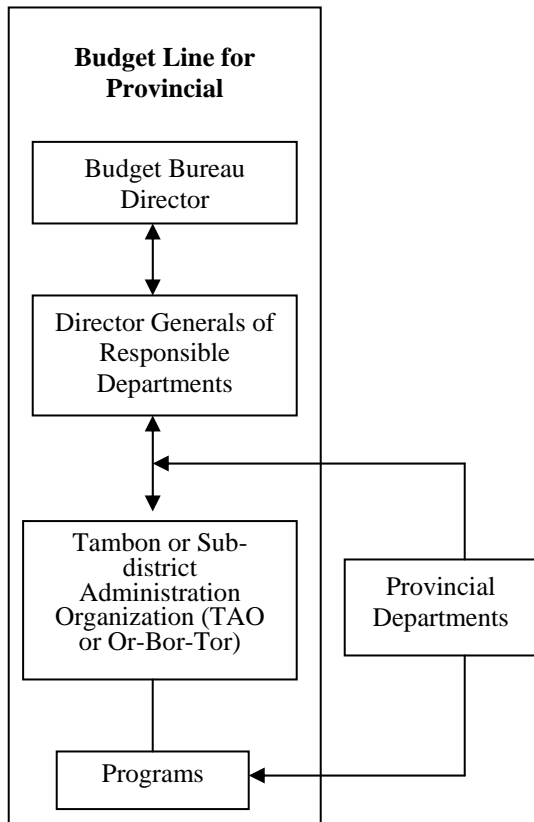
The budgetary process in Thailand is a combination of administrative and legislative process. The director of the Budget Bureau in the Office of the Prime Minister is responsible for budget administration processes. He/she announces annually the budget policy and the ceiling figure for each fiscal year. The government funding sources for provincial's priorities/programs are mainly through the Director Generals of the responsible line departments i.e., Department of Fisheries. The departments, at central administration then direct the approved programs to the provincial departments who later allocate the budget to the approved programs proposed by requests (Tambon or Sub-district Administration Organization or the provincial departments).



SFG, Shrimp Farming Group;  
 CORIN, Coastal Resources Institute;  
 KKRDC, Kung Krabaen Royal Development Study Center;  
 CCADC, Chantaburi Coastal Aquaculture Development Center;

SPWDPC, Shrimp Waste Development Planning Committee;  
 Or-Bor-To, Sub-district Administration Organization;  
 TSA, Thai Marine Shrimp Farmers Association

**Figure 5:** Project implementation and joint action as a component in the ICZDA process- Chantaburi Model



The newly created Tambon or Sub-district Administration Organization (TAO or Or-Bor-Tor) at the Sub-District Level is able to raise funds and is able to support some of their plan priorities. Non-Governmental Organizations and Private Sector in partnerships with the government, are another sources of funding for the implementation of specific projects, e.g. Shrimp Disease control. Furthermore, some of non-capital related activities may be effectively carried out by the use of volunteers in the community, e.g. Mangrove Planting Programs.

There were two kinds of costs that occur when implementing the integrated plan for shrimp farming development in Chantaburi Province, namely non-capital and capital costs.

**Non-capital costs** were associated with awareness building programs, workshop, consultation events, monitoring and other non-structural activities. The Shrimp Farming Group and Or-Bor-Tor coordinated these activities in partnership with other related government offices, general public, specific groups and cooperatives.

**Capital costs** were associated with structural projects such as sludge removal from the canal which were jointly decided by using the pre-specified design process. The projects remained the responsibility of the several agencies. This could also be a joint venture among or between the government, private sector and communities.

*Analysis of Key Factors Associated With the Success/Failure of the Chantaburi Model*

**Key Factors for Success-Chantaburi Model**

Balancing programs for

- Mangrove rehabilitation and environmental improvement
- Shrimp production and waste water improvement
- Recognition and handling of conflicts among user groups
- Involvement of major stakeholder groups in the preparation of the plan
- Clear specification of institutional responsibility and jurisdiction for implementation

The main and key success/failure factors to implement the integrated plan for shrimp farming development in Chantaburi Province were the formation of multi-stakeholders committees at different levels from the provincial to local level. The formation of community-based coastal/shrimp farm management plans was the culmination of a governance process that involved assessment of conditions and trends, issue identification, stakeholder consultation; and strengthening of shrimp farmers, government officers and local institutional capacity. The management plans created a balancing programs for mangrove rehabilitation and environmental improvement; shrimp production and wastewater improvement; recognition and handling of conflicts among user groups; involvement of major stakeholder groups in the preparation of the plan; and clear specification of institutional responsibility and jurisdiction for implementation. The formation of an appropriate level of the steering committee (SPWDPC) motivated and supported the multi-sectoral approach/co-ordination at all levels (local,



provincial and national). These alternately selected projects should be integrated in the five-year provincial plan and into provincial annual project plans within an umbrella of Provincial Development Plan and Environmental Action Plan (where the Chantaburi's Integrated Natural Resources and Environmental Management Plan are built in). Prominent institutional factors contributing to the success of the Chantaburi model are;

- The SFG had sufficient capacity to facilitate inter-agency cooperation
- The local government accepted the SFG's roles as an overall project coordinator.

## Multi-Level Stakeholders (MLS) Structure of Sustainable Shrimp Farming Development – Suratthani Model

Multi-Level Stakeholders (MLS) structure is the most desirable structure leading to sustainable shrimp farming. It is the Suratthani model that is considered to be moving in this direction.

### *Background to the Suratthani Model*

Chronology of Intensive Shrimp Farming in Suratthani	
1987	Intensive shrimp farming commenced in Suratthani
1989	Collapse of intensive shrimp farming in Upper Gulf Provinces
1990	SSFC was established
1989-1991	Mangrove reforestation on shrimp farms, but later cut down following the ban on commercial mangrove utilization
1991	The First Shrimp Day
1992	Beginning to face up with shrimp farming problems
1993	Infestation of yellow-head disease Alternate harvesting
1994	Experimentation of closed and recycle system by one of SSFC committee members
1996	Thai Marine Shrimp Farmers Association (TSA) was established
1998	First phase of the development of the Code of Conduct (March – June)
1999	Return to semi-intensive (low stock density) operation in some farms as a result from diseases and price drops Shrimp farming is increasingly difficult due to changing climatic patterns and poor quality of seedstocks Second phase of the Code of Conduct (January – March)
2000	Third phase of the Code of Co

Note: Since 1991, Shrimp Day has been conducted every year.

Intensive shrimp farming in Surat thani was developed after the problems in the Upper Gulf Provinces in 1987 leading to a complete collapse in 1989. Originally, there were three main types of shrimp farmers;

1. Local shrimp farmers who have lived in the locality suitable for shrimp farming. They are formerly capture fisherfolks or arable agriculturists.
2. Town shrimp farmers who lived in the town/city and saw an opportunity to invest in shrimp farming.
3. Other shrimp farmers who migrated to Suratthani area to seek opportunity and invest in shrimp farming. They were shrimp farmers from other nearby provinces, far provinces and Upper Gulf provinces. They had experiences and capital, but they mostly had incentives to utilize fertile and virgin areas for maximum benefits.

Main driving actors to solidify shrimp farming business were mainly local and town shrimp farmers who lived and would continue to live in Suratthani. They had fears of history repetition as occurred in the Upper Gulf Provinces. Moreover, the majority of them were dual professionals (two

professions at the same time) who could plan their investments cautiously. If the environments were not favorable, they were able to postpone their investment until the right time. This professional considerations had brought them together to analyze the situations and consult among themselves for solutions when problems emerged. This group cohesion originated from fears and needs for solutions or condolence. A more formal group was then initiated in a form of Suratthani Shrimp Farmers Club or SSFC in 1990 with supports from middle to large shrimp farms. At the beginning, the SSFC's objectives were to use the group's bargaining power to buy shrimp farming inputs, i.e., seed, feed and energy. Later on the SSFC expanded its activity horizon to a more environmentally conservative activity such as mangrove forest conservation and rehabilitation, and campaign for sludge disposal. They finally realized that sustainable shrimp farming was to go hand in hand with a good quality environment.

In order to improve the shrimp farming practices and technology while maintaining the environment, the SSFC attempted to coordinate several stakeholders, i.e., provincial governor and administration, government institutions, private companies, non-governmental organizations and non-governmental

individuals to play their roles in shrimp farming. This has given rises to an annually and remarkably successful Shrimp Day, which has been consecutively active for 10 years (in 2000)

Apart from the direct activities, the SSFC performs other supporting activities for sustainable shrimp farming such as releasing of shrimp seed stocks into natural sources, campaign for mangrove conservation and campaign not to discharge sludge into public water sources. These regular activities of the SSFC has enabled the SSFC to become a coordinating center for three main shrimp farming stakeholders, namely, shrimp farmers, government and private sectors.

#### **Objectives of the TSA are:**

- To promote marine shrimp farming in Thailand to feed the world population
- To support and assist members in solving difficulties and problems associated with shrimp farming for the benefits to all
- To become a centre to coordinate shrimp farming entrepreneurs, government sector and private sector for the systematic development of shrimp farming business
- To become a center to assemble shrimp farming knowledge and extend it to all members
- To provide market information to all members
- To protect, create and reserve righteous benefits of all members
- To create cooperation and opinion exchange among members
- To conserve the environment and water sources
- To develop shrimp farming technology for an achievement of excellence in terms of quality and quantity
- To enable shrimp farming a sustainable occupation
- To strictly prohibit an establishment of billiard or snooker rooms and no profit-seeking policy

In 1996, the first Thai Marine Shrimp Farmers Association (TSA) was established in line with the original SSFC. The TSA, however, focuses its operations more on a macro-scale and continues to work on a micro-scale closely with the SSFC. The TSA has been legally registered with the Department of Commercial Registration, Ministry of Commerce under Article 10 of the Commerce Association Act (1996). Some objectives of the TSA, *inter alia*, are to promote shrimp farming in Thailand to feed the world population, to support and assist members with shrimp farming problems, to become centre of coordination and data assembling, and to plan market strategies.

It is the primary purpose of this research to apply the Hierarchical Stakeholder Levels Analysis and ICZDA as analytical frameworks for both Chantaburi and Suratthani case studies. Using the ICZDA steps for the Suratthani Model can provide an insight into this model components that are contributing to the success of shrimp farming in Suratthani province. The Following sections are the ICZDA steps that explained the development process for sustainable shrimp farming in Suratthani.

#### *Clarification of Goals and Objectives*

Based on the data/information obtained from the review of literature and interviews with the SSFC and TSA core members, the goal and objectives of the two institutions (SSFC and TSA) in line with the ICZDA framework are synthesized as follows.

It is the goal of shrimp farmers in Suratthani province that “shrimp farming maintains its economic importance, social harmony and environmental compatibility for a long time”. These components of the goal are major factors directing toward the sustainable shrimp farming in Suratthani province.

In order to attain the above-stated goal, following objectives of the shrimp farming institutions are summarized as:

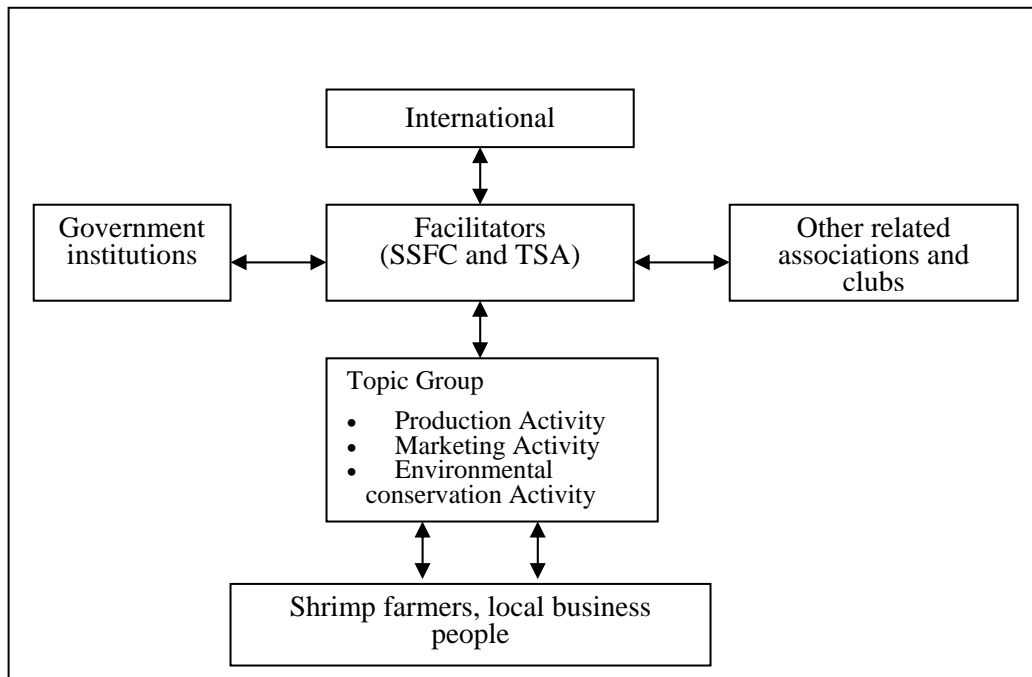
- To promote marine shrimp farming in Suratthani province and Thailand, aiming to maintain its position as major shrimp producers to feed the world population

- To become a center of shrimp farming intelligence in terms of knowledge, coordination, market planning strategies and problems solving
- To enhance shrimp farming image using internationally accepted means such as standards set by the ISO and FAO's Code of Conduct for Responsible Aquaculture.

*Establishment of Management Team and Framework*

The Suratthani model is a self-driven model set by shrimp farmers who have great concerns for the viability of this industry after witnessing the collapse in other areas. Several issues causing severe problems have been identified including disease outbreaks, pollution caused by other industries and households and by themselves, waterways dredging, super intensive operations, infrastructure development, and mismanagement due to insufficient experiences, awareness and personal greed.

From the above issues, it is clearly indicated that many stakeholders are involved in shrimp farming management. Using the SSFC and TSA as a center of management, the framework that relates these stakeholders to perform tasks for the achievement of objectives and goal is presented in Figure 6.



**Figure 6.** Shrimp Farming Management Team and its Institutional Management Framework

Description of these stakeholders are as follows:

*Facilitators*

The facilitators in the case of Suratthani Model is different from that of the Chantaburi Model. The facilitators emerge within the shrimp farming industry in the form of SSFC and TSA. This model exhibits the capacity of the shrimp farmers within their own circles of people with similar needs and problems. It is always the most desirable model that group formation is initiated by the members of the community, rather than others (governmental or non-governmental organizations) from outside. However, successful operations require not only self determination, but also assistance and co-operations from external institutions.

The most important factors for the long-term success of these facilitators has been accounted by the dedication of the members, and open vision of their leaders. These roles have been increasingly difficult because of the complexity of the micro-scale management problems, and macro-scale trade negotiation. The strategies to run their institutions had to be those of the sophisticated and up-to-date ones.

*Government Institutions*

The facilitators had sought cooperation and assistance from various government institutions. These cooperation and assistance and government institutions are listed as follows:

Sr. No.	Type of Cooperation and Assistance	Government Institution
1	Initial Establishment of SSFC and TSA	Provincial Governor, Ministry of Interior
2	Code of Conduct for Responsible Aquaculture	Marine Shrimp Aquaculture Research and Development Institute, Department of Fisheries
3	Shrimp Farming Research	National Institution of Coastal Aquaculture (NICA), Shrimp Research Center Department of Fisheries Ministry of Commerce
4	Input Provision	Electricity Generating Authority of Thailand
5	Environmental Impact Assessment, Monitoring and Control	Chulalongkorn University Habours Department Department of Pollution Control
6	Marketing Strategies	National Food Institute
7	International Competitiveness	Department of Export Promotion National Food Institute Department of Custom
8	Environmental Conservation	Department of Forestry Department of Export Promotion
9	Enforcement and implementation of Laws and Regulations	Department of Fisheries Ministry of Interior

These government institutions act as supporting agencies in terms of information provision, laws implementation and promotion of the SSFC and TSA. It has to be recognized that private sector in a form of group, club or association has better practical means to promote sustainable shrimp farming than the government sector. The role of the government is to compromise interests of all parties as to increase an overall welfare, while most of the private sector has a single objective so it has flexibility to take a lead in this risky enterprise.

*Other Related Associations and Clubs*

There are presently three main associations in shrimp farming industry in Thailand, namely, Thai Marine Shrimp Farmers Association (TSA), Thai Frozen Food Association and Instant Food Producers

Association. In addition, there are less formal clubs such as provincial shrimp farmers clubs and inputs traders clubs. These associations and clubs work in both vertical and horizontal lines of the shrimp farming industries.

#### *Topic Groups*

There are three main topic groups embedded in the shrimp farming operations in the Suratthani model. These groups formulate their strategies and activities with respect to; (i) production– related activities such as research needs to maintain shrimp production levels. The research has been focused on immediate requirements to pond and farm management, (ii) Marketing–related activities aiming at alternate stocking for partial harvest to avoid over supply at a particular time. These activities also include market planning, promotion of shrimp central markets in close proximity, and image and value-added creation of products utilizing internationally renowned standard settings, (iii) environmental conservation activity to support products and marketing activities, as well as better environments as a whole.

#### *Shrimp Farmers and Local Business People*

Upon the realization that every stakeholder is important for sustainable shrimp farming, all actors regardless of their sizes of operations have been involved to work on the same desirable direction. Shrimp farming industry creates many originating and continuing industries generating employment and distributing income. In an increased environmental awareness era, business enterprises have found their ways to support shrimp farmers in terms of substances or equipments to improve water-intake quality, or to treat water drainage.

#### *International Institutions*

The Suratthani Model has a distinct feature that it attempts to connect with international institutions. As is widely known, shrimp farming industry in Thailand aims at export markets where stiff competition, protectionism, environmental and health awareness, and economic and financial crises have been important barriers. Linkages with international institutions can help eradicate misunderstanding, improve product image, bargain for better trade deals, prepare shrimp product to suit with varying demands and uplift trade negotiations. Presently, the TSA has become a member of the Global Aquaculture Alliance (GAA), and has participated in many international forum. The FAO of the United Nations has put forward the Code of Conduct for Responsible Fisheries, which prompts the TSA and other related institutions to adopt it as principal framework for sustainable marine shrimp farming in Suratthani and Thailand.

#### *Selection of Preferred Location, and Problem and Opportunity Analysis*

The Suratthani Model operation covers all over Suratthani province (SSFC) and Thailand (TSA). There are seven districts along the coast of Suratthani province that are suitable for shrimp farming. However, there are some spatial differences in terms of water and soil quality, impacts from monsoons and chemical concentration in water. These areas are classified into three groups as:

- (1) Upper Suratthani Coast. This area covers three districts in the north coast facing directly the Gulf of Thailand. It has direct impacts from North-East monsoon contributing to good water quality, but quite acidic soil which make shrimp rearing difficult.
- (2) Ban Don Bay. This area is semi-closed, influenced by water discharged from nearby industries and households. Water quality here has to be settled and treated in storage ponds before being used in rearing ponds.
- (3) Low Salinity Area. This area using water from Tapee River which has low salinity. It used to be a disease-free zone but was hit by the diseases recently.

Farming characteristics of the first two areas are medium to large farms operating in high water salinity which is susceptible to easily be infected by shrimp diseases, whereas the last area has small farm operations and low water salinity.

Shrimp farming in Suratthani is facilitated by the SSFC who helps farmers with operations at Level 1, 2 and 3. The TSA plays role in assisting the operations at Level 4 and 5.

#### *Establishment of Specific Objectives and Management Strategies*

Specific objectives is aimed at guiding the institutions' projects to approach the ultimate goal. There are three main kinds of activities that the responsible institutions of the Suratthani Model has been involved. These activities can be interpreted as the specific objectives as follows:

- (1) To improve shrimp production with:
  - Assistance to design the Code of Conduct guideline and manual
  - Implementation of the Code of Conduct guideline and manual
  - Supports to conduct research and seminar on topics that are urgently needed for pond and farm management
  - Assistance to other clubs to deal with production negotiation
  - Compliance with the Royal Thai Government's economic policy.
- (2) To Increase International Trade Competitiveness with:
  - Cooperations with national institutions and relevant associations by means of meeting, brainstorming and working together
  - Affiliation with international agencies such as the Global Aquaculture Alliance (GAA)
  - Participation in international conferences
  - Provision of data and information to improve shrimp farming images
  - Compliance with international guidelines for product standardization and environmental protection.
- (3) To Conserve the Environment with:
  - Participation with other agencies (governmental, non-governmental organizations and private enterprises) in environmental rehabilitation and enrichment projects
  - Creation an awareness on environmentally friendly shrimp farming practices
  - Rehabilitation of mangrove forest
  - Assistance to other clubs in terms of amendments of environmental laws and regulations.

Strategies to achieve the first objective are directed toward the development and implementation of the Code of Conduct for Responsible Aquaculture, and assistance and advice to members or other clubs members regarding problems with input costs and input acquisition. These production strategies have to be in line with the government's economic policy (operations at Levels 2,3,4 and 5).

Strategies to achieve the second objective involve forming affiliation and alliance with national and international agencies to be known, and to create positive images of Thai marine shrimp (operations at Levels 4 and 5).

Strategies for an achievement of the third objective are awareness building, releasing of shrimp seedling to the natural habitat, mangrove replanting projects and investigating law amendment possibility (operation at Levels 3 and 4).

#### *Design of the Project and Joint Action*

Based on the four objectives, the SSFC and TSA have carried on with their activities which are directed to the benefits of the members and the local community as a whole. These activities are summarized in three implementation stages as shown in Figure 7.

### *Budget Allocation*

The SSFC and TSA are financially fuelled from three sources, (i) membership fees, (ii) donations and (iii) income from laboratory services. The main income is from donations which are the contribution of successful members. However, some activities are supported by government department such as the shrimp seedstocks enrichment project was supported by the Department of Export Promotion, Ministry of Commerce. Budget flow of the SSFC and TSA is best represented in the following Figure 8.



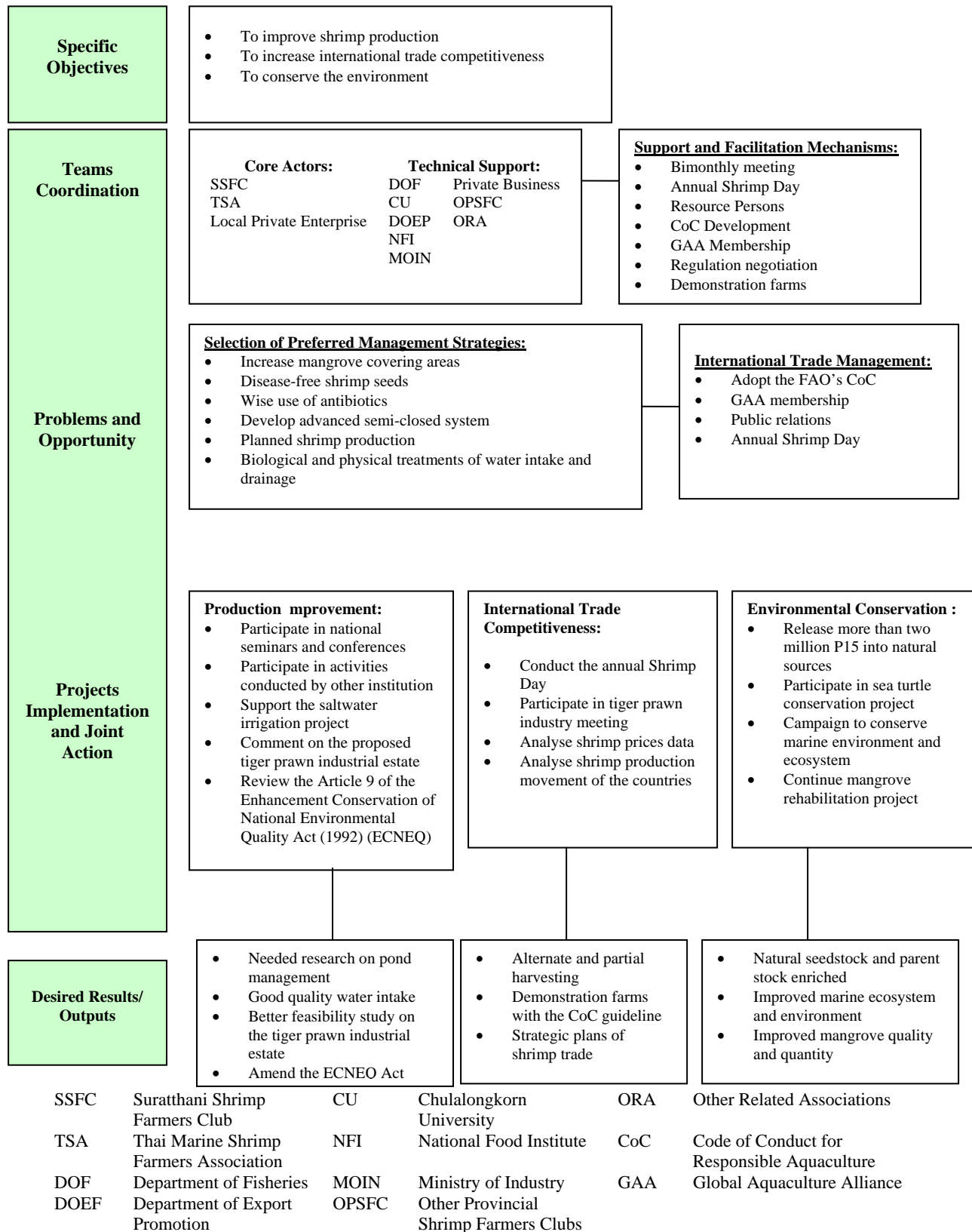
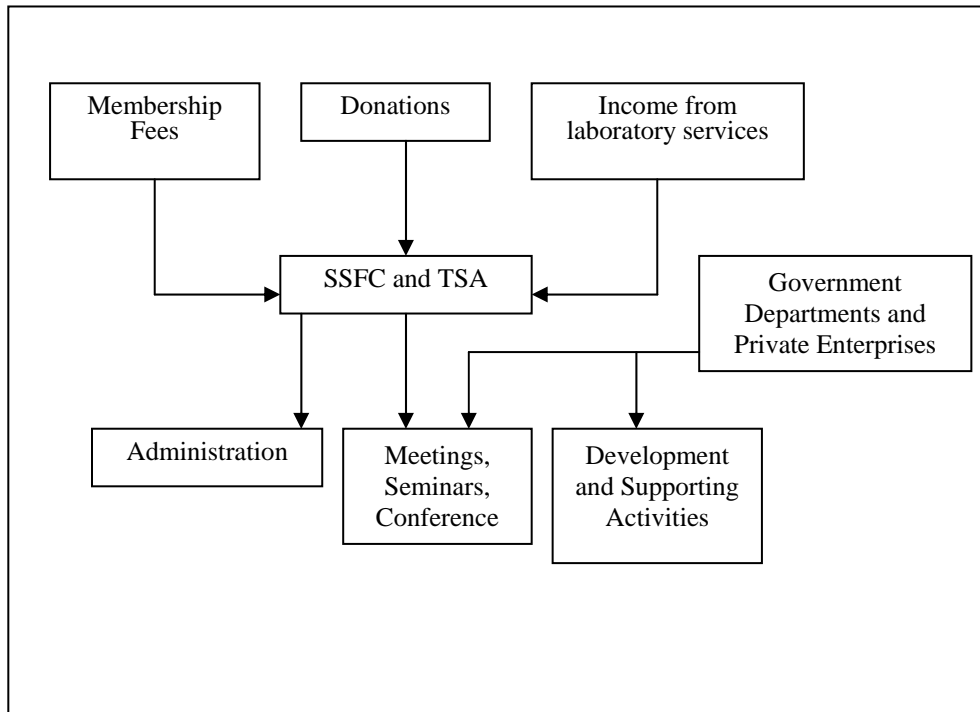


Figure 7. Projects Implementation and Joint Action as a Component in the ICZDA Process – Suratthani Model



**Figure 8.** Budget Allocation and Flows of the Suratthani Model

The existence of the SSFC and TSA is enabled by mainly supports from members, who voluntarily provide financial, intellectual and physical means. This remarkable dedication has been carried on as the members are able to witness group cohesion benefits (both tangible and intangible), which naturally have proven to be greater than combined individual benefits. Because of group forces, the SSFC and TSA have been able to create their production, marketing and environmental conservation activities by flows of supports from both governmental and private organizations.

*Analysis of Key Factors Associated With the Establishment of the TSA*

The TSA has played and continued to play increasing roles in promoting sustainable shrimp farming in Thailand. There are several key factors that are considered to be important for the determination of this association, which are summarized below (Surasak Dilokkiat, pers. comm. 2000).

It is the primary purpose of this research to apply the Hierarchical Stakeholder Levels Analysis and ICZDA as analytical frameworks for both Chantaburi and Suratthani case studies. Using the ICZDA steps for the Suratthani Model can provide an insight into these model components that are contributing to the success of shrimp farming in Suratthani province. The following sections are the ICZDA steps that explained the development process for sustainable shrimp farming in Suratthani.

### **Summary of TSA activities in 1999-2000**

**There are three main and regular activities of the TSA within the scope of production and marketing of marine shrimp.**

#### *Production Activities*

- Coordination and implementation of the Code of Conduct for Responsible Aquaculture
- Compliance with the Government's Economic Policy
- Research for an increase in international competition

#### *Marketing Activities*

- Coordination and implementation with relevant institutions to solve shrimp trade unfairness
- Coordination and implementation of data/information to the public both domestic and international

#### *Environment Conservation*

- Conservation of mangrove and the environment
- Enrichment of shrimp parentstocks
- Conservation of sea turtle

Leading members of the SSFC and TSA possess distinct characteristic to analyse problems for solutions. The problem issues sometimes are not directly affecting the shrimp farming, but they can play a major part for the existence of the industry.

- Weakness in group cohesion. There is a serious weakness in group cohesion embedded in the Thai culture. Thai individuals normally seek occupational excellence on his/her own. This knowledge is used for mostly private, or at the most small group benefits. Advantages for the invented excellence are kept in a closed niche. But the nature of shrimp farming practices are not entirely individualistic, it is a communal responsibility. The benefits gained by an individual can no longer exceed the communal benefits, which leads to failures experienced by many individual farmers
- Common problems. Shrimp farming has been hard hit by a series of problems, i.e., diseases, pollution, conflicts and trade policies. These are common problems that solving them individually can not show a significant impact. This leads to a group consultation to discuss, analyze the problems, and to find solutions for them.

- Seeking opportunity. The TSA has realized that acting passively in an increasingly high competitive and protectionism market would not help to increase bargaining powers. They strategically analyze the situation involving strengths, weaknesses, opportunity and treats occurring in their shrimp farming industries, which results in active activities and strong wills to lead the world in shrimp production and marketing.

#### *Group Cohesion Experiences*

Despite the weakness nature of group cohesion in Thai culture, the SSFC and TSA have managed to motivate their members to form group forces. As mentioned earlier that the main factors for this to happen were strong wills, analysis capability and common problems. The other important factors are fears of shrimp farming collapse, as experienced in the Upper Gulf Provinces. Because of these factors, the groups were formed. Initially, the group cohesion weakness was still evident, but it was later overcome by the obvious benefits accruing from group cohesion. The numbers of devoted members have been expanding covering many provinces and sectors.

### *Vertical and Horizontal Integration Concept*

Shrimp farming is a highly intensive and delicate enterprise. A successful farm requires not only high capability of farm management (Levels 1-3), but also deep cooperation among farms, communities, and national and international agencies. (Levels 4-5)

- **Vertical Integration.** This form of integration includes all stakeholders who are involved in shrimp farming from input producers to market distributors and to eventual consumers in both domestic and international markets. The TSA is attempting to perform this task by involving all relevant associations, i.e., Thai Frozen Food Association and Thai Feed Mills Association to plan for shrimp production and marketing strategies.
- **Horizontal Integration.** Within a Level of shrimp farm management, there is a form of integration, i.e., among farmers, among public and private sectors and among academic and business interests. The coordinating roles of a micro scale (i.e., farmers and farmers, groups and groups) to achieve the horizontal integration are largely in the hands of provincial or regional shrimp farming clubs, while the TSA play roles to achieve the horizontal integration in a more macro scale (i.e., public and private sectors, academicians and farmers)

The vertical and horizontal integration concept can be considered as a form of co-management where the TSA acts as mediator facilitator.

### **The Model**

Based on the two case study models presented in previous sections, the most desirable model incorporating important institutional settings in all operational levels 1-5 of sustainable shrimp farming process is developed and discussed in this section. This model may be delivered for adoption, and perhaps further adaptation is needed for it to be suitable for a particular location.

The ICZDA steps are applied for the development of this model with reference to the Hierarchical Multi-Level Stakeholders Analysis.

As indicated in the earlier sections that the Chantaburi and Suratthani Models are complementary with each other. The obvious differences that can be observed are their different levels of operations. The Chantaburi Model appears to operate their institutional settings at the operational levels 1-3, whereas the Suratthani Model attempts at the operational levels 1-5. It is emphasized that, no matter what maximum level they are operating at, sustainability in each level is necessary for an overall achievement of goal.

The following Model attempts to analyse important and complementary features of the Chantaburi and Suratthani Models and then incorporate them using the ICZDA steps.

### *Clarification of Goal and Objective*

The goal of the model is stated as:

“To develop and maintain sustainable shrimp farming practices as an **economic** enterprise for the production of **internationally recognized** shrimp products with adequate **social** and **environmental** responsibilities.”

With the above goal, there are at least four important keywords that are utilized as the objectives of the Model. They are:

- (1) **Economic Enterprise.** An economic enterprise seeks economic returns to cover the costs and normal profit. The costs involve not only financial costs, but also social and environmental costs. Hence, the economic objective of the Model is;
  - To maintain and rightfully increase economic returns to shrimp farming entrepreneurs at all levels
  - To integrate shrimp farming development plan into the national plans and policies
- (2) **International Recognition.** In the present trade globalization, products recognition is important for international trading advantages. The recognition is in a form of product differentiation via standardization, positive attitudes toward the products, acceptable production process and products delivery systems. The objective of the Model is formulated as follows:
  - To adopt and implement the FAO of the United Nations' Code of Conduct for Responsible Aquaculture.
- (3) **Social Responsibility.** In the shrimp farming process, many social aspects are involved. These aspects are, for example, exploitation of child and alien labour, equitable distribution of benefits, conflicts among stakeholders who have and care for different occupations and interests, and human migration and resettlement due to polluted waterways, coastal erosion and soil contamination. The Model's objective is developed as:
  - To minimize social problems accruing from the development of shrimp farming.
- (4) **Environmental Responsibility.** There have been various studies on environmental impacts from shrimp farming. These impacts can be divided into two main categories: those arising from the destruction of mangrove forests, and those produced by the day-to-day operation of the shrimp farming industry. The apparent impacts are mangrove degradation, water and soil contamination by chemicals and salt, farm pollutants, eutrophication and loss of aesthetic values of landscape. Hence, the Model's objectives are formulated as :
  - To minimize environmental impacts from the shrimp farming industries
  - To restore environmental quality of the locality where shrimp farming is situated, and larger areas.

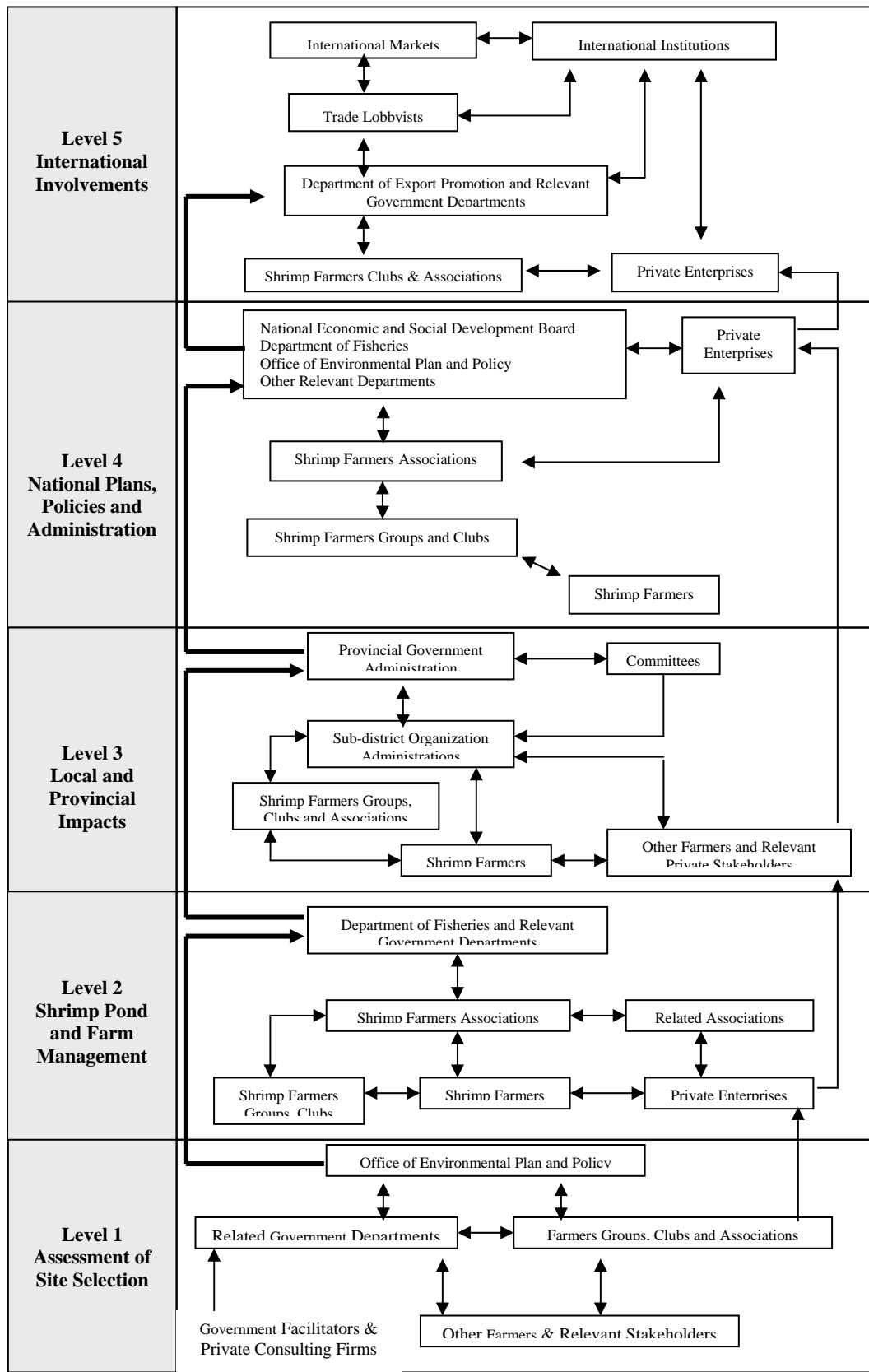
#### *Establishment of Management Team and Framework*

The Model is convinced that in each level of the Hierarchical Stakeholders structure, vertical and horizontal integrations of institutions and people involved in the institutions are necessary for the achievement of the goal and objectives. The manage team is proposed to be arranged in a diagrammatic representation as in Figure 9.

#### *Selection of Preferred Location and Problem and Opportunity Analysis*

There are three sets of locations throughout Thailand in which this desirable model can be implemented;

1. Coastal location where marine shrimp farming is predominant and bands of coastal areas along the Gulf of Thailand, inner Gulf and Andaman Sea.
2. Existing and potential locations for freshwater shrimp farming
3. Abandoned shrimp farms in coastal and freshwater locations. This location is physically located in both (1) and (2) above, but because of its special characteristics it could be treated separately.



**Figure 9.** Diagrammatic Representation of Proposed Management Teams

In each location, however, analysis has to be made with respect to water supplies, water quality, topographic properties, socio-economic characteristics, existing institutional arrangements, and problems and opportunities. Spatial and temporal differences among these locations are elaborately analyzed so that various management options could be put in the right place at the right time.

Spatial and temporal differences among these locations are elaborately analyzed so that various management options could be put in the right place at the right time.

Special attention is made on the location where abandoned shrimp farms in both coastal and freshwater areas are numerous. It should be the highest attempts to limit an area expansion under shrimp farming, but to maximum utilize the existing areas especially those abandoned.

*Establishment of Specific Objectives and Management Strategies*

The specific objectives are directly corresponded with the Goal of the Model mentioned above. These objectives and framework for management strategies are summarized as follows.

<b>Objective</b>	<b>Framework for Management Strategies</b>
1. To maintain and rightfully increase economic returns to shrimp farming entrepreneurs at all levels	<p>Level 1</p> <ul style="list-style-type: none"> <li>• Site selection criteria</li> <li>• Limitation of growth of fresh water shrimp farming</li> </ul> <hr/> <p>Level 2</p> <ul style="list-style-type: none"> <li>• Appropriate water management techniques</li> <li>• Emphasis on economic efficiency (not technical or financial)</li> <li>• Managed stocking density, and uses of others inputs</li> <li>• Chosen closed, semi-closed or open systems according to pond, farm and environmental conditions</li> <li>• Controlled uses of chemicals (fertilizers, antibiotics, additives)</li> </ul> <hr/> <p>Level 3</p> <ul style="list-style-type: none"> <li>• Increased roles of local administration to impose appropriate taxation system (direct, social and environmental taxes)</li> </ul> <hr/> <p>Level 4</p> <ul style="list-style-type: none"> <li>• Amendment of laws to support shrimp farming</li> <li>• Clear policy, measures and plans</li> </ul> <hr/> <p>Level 5</p> <ul style="list-style-type: none"> <li>• Quality assurance (HCAPP, ISO, Green labelling)</li> <li>• New market within Asia and Oceania</li> <li>• Establishment of international cooperations</li> </ul>
2. To integrate shrimp farming development plan into the national plans and policies	<p>Level 1</p> <ul style="list-style-type: none"> <li>• Shrimp farming zoning based on physical, socio-economic and environmental considerations</li> <li>• Proper EIA</li> </ul> <hr/> <p>Level 2</p> <ul style="list-style-type: none"> <li>• Correct estimation of financial, economic and environmental cash flow.</li> </ul>

Objective	Framework for Management Strategies
	<p>Level 3</p> <ul style="list-style-type: none"> <li>• Local administrations' participation in plan and policy setting</li> <li>• Trained local personnels in particular topics relating to shrimp farming</li> <li>• Local monitoring and evaluation of activities related with shrimp farming</li> <li>• Coordination with private enterprises</li> </ul> <p>Level 4</p> <ul style="list-style-type: none"> <li>• Provision of clear channels to integrate shrimp farming development plan into the national plans and policies</li> <li>• Provision of personnel and financial assistance to local administration for the preparation of plans</li> </ul> <p>Level 5</p> <ul style="list-style-type: none"> <li>• Shrimp farming development plan in terms of environmental, social and health concerns is in the national agenda for international market promotion</li> </ul>
<p>3. To adopt and implement the FAO of the United Nations' Code of Conduct for Responsible Aquaculture</p>	<p>Level 1</p> <ul style="list-style-type: none"> <li>• Following the Code of Conduct, but adjusting it to fit well with local conditions</li> </ul> <p>Level 2</p> <ul style="list-style-type: none"> <li>• As in Level 1</li> </ul> <p>Level 3</p> <ul style="list-style-type: none"> <li>• As in Level 1</li> <li>• Increased local supports to implement the Code of Conduct</li> <li>• Development of specifically local Code of Conduct</li> </ul> <p>Level 4</p> <ul style="list-style-type: none"> <li>• As in Level 1</li> <li>• Development of specifically national Code of Conduct</li> </ul> <p>Level 5</p> <ul style="list-style-type: none"> <li>• As in Level 1</li> <li>• Campaigning to show the international community that Thailand takes the Code of Conduct seriously</li> </ul>
<p>4. To minimize social problems accruing from the development of shrimp farming</p>	<p>Level 1</p> <ul style="list-style-type: none"> <li>• Social factors are taken into account when performing the tasks (EIA, zoning, landscape design)</li> <li>• Improve pond and farm designs</li> </ul> <p>Level 2</p> <ul style="list-style-type: none"> <li>• Improved pond and farm management to minimize social conflicts</li> <li>• Salinity, water drainage and sludge controls</li> <li>• Social parity management (conducting social functions, social benefit distribution, participation in social events)</li> </ul> <p>Level 3</p> <ul style="list-style-type: none"> <li>• Improved local administration involvement in conflicts management</li> <li>• Increased local authorities to manage the occurred conflicts</li> </ul>



Objective	Framework for Management Strategies
	<p>Level 4</p> <ul style="list-style-type: none"> <li>• National policies supporting social harmony via informative and informal education</li> <li>• Decisions to conflicts with national benefits as the main goal</li> </ul> <hr/> <p>Level 5</p> <ul style="list-style-type: none"> <li>• Exhibition of social conflict resolution, perhaps using the Thai ways to the international community</li> <li>• Showing that social harmony is the Thai way of life.</li> </ul>
<p>5. To minimize environmental impacts from shrimp farming industries</p>	<p>Level 1</p> <ul style="list-style-type: none"> <li>• Improved aquaculture landscape design</li> <li>• Proper aquaculture engineering (water intake and drainage) designs</li> <li>• EIA is inclusive of every components (economic, social, financial, natural and environmental valuation)</li> </ul> <hr/> <p>Level 2</p> <ul style="list-style-type: none"> <li>• Constant monitoring of water effluents and sludge from shrimp farms</li> <li>• Water intake and settling ponds</li> <li>• Timing of water intake and drainage</li> </ul> <hr/> <p>Level 3</p> <ul style="list-style-type: none"> <li>• Increased local authorities to monitor and control environmental impacts</li> <li>• Penalties due to violation go to local administration.</li> </ul> <hr/> <p>Level 4</p> <ul style="list-style-type: none"> <li>• Assisting local administration to monitor and control environmental impacts</li> <li>• Training on the monitoring and control techniques to local personnel</li> <li>• Counterbalancing the enforcement of local authorities</li> </ul> <hr/> <p>Level 5</p> <ul style="list-style-type: none"> <li>• Showing that Thailand is serious about the environmental impacts from shrimp farming</li> <li>• Showing that local communities are involved in the environmental impact minimization process.</li> </ul>
<p>6. To restore environmental quality of the locality where shrimp farming is situated, and larger areas</p>	<p>Level 1</p> <ul style="list-style-type: none"> <li>• Positioning of coastal areas for mangrove rehabilitation programs</li> <li>• Mapping of coastal areas (waters) with varying degrees of environmental quality (endangered species, chemical concentration, mangrove depletion and succession)</li> </ul> <hr/> <p>Level 2</p> <ul style="list-style-type: none"> <li>• Participation in environmental restoration programs (mangrove rehabilitation, fish and shrimp seed enrichment, dugong, dolphin, sea turtle conservation)</li> <li>• Promoting the environmental restoration programs</li> </ul>

Objective	Framework for Management Strategies
	Level 3 <ul style="list-style-type: none"> <li>• Creating and supporting mangrove rehabilitation programs</li> <li>• General public announcement and encouragement</li> </ul>
	Level 4 <ul style="list-style-type: none"> <li>• Promotion techniques (reward)</li> <li>• Environmental quality restoration is the national policy</li> </ul> Encouragement of research and education programs
	Level 5 <ul style="list-style-type: none"> <li>• Showing the national policy and its achievement to restore Thailand's environmental quality to the international community.</li> <li>• Using the above strategies as Thai brand names</li> </ul>

*Design of Project and Joint Action*

The six objectives of The Model form a basis for project designs and joint action that should be performed by responsible individuals and institutions in all operation levels. Figure 3.7 presents the projects implementation and joint action of The Model.

*Budget Allocation*

The proposed project designs and joint actions require financial supports for their implementation. Part of the supports is expected to be from the government's budget line. Some other parts could be from (i) national and international donors, and (ii) membership fees. It is important for shrimp farmers to form an "Office of Shrimp Farming Aid Fund" Similar to that of the rubber replanting aid fund. This shrimp farming aid fund with relevant actors, facilitators and technical supporters can perform several actions indicated in Figure 9. In addition, Thai Marine Shrimp Farmers Association (TSA) has high potentials to develop its plans and activities to attract funds from both local, national and international development agencies.

<p><b>Specific Objectives</b></p>	<ul style="list-style-type: none"> <li>To maintain and rightfully increase economic returns to shrimp farming entrepreneurs at all levels</li> <li>To integrate shrimp farming development plan into the national plans and policies</li> <li>To adopt and implement the FAO of the United Nations' Code of Conduct for Responsible Aquaculture</li> <li>To minimize social problems accruing from the development of shrimp farming</li> <li>To minimize environmental impacts from shrimp farming industry</li> <li>To restore environmental quality of the locality where shrimp farming is situated, and larger areas.</li> </ul>																							
<p><b>Teams Coordination</b></p>	<table border="1"> <tr> <td><b>Core Actors:</b></td> <td><b>Facilitator:</b></td> <td><b>Technical Support:</b></td> </tr> <tr> <td>-DOF</td> <td>-Educational and Research Institutes or centers</td> <td>-OEPP</td> </tr> <tr> <td>-Or-Bor-To</td> <td></td> <td>-NESDB</td> </tr> <tr> <td>-Provincial Shrimp Farmers Clubs</td> <td>-TSA</td> <td>-DOEP</td> </tr> <tr> <td>-Local Private Enterprises</td> <td>-Provincial Governments</td> <td>-DOF</td> </tr> <tr> <td>-Coastal Shrimp farmers</td> <td>-Related NGOs</td> <td>-Private Business</td> </tr> <tr> <td>-Freshwater shrimp</td> <td></td> <td></td> </tr> </table>	<b>Core Actors:</b>	<b>Facilitator:</b>	<b>Technical Support:</b>	-DOF	-Educational and Research Institutes or centers	-OEPP	-Or-Bor-To		-NESDB	-Provincial Shrimp Farmers Clubs	-TSA	-DOEP	-Local Private Enterprises	-Provincial Governments	-DOF	-Coastal Shrimp farmers	-Related NGOs	-Private Business	-Freshwater shrimp			<p><b>Support and Facilitation Mechanisms:</b></p> <ul style="list-style-type: none"> <li>Research in all relevant aspects</li> <li>Workshop, training, seminar, conference, meeting</li> <li>Publication, data and information center, websites</li> <li>Regulations development</li> <li>Member of key organization</li> <li>Demonstration projects</li> <li>Resource persons</li> </ul>	
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-Freshwater shrimp																								
<p><b>Problems and Opportunity</b></p>	<p><b>Selection of Preferred Management Strategies:</b></p> <p>As indicated in Section 3.4.3. The management strategies are corresponded with each specific objective for each operation level.</p>	<p><b>Sustainable Shrimp Farming:</b></p> <ul style="list-style-type: none"> <li>Maintain foreign exchange earnings from shrimp farming</li> <li>Present appropriate shrimp farming culturing techniques</li> <li>Comply with the Code of Conduct</li> <li>Resolve environmental and social problems</li> <li>Integrate shrimp farming development plan as the national plans and policies</li> <li>Maintain and seek international markets</li> <li>Enrich environmental conditions</li> <li>Control water effluents and sludge</li> <li>Encourage vertical and horizontal integration</li> </ul>																						
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<p><b>Desired Results/ Outputs</b></p>	<ul style="list-style-type: none"> <li>Economic returns maintained</li> <li>Social conflicts resolved</li> <li>Shrimp farming development plan integrated into the national plans and policies</li> </ul>	<ul style="list-style-type: none"> <li>Environmental impacts satisfactorily minimized</li> <li>Codes of conduct developed</li> <li>Shrimp farm zoning imposed</li> </ul>	<ul style="list-style-type: none"> <li>Laws and regulation enforced</li> <li>Mangrove forest rehabilitated and enriched</li> <li>Research in all aspect</li> <li>Water effluents and sludge controlled</li> <li>International approval</li> </ul>																					

Figure 9. Projects implementation and joint action as a component in the ICZDA process – The Model

## **Summary and Conclusion**

This chapter analyzes two case studies based on the Hierarchical Stakeholder Levels Analysis and Integrated Coastal Zone Development Analysis. The synthesis accruing from the analysis results of these two case studies gives rise to the most desirable model of sustainable shrimp farming in Thailand or shortly called “The Model”.

The Model presents all aspects of shrimp farming development in the Integrated Coastal Zone Development Analysis framework that includes goal and objectives, problem and opportunity identification, team (or stakeholders) coordination, designs of management strategies, project implementation and joint action and budget allocation. All five levels of stakeholders are key settings for the analysis.

Thai shrimp farming industry continues to play an important role for the economy. Its production techniques and management arrangements are adjusted to fit with changing environments and trade patterns. Roles of institutions and their arrangements have come to play increasing roles to put Thai shrimp farming industry in a position that continue to lead the world in terms of culturing technology; pond, farm and environment management, institutional mechanisms, human resource development, contribution to other countries and international trade negotiating strategies. It is also important that Thailand is a central core for international cooperation with respect to all aspects mentioned earlier.

## **Type of Data/Information and Delivery Systems**

### **Introduction**

The Model – the most desirable model for shrimp farming – was developed as a model that guarantees sustainable management of shrimp farming in Thailand. This proposed model and its operation levels require different kinds of data/information from institutions responsible for data/information gathering, compiling and delivering systems. In the ICZDA framework, data/information are important inputs to the designing of shrimp farming management plan, and to all components in the ICZM process leading to the effective and sustainable development of this industry.

Three categories of information are required to perform sustainable shrimp management and to guide for an appropriate selection of technical management guidelines. They are; (i) shrimp pond and farm sites; (ii) water supply sources, shrimp seedlings, pond and farm management techniques; and (iii) institutional settings.

At the operational level 1, responsible institutions need to rely on more regional data sources such as spatial and temporal environmental quality parameters, socio-economic characteristics, existing political players, and levels of laws enforcement and compliance.

### **Data/Information**

At the operational level 2 (ponds and farms) and level 3 (community), much of needed data/information are collected directly from local farmers, private enterprises and local governments (i.e., Tambon or Sub-district Administration Organization, Provincial Administration Organization and other government offices) with an aim to strengthen co-management partnership. This data/information are current pond and farm management practices that have been developed by independent farmers or private enterprises, effluents parameters released from ponds and farms, chronic and arising local conflicts, and laws enforcement institutions and their levels of implementation.

At the operational level 4 and 5, data/information can be obtained from national and international institutions. Data/information on shrimp farming zones, plans and policies, EIA requirements, current

trading patterns, demand of the importing countries, supply of the competing countries and their farming situations, and effluent standards can help plan for sustainable management of shrimp farming. Access to this set of data/information is much easier in the present time.

Though the international communities may have limited knowledge about present shrimp farming operations in Thailand (e.g. levels of environmental degradation due to shrimp farming, degrees of mangrove forest destruction, government's measures to tackle these environmental issues), they are able to assume proxy knowledge using an evaluative judgement of product quality which, unfortunately in many cases produce faulty conclusions. It is an important role for all concerned institutions to help promote shrimp product quality assurance and guarantee of product quality satisfaction. The data/information required to facilitate product quality acceptance are current environmentally friendly products, right use of drugs and other chemicals, human rights protection and health concerned production process.

Current development of shrimp farming practices has produced set of data/information that future and sustainable shrimp farming in Thailand will require the following knowledge.

- Areas of under productive shrimp farming involving customarily allowable freshwater shrimp farming, salt water irrigation areas, group or cooperative farming areas
- Low risk shrimp farming system (mainly via lower stocking rates) has to weight returns from lower yields in correspond with lower stocking rates, lower feeding rates and lower use of other inputs
- Closed, semi-closed, and alternate close systems have to be clearly defined for implementation. Naturally each shrimp farming location can practice different water use system. The Charoen Pokphand (CP) group has developed its own techniques, and some of the techniques have proven effective
- Sustainable shrimp farming plans and policies of the national government including its position in the plan and policy priority
- Demand of the importing countries in terms of product specification (e.g., cooked, peeled, live) and quantity demanded in each month or season. Importing policies of each country have to be analyzed for designing of appropriate and competitive strategies
- Supply of other shrimp producing and exporting countries and their policies. This can help plan for shrimp rearing and harvesting times to avoid an oversupply situation. Knowledge on disease infestation, shrimp product diversification and amount supplied, and trade policies can help Thai shrimp products gain higher market shares.

#### *Data/Information*

There are sets of information about shrimp farming management, which could be effectively delivered in different management levels with several management objectives. They are summarized in three categories corresponding with the required data/information as follows:

<b>Management level</b>	<b>Management Delivery System</b>	<b>Primary Objectives</b>
I. Managing Shrimp Pond And Farm Sites	<ul style="list-style-type: none"> <li>• Environmental protection guidelines</li> <li>• Habitat restoration guidelines</li> <li>• Zoning management Guidelines</li> </ul>	<ul style="list-style-type: none"> <li>• Maintain overall integrity and productivity of the mangrove/natural systems</li> <li>• Maintain primary habitats for shrimp pond effluent treatments</li> <li>• Allow shrimp pond development only in aquaculture zone</li> </ul>
II.1 Managing shrimp farming operations	<ul style="list-style-type: none"> <li>• Aquaculture licensing</li> <li>• Sediment/sludge/salt control manual</li> </ul>	<ul style="list-style-type: none"> <li>• Limit number of farmers/area sustainable revenue</li> <li>• Control sediment/sludge/salt disposal</li> <li>• Reduce conflicts between farmers (control waste)</li> </ul>
II.2 Managing pond production and types of farming technique	<ul style="list-style-type: none"> <li>• Shrimp production handbook</li> <li>• Conference, seminar and training workshop</li> <li>• Shrimp post larvae sources list</li> <li>• Procedures for acquisition of good quality seed stocks</li> <li>• Manuals for shrimp diseases diagnosis and treatments</li> <li>• Panel of experts</li> </ul>	<p>Demonstrate different shrimp farming techniques as options for selection. Provide information on:</p> <ul style="list-style-type: none"> <li>• Sources of good quality parent stocks</li> <li>• Sources of high quality seed stocks</li> <li>• Checklist of good seed stock quality</li> <li>• Immediate consultation of experts to help avoid serious pond and farm management problems</li> </ul>
II.3 Managing Shrimp Products	<ul style="list-style-type: none"> <li>• Product standard manual</li> <li>• Conference and training workshop</li> </ul>	<ul style="list-style-type: none"> <li>• Improve quality of shrimp products at farm</li> </ul>
III.1 Managing local shrimp production clubs	<ul style="list-style-type: none"> <li>• Local agreement on Code of Conduct</li> <li>• Meeting and seminar</li> </ul>	<ul style="list-style-type: none"> <li>• Provide guideline for responsible shrimp farming</li> <li>• Minimize risks from external sources</li> <li>• Minimize conflicts</li> <li>• Improve income</li> </ul>
III.2 Managing local administration	<ul style="list-style-type: none"> <li>• Meeting and seminar</li> </ul>	<ul style="list-style-type: none"> <li>• Resolve conflicts</li> <li>• Improve common property resource management techniques</li> </ul>
III.3 Managing national government	<ul style="list-style-type: none"> <li>• Plan and policy guidelines</li> </ul>	<ul style="list-style-type: none"> <li>• Guarantee certain position of shrimp farming</li> <li>• Improve shrimp productivity</li> <li>• Guarantee shrimp production and income levels</li> <li>• Improve common property resource management techniques</li> </ul>
III.4 Managing international communities	<ul style="list-style-type: none"> <li>• Membership of international agencies</li> <li>• Newsletters</li> <li>• Web sites</li> </ul>	<ul style="list-style-type: none"> <li>• Prove environmentally friendly shrimp farming</li> <li>• Seek international cooperation</li> <li>• Provide information on shrimp farming progress with respect to technical know-how and effective resource management techniques</li> </ul>

## Summary

This section provides checklist of data/information needed for sustainable management of shrimp farming in Thailand. The checklist is provided in correspond with the three categories of data/information, but in a particular details and urgency.

<b>Checklist of Data/information and Delivery System Needed for Sustainable Management of Shrimp Farming</b>
<p>I. Site and Shrimp Farming Landscape</p> <ul style="list-style-type: none"><li>Regional and local maps of landscape, including:</li><li>Availability of land and clean water supply (rivers, canal, open ocean)</li><li>Proximity of labor, power, supplies, roads, and markets.</li><li>Regional maps or Satellite Images indicating sectoral resource use (potential catchment influences on shrimp aquaculture).</li></ul>
<p>II.1 Water Supply</p> <ul style="list-style-type: none"><li>Sources of pollution (shrimp sludge, organic matters) entering water supply bodies.</li><li>Predict impact of management tools on the prevention of water pollutions and disease outbreaks.</li><li>Habitat restoration.</li></ul>
<p>II.2 Seedling/Post-larvae</p> <ul style="list-style-type: none"><li>Location and operation of hatcheries</li><li>Seed stock quality from each hatchery type</li><li>Accessibility of shrimp farmer to key hatcheries and screening laboratories</li></ul>
<p>II.3 Pond Management</p> <ul style="list-style-type: none"><li>Matrices of relative harvest values between stocking density and pond conditions</li><li>For the pond conditions producing the good benefits harvests:</li><li>Which ways to test feed quality?</li><li>What is the causes and effects of shrimp diseases?</li><li>How to prevent and treat the diseases?</li><li>How to improve the operation of water exchange, aeration, water treatment, feeding rate, water quality monitoring and bottom sediment removed.</li></ul>
<p>III Institutional Arrangements and Objectives</p> <ul style="list-style-type: none"><li>What regulations are there? Who is responsibilities, and why? Sludge? Water? Disease? Feed? Seedling? Habitat? Market and trade</li><li>Formal and Informal relationships between the farmers and the rules making bodies.</li><li>Conflicts among shrimp farmers, other farmers or sectors and other problems</li></ul>

It can be seen that a sustainable management of shrimp farming is truly a complicated matter, requiring both precise and reliable data/information, and effective delivery system. The synthesis of such requirements based on the proposed desirable model has indicated that all five levels of shrimp farming operations are related and data/information transfers is necessary. In short, all levels need effective cooperation via both vertical and horizontal coordination.

# **Human Skills Needed for Management of Shrimp Farming as an Option for Coastal Zone Management**

## **Introduction**

This chapter provides an overview of human skills required by institutions (e.g., managers, administrators, planners, decision makers) who have been involved in sustainable management of shrimp farming within the context of coastal ecosystems. The sustainable management is a complex concept requiring proper human resource development. The challenges are obviously complicated but certainly are not beyond human ability. The professionals and staff are required to access a combination of knowledge, skills, and attitudes in three main categories as; (i) knowledge of how ecosystems function (shrimp pond/farm/coastal area), (ii) strategic analysis and policy process, and (iii) cultural inheritance.

## **The Challenges**

Shrimp farming is a significant export industry in Thailand which has important impacts on the environment and coastal communities. This activity has placed enormous pressures on coastal ecosystems and made it difficult for local people to pursue traditional lifestyles. The challenge faced by shrimp farming institutions is that the people and institutions at local, national and international levels are encouraging environmentally friendly and high quality shrimp production techniques.

The importance and need for effective management of shrimp farm and their impacts in coastal environments was highlighted in the FAO Code of Conduct for Responsible Fisheries (1995). One important constraint to sustainable shrimp aquaculture is limited institutional capacity and ability to effectively practice Integrated Coastal Zone Management (ICZM). It is necessary for all those concerned with shrimp research and management to be trained in the concepts underlying coastal resources management goals, strategies and plans be sound and promote thinking that leads to workable balance between the shrimp farms in a given place and the ecosystem of which they are crucial members.

The first concept for consideration is that shrimp researchers and managers who are involved in all operational levels 1 to 5 should be educated to manage the ecosystem that shrimp farming is a part. This requires systematic thinking focusing on how coastal ecosystems respond to human interference (e.g. shrimp farming). Usually the ecosystem and social values are consequently lost from the human interference. These factors are major underlying causes of unsustainable shrimp farming. The second concept is that people who are involved in this industry must be equipped with tools to practice an adaptive management of shrimp farming, which would lead to the desirable sustainability. Various tools are available for the evaluation of strategies involving multiple objectives and criteria. Skills to use these tools in appropriate situations are needed.

Coastal ecosystems must be viewed and analyzed with human societies as an integral component, not something above or outside the system. This approach requires all elements of ecosystem functions that relate to human's socio-economic functions. These elements evolve through time. The scientific knowledge and skills which managers need for sustainable shrimp farming management can be obtained from; (i) system ecology (physical and ecological functions); (ii) socio-economic and political functions; and (iii) environmental engineering and landscape design.

## **Knowledge, Skills and Attitude**

Coastal management is primarily concerned with managing people, their politics and institutions. Its goal is to influence the values and behavior of a society to elicit a positive response to an integrated management scheme. Successful profile of an ideal shrimp management knowledge, skills and attitudes required for



sustainable establishment and management of shrimp farming as an option for Integrated Coastal Zone Management can be grouped into three broad and interrelated categories:

#### *Knowledge of How*

This category contains more technical aspects that are often stressed by those who enter shrimp farming management. An education in sciences is necessary. An ideal managers of shrimp activities must be able to transcend a particular scientific specialization and view the process that governs the functioning of an ecosystem and how it responds to anthropologic and natural change. What happens to coastal ecosystem stability and resilience when the system is disrupted is poorly understood, as are the interconnections and interdependencies between the coastal water, coastal land, shoreline, estuaries, freshwater and watersheds. It is of the utmost importance to have people capable to assess the implications of the scientific uncertainty that swirls around all important issues in ecosystem management and then being able to formulate a responsible course of action

#### *Strategic Analysis and Policy Process*

Coastal management programs need individuals with ability to articulate a vision and inspire the collaboration required to achieve the program's objectives. Closely coupled to leadership abilities is an appreciation of the policy process or operation planning and project design actions and the skills to perform a strategic analysis of a situation. These abilities are essential to plan a course of action that will yield positive results and bring a program through to implementation. Strategic analysis and planning is made challenging by the inevitable complexity of the institutional context within which the management of coastal ecosystems is played out. The experiences in Chantaburi and Suratthani demonstrate that no single agency can hope to formulate and implement the management measures required to maintain or restore the quality of these ecosystems. Collaborative action is both unavoidable and desirable. The coastal/shrimp manager, besides being a good strategist and leader, needs a solid foundation in the skill and knowledge required for:

- Conflict resolution
- Managing group processes (facilitator)
- Administration of complex institutions and programs
- Design and administration of transdisciplinary research programs
- Design and administration of public education and public participation programs
- Program evaluation.

#### *Understanding Aultural Aspects*

Every society is inherited with culture, tradition and beliefs. The ecosystem, despite its generally independent functions, is eventually connected with the human's strategic analysis and policy process, and cultural inheritance. The understanding of cultural inheritance improves attitudes of the people involved in sustainable shrimp farming management.

There should be a core group within the community that takes leadership responsibility for the management process of shrimp farming. The Suratthani case study exhibits well the importance of the above argument. It is the nature of shrimp farmers who seek individual excellence. With uncertain probabilities, some of them succeeded in achieving their primary objective of maximization of short-run private profits. However, the achievement needs not be true for all the shrimp farmers as the profit from one farmers can be a loss of the others. An overall group benefits can not be achieved by this attitude. Instead, group excellence for community profits in shrimp farming can be the best option for sustainable shrimp farming. This cultural burden can be overcome by a strategy to turn this unknowingly weak institutional and management arrangements into strong ones. Shrimp farming group with capable professionals (such as the TSA) should

be able to analyze this cultural behavior and formulate desirable cooperation so that the overall community benefits could be seen in both short and long runs. Similarly is in the case of the Chantaburi model, the Shrimp Farmers Group (SFG) offers a good opportunity to make use of locally technical resource persons to bridge the technical knowledge gap (shrimp farmers community and technical institutions), and to assist with fuelling of this technical knowledge to the SFG. The attitude of group solidarity brings confidence to the community and it is one of the main contributors to the success of this model.

It is equally important that these social behaviors are taken into account in all levels of planning. The understanding of cultural inheritance of the people in the target areas can be achieved through experiences, comprehensive series of training and personal interests.

Human skills needed in sustainable shrimp farming are certainly quite significant. However, suggestions from the present study derived from the Chantaburi and Suratthani case studies and summarized in the following Table 2.

**Table 2.** Human Knowledge, Skills and Attitudes Needed in Sustainable Management of Shrimp Farming

<b>Case Study</b>	<b>Actor</b>	<b>Activity</b>	<b>Success Factor</b>	<b>Knowledge/Skills/Attitudes (K/S/A) Needed</b>
Chantaburi	1. Shrimp Farmers Group (SFG)	<ul style="list-style-type: none"> <li>• Development of their own regulations</li> <li>• Pond production demonstration trials</li> <li>• Mangrove replanting</li> <li>• Development of project plans with TAO</li> </ul>	<ul style="list-style-type: none"> <li>• Coordination ability (exchange of knowledge and skills; resource sharing)</li> <li>• Joint awareness of environmental importance</li> <li>• Ability to work closely with provincial and local governments</li> <li>• Joint responsibility for common-property resources management</li> </ul>	<ul style="list-style-type: none"> <li>• Knowledge on strategic thinking</li> <li>• Shrimp farming production knowledge</li> <li>• Knowledge on how habitat functions</li> <li>• Dedication to work for the group</li> <li>• Positive attitudes toward working together with many different stakeholders</li> <li>• Similar skills as in the case of CORIN.</li> </ul>
	2. Tambon Administration Organization (TAO)	<ul style="list-style-type: none"> <li>• Allocation of budget for infrastructure development, natural resources and environmental management</li> <li>• Development of action plans</li> <li>• Technical and financial supports to SFG</li> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• Action plans successfully developed</li> </ul>	<ul style="list-style-type: none"> <li>• Knowledge on strategic plan preparations (concept and principles)</li> <li>• Knowledge on data/information acquisition</li> <li>• Skills in communication</li> <li>• Open-minded for public participation.</li> </ul>

<b>Case Study</b>	<b>Actor</b>	<b>Activity</b>	<b>Success Factor</b>	<b>Knowledge/Skills/Attitudes (K/S/A) Needed</b>
	3. Provincial Government (Provincial Administration Organization and Local Government)	<ul style="list-style-type: none"> <li>• Technical and financial supports to TAO</li> </ul>	<ul style="list-style-type: none"> <li>• Annual budget in place</li> <li>• Sufficient and qualified personnel</li> </ul>	<ul style="list-style-type: none"> <li>• Knowledge on policy and plan linkages at TAO, PAO and national levels</li> <li>• Knowledge on strategic plan preparations</li> <li>• Project proposal writing skills</li> <li>• Lobbying skills</li> <li>• Positive attitudes on projects for local and provincial development.</li> </ul>
	4. Regional Government Office (KKRDC SPWDCC)	<ul style="list-style-type: none"> <li>• Research and monitoring</li> <li>• Seed stock quality inspection</li> </ul>	<ul style="list-style-type: none"> <li>• Available laboratory for analyzing water and sediment parameters</li> <li>• Reliable results</li> </ul>	<ul style="list-style-type: none"> <li>• Scientific and technical knowledge</li> <li>• Knowledge on pond and farm ecosystems</li> <li>• Skills on extension</li> <li>• Skills on diagnosis of diseases and environmental quality of ponds and farms</li> <li>• Service-minded attitudes</li> <li>• Ability to provide options for shrimp farmers to choose.</li> </ul>
	5. Coastal Resources Institute (CORIN)	<ul style="list-style-type: none"> <li>• Planning and coordinating provincial government and TAO with SFG's activities</li> <li>• Capacity building focusing on SFG and Provincial government on shrimp farming production and waste controls.</li> </ul>	<ul style="list-style-type: none"> <li>• Involvement of a mediator to facilitate shrimp farming strategic plans.</li> <li>• Accountability that is accepted</li> </ul>	<ul style="list-style-type: none"> <li>• Skills on consensus facilitation</li> <li>• Skills on appropriately use of management tools</li> <li>• Skills in communication</li> <li>• Skills in dealing with political issues</li> <li>• Technical knowledge (ecosystem-based and socio-economic)</li> <li>• Open-minded and mature attitudes</li> </ul>
	6. Private Enterprises	<ul style="list-style-type: none"> <li>• Shrimp seed, feed and other farm inputs supplies</li> <li>• Laboratory services</li> <li>• Technical advice</li> </ul>	<ul style="list-style-type: none"> <li>• Honors</li> <li>• Good quality products</li> <li>• Regular visits to farms</li> </ul>	<ul style="list-style-type: none"> <li>• Technical knowledge</li> <li>• Skills on extension</li> <li>• Fairness</li> </ul>

<b>Case Study</b>	<b>Actor</b>	<b>Activity</b>	<b>Success Factor</b>	<b>Knowledge/Skills/Attitudes (K/S/A) Needed</b>
Suratthani	1. Suratthani Shrimp Farmers Club and Thai Marine Shrimp Association (SSFC and TSA)	<ul style="list-style-type: none"> <li>• Exchange of shrimp farming techniques</li> <li>• Regular meetings</li> <li>• Active participation in community, provincial, national and international programs</li> <li>• Mangrove rehabilitation programs</li> <li>• Environmental conservation programs</li> <li>• Annual Shrimp day</li> </ul>	<ul style="list-style-type: none"> <li>• Group cohesion</li> <li>• Vertical and horizontal integration among private enterprises and government offices</li> <li>• In line with the government's budget</li> <li>• Dedication of key personnel and farmers.</li> </ul>	<ul style="list-style-type: none"> <li>• Knowledge on shrimp production techniques</li> <li>• Knowledge on current movements of shrimp farming (local, national, regional and international)</li> <li>• Knowledge on public administration</li> <li>• Knowledge on strategic management and planning</li> <li>• Skills in coordination</li> <li>• Positive attitudes on working closely together</li> <li>• Favorable attitudes toward hard working.</li> </ul>
	2. Provincial and Local Administration Organizations (TAO, PAO, Provincial Government Offices)	<ul style="list-style-type: none"> <li>• Coordination and technical supports to SSFC and TSA, and in some cases if the programs are in line with the budget, financial supports</li> <li>• Participation and contribution in the Annual Shrimp Day.</li> </ul>	<ul style="list-style-type: none"> <li>• Annual budget is in place</li> <li>• Formal authority</li> </ul>	<ul style="list-style-type: none"> <li>• Knowledge in public administration and laws</li> <li>• Skills in coordination</li> <li>• Skills in project proposal writing</li> <li>• Positive attitudes toward the development of shrimp farming</li> <li>• Fairness and just.</li> </ul>
	3. Regional Government Offices (DOF, Research Institutes and Universities)	<ul style="list-style-type: none"> <li>• Dissemination of research findings</li> <li>• Participation and contribution in the Annual Shrimp Day</li> <li>• Planning and providing decision support system</li> </ul>	<ul style="list-style-type: none"> <li>• Shrimp farming technical know-how</li> <li>• Aquaculture options (Species, aquaculture techniques)</li> <li>• Scientific equipment and know-how available</li> <li>• Qualified personnel</li> </ul>	<ul style="list-style-type: none"> <li>• Knowledge on shrimp farming techniques</li> <li>• Knowledge on marine and aquatic sciences</li> <li>• Skills on communication</li> <li>• Skills on extension techniques</li> <li>• Skills on choices of planning and decision system</li> <li>• Positive attitudes toward shrimp farming and/or aquaculture development.</li> </ul>

Case Study	Actor	Activity	Success Factor	Knowledge/Skills/Attitudes (K/S/A) Needed
	4. Private Enterprises.	<ul style="list-style-type: none"> <li>• Technical supports to SSFC, TSA and shrimp farmers</li> <li>• Provision of inputs (seed, feeds and other supplies).</li> </ul>	<ul style="list-style-type: none"> <li>• Quick decision</li> <li>• Technical know-how</li> <li>• Mutual awareness of environmental degradation which could affect the private business.</li> </ul>	<ul style="list-style-type: none"> <li>• Skills in communication</li> <li>• Fairness and just.</li> </ul>

### Summary

The two case studies, Chantaburi and Suratthani have shown a clear picture of human knowledge, skills and attitudes needed in order to manage Thailand's shrimp farming industry in a sustainable way.

Knowledge of how the ecosystem functions involve managers and researchers who have skills in various disciplines such as sciences, technology and engineering. Similarly as in the case of strategic analysis and policy process, and cultural inheritance that knowledge and skills are equally necessary with an addition of attitudes to appreciate differences in culture, and understand nature of the community and people within.

Knowledge can be obtained via formal and informal education while skills are achieved by practical experiences, and repeated training and exercises. Attitudes, on the other hand, have its more complicated characteristics in that they are inherited through time. However, comprehensive education and training on social and cultural issues can be a short route to enhance understanding of attitudes of people involved.

Development of shrimp farming in Thailand has been through boom and bust cycle, and yet Thailand has continued its pace to lead the world for an achievement of sustainable management. This achievement is not by chance, but by continued efforts of all people in several institutions whose dedication and creative thinking are major contributors. These valuable experiences have been shared through many human resources development programs that both Thailand and international agencies have jointly sponsored.

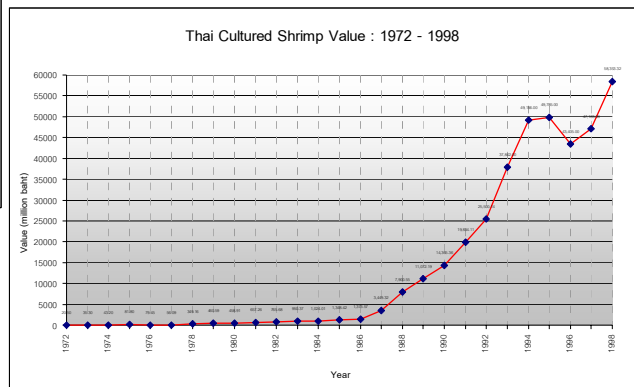
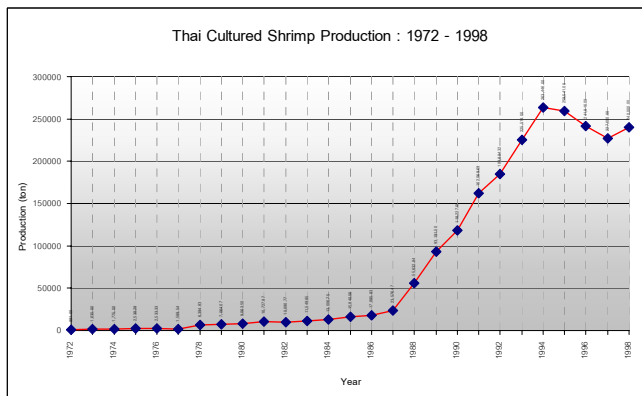
## Future Prospects and Adaptive Adjustments

### Future Look of Shrimp Farming Industry in Thailand

This study believes that shrimp farming in Thailand continues to be an important agricultural industry. The future look of shrimp farming in Thailand can be forecasted on the basis of the synthesis resulting from this study as presented below.

#### *Foreign Exchange Earnings.*

Thailand has exported tiger shrimp products, of which 99 per cent are from shrimp farming, value at 58,353.32 million baht in 1998(Appendix 1). By simple trend analysis coupled with qualitative analysis (interviews with key shrimp farmers, scientists and planners; and field observation), foreign exchange earnings from shrimp farming is expected to be more or at least maintain its present level. As show in Figures below, both production and value of Thai cultured shrimp during 1972 – 1998 show a similar and interesting trends.



It can be observed that tiger shrimp production and value started to take off in 1986 with an exponential growth during 1986 to 1994. The tiger shrimp production faced a decline during 1994 to 1997, and started to take up again in 1998 at a slower rate than those during 1986-1994. The tiger shrimp values, however, declined only during 1995-1996 then they started to grow at a greater rate than the production rate during 1996 – 1998. These were due to high prices as most of shrimp producers in other countries faced with low production, economic recovery of some importing countries and the devaluation of baht.

Recent data on shrimp export in 1999 and the first quarter of 2000 showed some fluctuations, i.e., both quantity (240,529 ton) and value of export (87,580 million baht) in 1999 declined at the rates of one and nine percent, respectively when compared with the previous year (241,981 ton and 95,783 million baht). The first quarter of 2000, however, showed an unchanged export quantity (240,529 ton), but the value increased dramatically at the rate of 21 percent. The best reasons explaining this can be successive impacts of the devaluation of baht and higher prices.

With the government policy to limit the production area not exceeding 500,000 rai, foreign exchange earnings from tiger shrimp export are expected to fluctuate around 60,000–90,000 million baht per year.

However, concerns have been expressed over import proportion of inputs used for tiger prawn production. It was estimated that approximately 25 to 50 percent of inputs were from foreign sources such as feed components, chemicals, farm equipment and petroleum. Several attempts by farmers and farmers' groups have been done to reduce this input import dependence with some remarkable successes. However, at least 25 percent of inputs are still from foreign sources (Surasak Dilokkiat 2000 pers.comm.).

#### *Development of Sustainable Culture Techniques*

There are several fisheries research stations, both government and private, conducting research and experiments on almost all aspects of tiger prawn farming. Research on tiger prawn diseases control has been at the highest priority. However, other aspects of research supporting tiger prawn farming such as appropriate culturing techniques, in site seed production, feed formula, oxygen demand and others.

It is observed that most of the popular research focuses its attention mainly on pond and farm management. Therefore, some concrete knowledge of this aspect is well documented. Future look of culturing techniques ranges from super intensive, anticipated intensive to less intensive. Whatever culturing techniques a shrimp farmer is going to take, he/she has very well experiences of its consequences. Shrimp farming is increasingly a risky business, and every step in the production process has to be closely monitored and controlled. An instant or formula techniques are non-existence for blind imitation, but the delicate culturing techniques could, hopefully, be learnt.

Few research initiatives on the economic and social impacts of shrimp farming on local communities and the environment have been done. Perhaps the quick returns from shrimp farming as a result from good pond management offset the socio-economic and environmental costs. After the conflicts accruing from freshwater shrimp farms – freshwater area in 1998, interests on strategic management to find ways for appropriate solutions have been focused. Shrimp farming management has expanded its horizon to include not only pond and farm management, but also temporal and spatial management to be integrated with local, provincial and national administration.

Roles of private sector, non-government individuals and organizations have been encouraged by the New Constitution which provides management integration in terms of institutional involvement.

#### *Social Conflicts*

It is foreseen that Thailand's New Constitution when fully implemented would effect Thailand's current patron-client public administration system. This would lead to an improved strategic management of all sectors including shrimp farming industry. Within this industry, the strategic management appears in all five system levels with common issues presented below.

#### *Full Participation.*

There will be vertical and horizontal participation of all stakeholders involved in shrimp farming industry for planning and monitoring of shrimp farms. The implementation of any large scale shrimp farming projects will need a long process to get public supports, but they will be more efficiently operated. This participation needs a process of *inter alia* issues identification, stakeholder identification, brainstorming and public hearing. This process naturally requires institutional involvement from both public and private sectors.

#### *Compromised Attitudes*

It is expected that shrimp farming stakeholders as well as the general population will have compromised attitudes toward impacts from shrimp farming. Shrimp farmers themselves have realized the importance of social and environmental management in terms of public awareness and environmental conservation

activities such as conservation of mangrove forest and sea turtle; mangrove rehabilitation; Code of Conduct; and water discharge and sludge controls.

#### *Co-existence with Other Sectors*

##### **Sequence of Strategic Management or Shrimp Farming**

Co-existence with other sectors  
Compromised attitudes  
Full Participation

It is important that shrimp farming industry has to co-exist with other agricultural and industrial sectors; and local communities and administration. This is an important aspects for the creation of compromised attitudes and full participation.

#### *Contribution to Shrimp Farm Management*

There has been a well-publicized statement that Thailand should play a role in producing food to feed the world's population. This statement has been proven true in rice, tropical fruit, livestock, seafood and shrimp production. This achievement does not come instantly but with long historical inherited and hard work. Thailand's roles for such achievement, especially in shrimp production and export, can be discussed as follows:

#### *Aquaculture experience*

Shrimp farming development in Thailand has been through several stages of development as shown and discussed in Figure 1. Because of its long-inherited engagement in agricultural production; continuous supports by the government and private sectors; commitments to become a food producing hub of the world; and diligence, determination and dedication; Thailand has maintained its position as the number one shrimp exporter for many years.

#### *Institutional Support*

Both Thai and foreign agencies have continued to provide supports (both technical and financial) for the shrimp farming industry to be developed as it is today. However, new areas of shrimp farming research have been initiated as important components of the holistic management concept. Less technical research in the fields of social sciences and humanities is able to provide guidance on conflicts resolution, efficient public administration and effective law enforcement. The Thai government is increasingly providing support for research on these aspects.

#### *Training*

As mentioned earlier that shrimp farming experiences and continued supports of concerned institutions are key factors for the success of shrimp farming management. These can be Thailand's contribution to the world's communities. Through carefully designed training programs, these shrimp farming knowledge and experiences can be effectively transferred to both shrimp farmers in Thailand and other parts of the world. These training programs are not necessary to be only in the forms of the traditional arrangements (in house training, formal training, tailor-made course), they can be in the forms of CD-ROM, Open Access System (the Internet), Self and Interactive Learning System.

The following section presents the training package for sustainable shrimp farming management using the Thai's experiences. This package can be adapted to be used in many areas (countries, regions, localities) and many training delivery systems.

### **Development of a Training Package Based on Thai Experiences**

With regards to tiger shrimp farming, Thailand has led and continued to lead the world on the grounds of sustainable culturing technology development; institutional and human resource development; and integrated management of shrimp farming in Thailand's coastal zone. Certainly, Thailand has experienced



boom, bust and adaptive adjustments involving shrimp farming technology and knowledge, management skills and attitudes, which all could be shared.

**The Training package can be used in three possible ways**

- Direct training package
- Self training via CD-ROM
- Self training via the Internet

The most efficient way to share these valuable experiences is by developing a training package incorporating an objective training curriculum design with fieldtrip, exercises and some achievement test. The training package is expected to draw attention from many users who are involved with shrimp farming both domestic and international. For international users a particular attention should be focused on countries with the proximity of the equator in Asia, Africa and South America where tropical marine shrimp farming has been widely practiced.

The following training package was developed based on this study approach for sustainable shrimp farming management discussed in the previous Chapters. The package is in a form of modules collection which can be used for direct training or used as a self or interactive study package via CD-ROM or Internet.

*Objectives of the Training Package*

The general objective of the training package is to familiarize the users with an integrated, multi-disciplinary approach for the sustainable management of shrimp farming. Specifically, the users are expected to achieve the following objectives upon the completion of the training.

- (1) To be aware of opportunity and problems accruing from the development of marine shrimp farming in the coastal zone; to know several tools (i.e., Geographic Information System (GIS), Participatory Rural Appraisal (PRA), Cost-Benefit Analysis, Economic Valuation Techniques) and data/information for marine shrimp farming landscape design; to be aware of Environmental Impact Assessment (EIA) techniques available for the design of marine shrimp farming.
- (2) To be acquainted with marine shrimp farming in terms of pond and farm management techniques that have been developed in Thailand; to be able to apply the ICZM process in marine shrimp pond and farm management plans.
- (3) To be aware of the roles of local and provincial administration, and private sector; to be able to formulate plans and strategies for the local and provincial cooperations.
- (4) To be aware of the national plan, policy and institutional arrangements for marine shrimp farming development; to know the decision making process and relevant actors involved in making the decision for the support of marine shrimp farming management.
- (5) To be aware of increasingly international competition for marine shrimp products; to be aware of shrimp product standardization; to be aware of international concerns over health and environmental consequences of the marine shrimp farming; to be aware of obtained benefits from international cooperations in marine shrimp farming.

*Framework for the Development of Training Packages*

From the survival experiences of marine shrimp farming in Thailand, not only technical pond and farm management aspects are important determinations of success or failure, but also other aspects such as shrimp farming landscape design, socio-economic consideration, and legal and institutional arrangement perspectives. These aspects are intra- and inter-related through a multi-level and multi-stakeholder structures, which form a center core of this training module development framework. This framework can be further explained as follows.

### *Module 1: Shrimp Aquaculture Landscape Design*

The coastal landscape is complex in its nature. If marine shrimp farming is to be developed in the coastal zone, then its coastal landscape complexity has to be understood. Zoning of the coastal landscape requires inputs from as many stakeholders (i.e., public and private institutions, local communities, national and international organizations) as possible. The zoning may identify three main zones, namely, protection zone, production zone and development zone. The shrimp farming is identified to be in the production zone.

### *Module 2 Shrimp Pond and Farm Management*

A marine shrimp farm comprises of shrimp rearing ponds and other kinds of ponds necessary to run the farm such as water intake ponds, water settling ponds and sludge storing ponds. These ponds are to be managed in relation to good survival and growth rates, satisfactory financial and economic returns and compatible social ways of the farmers.

### *Module 3 Local and Provincial Management Arrangements*

At this level, shrimp ponds and farms are interconnected in terms of their environmental impacts with each other, and impacts to the coastal landscape. Marine shrimp farming is believed to survive when local communities and provincial authorities are coordinated to manage the shrimp farming area.

### *Module 4 National Supports*

At a larger scale, the national development plan includes mitigation of impacts from shrimp farming to coastal landscape, and also impacts from other sources such as industry, household, tourism, infrastructure development and other agriculture. Management in this level needs institutional, legal and policy supports from the national administration.

### *Module 5 International Involvement*

It is inevitable that shrimp farming has to link with international agreements and treaties on trade, development and environment. Shrimp products have to be processed in a way that meet with the international standards and requirements.

On applying the above framework for the training module development, it is believed that this module on shrimp farming management will provide the users with complete information on marine shrimp farming management ranging from landscape design to international marketing of the shrimp products. The module is therefore comprehensive in its nature and contents, which can be treat as experiences to be learnt for an application to other similar situations. Even in countries of different coastal landscape and institutional arrangements, it is believed that after careful analysis and adjustment, this module can offer some kinds of guidance for the management.

### *Users of the Training Package and Some Requirements*

There are several groups of people specified as expected users of the training module. But the main users are all who are involved in the development of marine shrimp farming. Based on some occupational characteristics, these expected users are described as follows:

**Marine Shrimp Farmers.** Existing and future marine shrimp farmers are direct users as they will be able to learn farming practices and plan their farming strategies in order to obtain satisfactory returns. Modules at Level 1, 2 and 3 are necessary, while at Level 4 and 5 are complementary.

**Marine Shrimp farmers Groups/Clubs/Associations.** Members of the marine shrimp farmers groups/clubs/associations are shrimp farmers themselves and/or planners, coordinators or administrators who play roles in shrimp farming development. Most of them deal with farm planning, infrastructure

development, input acquisition and negotiation and conflict resolutions. They are representatives of the farmers. It is advisable for them to pay special attention to Modules at Level 1, 3 and 4, while Level 5 is complementary. Modules at Level 2 can be too specific, but they can be treated as given knowledge as most planners should have sufficient background on the pond and farm management.

**Planners and Policy Developers.** There are planners at different levels of public administration such as local, provincial, regional and national; while policy developers are at central or national level. They are personnel from mainly government departments, ministries and development institutions. These planners and policy developers are to prepare various plans and policies that are relevant to the local situation, and to put these plans and policies on the political agenda. They should be able to prepare information and materials needed for the decision makers to make appropriate decisions. Modules that are useful for them are at Level 1, 3, 4 and 5; while Level 2 many be consulted.

**Academia and Specialists.** The academia and specialists are domain experts who play a role in putting technical inputs into the module, and continuously validating and revising the contents within. They are, for example, integrated coastal zone management specialists, marine shrimp aquaculture scientists, aquaculture engineers, ecologists from both government research stations and private enterprises who contribute to Modules at Level 1 and 2, while others such as economists, lawyers, social anthropologists, and public administration analysts are main contributors to Modules at Level 3, 4 and 5. In turn, these academia and specialists can learn, or advise some others (students, employees, young scientists) to learn from these Modules for further research, application, monitoring and validation of the module contents.

**Decision Makers.** The decision makers at different levels of public administration, developmental project implementation are able to consult Components of this module to assist them in making a decision. The most useful Modules are at Level 3, 4 and 5. However, Modules at Level 1 and 2 can be useful when some additional details are needed to support their decision.

**Non-governmental Individuals and Organizations (NGIs and NGOs).** There are NGIs and NGOs who are interested or involved in the marine shrimp farming development. Modules at all levels (1, 2, 3, 4, 5) are important for them to understand the complexity of the shrimp farming system.

It is envisioned that this module will be beneficial for the above specified users in many countries. Thai marine shrimp farming can be a classic model to be learnt, as its struggling to maintain the levels of shrimp production is outstanding. Currently, shrimp farmers and people involved in shrimp farming from neighboring countries, and other countries in South America (Ecuador) have made some study tours to learn the so-called Thai techniques. However, sustainable shrimp farming is not a static concept as it needs a continuous adaptive adjustment process to be best fit with the changing socio-economic and environmental conditions. Therefore, there are simultaneous needs of scientific and technological inputs, implementation difficulties and interactive responses (exercises, tests and comments) from the module users.

### *Design of Modules*

There are basically five training modules. There is an introduction section containing, for example, background of the module development and users specification and prerequisites. This introductory section is followed by main five modules in line with the five levels (Levels 1-5).

- 1 Introduction to Training Module on Marine Shrimp Farming**
- 1 Background
- 1.1 Training Module Development
- 1.2 Training Module Objectives

- 1.3 Training Module Users
- 1.4 Overview of the Prerequisites

## **2 Marine Shrimp Farming as an Important Industry**

- 2.1 Importance of Marine Shrimp Farming to the Economy
- 2.2 Ecological and Environmental Issues Resulting from Implementation of Marine Shrimp Farming
- 2.3 Expected Benefits upon the Completion of the training package

### **Module 1: Shrimp Farming Landscape Design**

- 1.1 Introduction
  - 1.1.1 Module Objectives
  - 1.1.2 Module arrangements
- 1.2 Data/Information/Decision Support System (DSS) Required for Marine Shrimp Farming Management
  - 1.2.1 Types and Sources of Data/Information/DSS
  - 1.2.2 Geographic Information System and Remote Sensing
  - 1.2.3 Participatory Rural Appraisal/Rapid Rural Appraisal
    - (1) Issue identification
    - (2) Stakeholder identification
    - (3) Issue and stakeholder analysis
  - 1.2.4 Benefit-Cost Analysis and Economic Valuation
    - (1) Identification of benefits
    - (2) Identification of costs
    - (3) Calculation of B-C, and IRR
    - (4) Decision criteria
    - (5) Economic valuation
- 1.3 Environmental Impact Assessment (EIA)
  - 1.3.1 EIA Methods
    - (1) Available of popular EIA methods
    - (2) Components of the EIA methods
    - (3) Environmental impacts from marine shrimp farming
    - (4) Social and other impacts from marine shrimp farming
    - (5) Environmental standards
  - 1.3.2 Exercise on EIA Techniques
- 1.4 Marine Shrimp Farming Zoning
  - 1.4.1 Zoning Technique
    - (1) Data/information/DSS required
    - (2) Criteria for zoning
    - (3) Presentation of zoning
  - 1.4.2 Exercise on Marine Shrimp Farming Zoning Techniques
- 1.5 Marine Shrimp Aquaculture Pond and Farm Lay-outs
  - 1.5.1 Pond and Farm Lay-outs
    - (1) Data/information/DSS required
    - (2) Various types of marine shrimp farming techniques
    - (3) Pond lay-out
    - (4) Farm lay-out
- 1.6 Mastery Test specifically on EIA Application on Designing Marine Shrimp Farming Landscape

## **Module 2: Pond and Farm Management**

- 2.1 Pond Management
  - 2.1.1 Pond Preparation
    - (1) Physical (mechanical) preparation of pond
    - (2) Biological preparation of pond
    - (3) Chemical preparation of pond
    - (4) Water intaking and important considerations
    - (5) Monitoring and control of water
  - 2.1.2 Seed Stocking
    - (1) Sources of seeds
    - (2) Criteria for the selection of good quality seeds
    - (3) Methods of seed nursing
    - (4) Mortality control of seeds
  - 2.1.3 Feeding
    - (1) Types of feed and feed formulae
    - (2) Feeding calendar and techniques
    - (3) Feed monitoring and control
  - 2.1.4 Exercise on Water Intaking, Seed Stocking and Feeding
  - 2.1.5 Other Necessary Pond Management Techniques
    - (1) Aeration
    - (2) Disease control
    - (3) Mortality control and sizing
    - (4) Water and pond bottom sediment monitoring and control
  - 2.1.6 Exercise on Overall Pond Management
  - 2.1.7 Progress Test on Water Treatment and Pond Preparation
- 2.2 Farm Management
  - 2.2.1 Cost Management
    - (1) Identification of cost items
    - (2) Cost controlling techniques
  - 2.2.2 Return Management
    - (1) Harvest timing
    - (2) Harvest bidding and contracting
    - (3) Harvesting techniques
    - (4) Minimization of loss occurring from harvesting
    - (5) Price forecasting and planning
    - (6) Return budgeting
  - 2.2.3 Other Necessary Farm Management
    - (1) Farm budgeting management
    - (2) Farm public relations
    - (3) Farm input acquisition
    - (4) Control of Farm Effluents
    - (5) Handling of conflicts
  - 2.2.4 Exercise on Farm Management Program
- 2.3 Mastery Test on Pond and Farm Management Techniques

### **Module 3: Local and Provincial Management Arrangements**

- 3.1 Identification of Local and Provincial Stakeholders
  - 3.1.1 Local Administration Organizations (LAO)
    - (1) Who is who in the LAO
    - (2) LAO involvement in marine shrimp farming management
  - 3.1.2 Provincial Administration Organizations (PAO)
    - (1) Who is who in the PAO
    - (2) PAO involvement in marine shrimp farming management
  - 3.1.3 Relationship between LAO and PAO
    - (1) Relationship in the existing line of administration
    - (2) Informal relationships
  - 3.1.4 Exercise on Stakeholder Identification
- 3.2 Local and Provincial Rules and Regulations for Shrimp Farming Management
  - 3.2.1 Issues of Conflicts to the Local Communities
    - (1) Conflicts amongst marine shrimp farmers
    - (2) Conflicts between marine shrimp farmers and neighbouring farmers
    - (3) Social and environmental conflicts
  - 3.2.2 Local and Provincial Involvement in Implementing Local Rules and Regulations
    - (1) Local rules and regulations (both formal and customary)
    - (2) Implementation principles
  - 3.2.3 Local and Provincial Organizations Supporting Marine Shrimp Farming
    - (1) Marine shrimp farmers' club/group/association
    - (2) Local organizational roles and responsibilities
  - 3.2.4 Exercise on Local and Provincial Organizations' Roles and Responsibilities on Solving Conflicts, and Promoting Cooperations
  - 3.2.5 Progress Test on Farms' Effluent Standard Values
- 3.3 Mastery Test on Impacts from Marine Shrimp Farming on Local Communities and Local Implementation of Rules and Regulations in Controlling Farms' Effluents

### **Module 4: National Supports**

- 4.1 National Plan and Policy on Coastal Zone
  - 4.1.1 National Plan and Policy on Coastal Zone
    - (1) Analysis of national economy contributions of marine shrimp farming
    - (2) Position of marine shrimp farming in the national coastal zone management
    - (3) National policy
    - (4) Short-, medium- and long-term plans
  - 4.1.2 Relevant Stakeholders in National Plan and Policy Making
    - (1) Identification of key stakeholders
    - (2) Relationships of the stakeholders
    - (3) Decision making process
  - 4.1.3 Exercise on Stakeholder Identification in Making the National Plan and Policy
  - 4.1.4 Progress Test on Roles and Responsibilities of Relevant Stakeholders and Decision Making process on Marine Shrimp Farming Management
- 4.2 National Decision Supporting Mechanisms
  - 4.2.1 Decision Supporting Systems (DSS)
    - (1) Marine shrimp farming management data/ information/alternatives

- (2) Relevant DSS for data/information utilization and for selection of appropriate marine shrimp farming management alternatives
- 4.2.2 Integration of the Management Alternatives into National Plans and Policy
  - (1) Presentation of marine shrimp farming management alternatives to the decision makers
  - (2) Integration in the existing line of administration
- 4.2.3 Exercise on data/information/DSS required for marine shrimp farming management
- 4.3 Mastery Test on Marine Shrimp Farming Management Alternatives for the Integration into the National Plans and Policies

## **Module 5: International Involvement**

- 5.1 Marine Shrimp Farming Products in the International Markets
  - 5.1.1 Significance of Marine Shrimp Products as Food
    - (1) Trade and economic importance as a source of foreign exchange earnings of developing countries
    - (2) Substitute for shrimp from capture fisheries
  - 5.1.2 International Markets for marine shrimp farming products
    - (1) Exporting and importing countries
    - (2) Volume and value of trade in the international Market
- 5.2 Relevant International Agreements and Treaties
  - 5.2.1 Directly Relevant International Agreements and Treaties
    - (1) Impacts on marine shrimp production and marketing
    - (2) Proposed solutions
  - 5.2.2 Other Relevant International Agreements and Treaties
    - (1) Impacts on marine shrimp production and marketing
    - (2) Proposed solutions
- 5.3 International Marketing Strategies
  - 5.3.1 International Marketing Requirements
    - (1) Environment standards
    - (2) Health awareness
    - (3) Social issues such as child labour
  - 5.3.2 Farming Strategies
    - (1) Production and marketing plans
    - (2) Alterations of farming practices
    - (3) Marine shrimp farmers cooperative/ association
    - (4) Producer-consumer direct contract deals
  - 5.3.3 Marketing Strategies
    - (1) Marine shrimp price fluctuations
    - (2) Marketing campaigns to raise awareness on environmental friendly and health concerned farming practices
    - (3) Product differentiation and promotion
    - (4) Trade negotiations
    - (5) Market options (new market sites)
    - (6) International Marine Shrimp Producers Associations
  - 5.3.4 Exercise on Production and Marketing Strategies Planning
  - 5.3.5 Progress Test on International Requirements for Marine Shrimp from Farming

5.4 Mastery Test on an Overall Planning to Increase Competitiveness of Marine Shrimp Farming Products in the International Markets



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## Appendix 1

Thai Cultured Shrimp Production, Number of Farmers, Area and Value: 1972-1999

Year	No. of Farmers	Area (rai) <sup>1</sup>	Production (ton)	Value (million bath)
1972	1,154.00	56,602.00	991.00	20.50
1973	1,462.00	71,678.00	1,635.00	35.30
1974	1,518.00	75,576.00	1,775.00	43.20
1975	1,568.00	80,422.00	2,538.29	81.80
1976	1,544.00	76,850.00	2,533.33	79.45
1977	1,437.00	77,567.00	1,589.54	56.09
1978	3,045.00	151,055.00	6,394.83	349.16
1979	3,378.00	154,222.00	7,064.07	460.59
1980	3,572.00	162,727.00	8,063.50	458.91
1981	3,657.00	171,619.00	10,727.87	657.26
1982	3,943.00	192,453.00	10,090.77	765.68
1983	4,327.00	222,107.00	11,549.85	950.37
1984	4,519.00	229,949.00	13,006.75	1,024.01
1985	4,939.00	254,805.00	15,840.56	1,348.42
1986	5,534.00	283,548.00	17,885.83	1,373.57
1987	7,264.00	325,929.00	23,576.47	3,449.32
1988	11,838.00	417,071.00	55,632.84	7,900.55
1989	14,253.00	474,551.00	93,191.50	11,072.19
1990	15,072.00	403,787.00	118,227.10	14,365.36
1991	18,998.00	470,826.00	162,069.70	19,834.11
1992	19,403.00	454,975.00	184,884.30	25,500.14
1993	20,027.00	449,292.00	225,514.00	37,842.00 <sup>2</sup>
1994	22,197.00	448,000.00	263,446.00	49,156.00 <sup>2</sup>
1995	26,145.00	468,386.00	259,541.00	49,785.00 <sup>2</sup>
1996	16,000.00	500,000.00	241,816.00	43,405.00 <sup>2</sup>
1997	15,500.00	450,000.00	227,000.00	47,183.86
1998	12,800.00	460,000.00	240,000.00	58,353.32
1999	n.a.	n.a.	220,000.00	n.a.
2000	n.a.	n.a.	n.a.	n.a.

<sup>1</sup>6.25 rai = 1 hectare

<sup>2</sup>Estimated figure

Source: Department of Fisheries (1998), Shrimp Culture Newsletter (several issues) and Custom Department (1998)

## Appendix 2

Names and Roles of Responsible Institutions and committees on Sustainable Shrimp Farming Development

Name of Institutions/Committees	Roles and Responsibility on Shrimp Farmer Development								
	Plan Formulation	Plan Implementation	Plan Monitoring	Planning	Budget	Research	Enforcement	Supplement	Credit
<b>Government Sector</b>									
<b>1. Office of the Prime Minister</b>									
1.1 Office of the National Economic & Social Development Board	√		√			√			
1.2 The Bureau of Budget			√		√				
<b>2. Ministry of Agriculture &amp; Cooperative</b>									
2.1 Department of Fisheries	√	√	√	√		√	√	√	
2.2 Department of Agricultural Extension								√	
2.3 The Cooperatives Promotion Department					√			√	√
2.4 Agricultural Land Reform Office								√	
2.5 Land Development Department								√	
2.6 The Royal Irrigation Department								√	
<b>3. Ministry of Science, Technology &amp; Environment</b>									
3.1 Office of Environmental Policy & Planning	√	√	√	√		√	√	√	
3.2 Pollution Control Department								√	
3.3 The National Research Council of Thailand						√			
<b>4. Ministry of Interior</b>									
4.1 Department of Local Administration								√	
4.2 The Royal Thai Police Department							√		
4.3 The Community Development Department								√	

4.4 The office of Accelerated Rural Development								√	
<b>5. Ministry of Defense</b>									
5.1 Royal Thai Navy								√	
<b>6. Ministry of University Affairs</b>						√			
<b>7. Ministry of Transport &amp; Communication</b>									
7.1 The Harbor Department							√		
7.2 The Highway Department							√		
<b>Private Sector</b>									
1. Charoen PokPhan (CP)						√		√	√
2. Aquastar						√		√	√
3. Farmers' Groups								√	√
4. Cooperatives								√	√
5. Private farms						√		√	√
6. Seafood Processing Factories								√	√
7. Thai Shrimp Farmer Association						√		√	
<b>State Enterprises</b>									
1. Fishery Marketing Organization								√	
2. Wastewater Control Organization	√	√	√	√					
3. Bank for Agriculture & Agricultural Cooperatives									√

## Appendix 3

<b>Topic/Activity/Natural Resources Laws</b>	
1. Fishery Act, 1947 amended in 1985	16. National Forest Reserves Act, 1964
2. Navigation in Thai Waters Act, 1913 amended in 1992	17. Forest Act, 1941
3. Fishery Rights in Thai Territory Act, 1939, amended in 1996	18. National Parks Act, 1961
4. Thai Boat Act, 1938	19. Wild Animal Protection and Reserves Act, 1992
5. Royal Irrigation Act 1942	20. Forest Reserves Act, 1992
6. Public Irrigation Act, 1939	21. Criminal Code
7. Canal Protection Act, 1903	22. Town Cleanliness and Tidiness Act, 1992
8. Water Supply Canal Protection Act, 1983	23. Enhancement and Conservation of National Quality Act, 1992
9. Embankment and Dike Act, 1962	24. Mineral Act, 1967
10. Ministry of Agriculture and Agricultural Cooperatives Notification on 20 July 1972 prohibiting the use of push net and travel within 3000 meters from coastal line, and prohibition of push net boats and trawlers in the Songkhla Lake	25. Electricity Generating Authority of Thailand Act, 1968
11. Agricultural Land Reform Act, 1975	26. Factory Act, 1992
12. Agricultural Land Management Act, 1974	27. Dangerous Substances Act, 1992
13. Land Development Act, 1983	28. Building Control Act, 1979
14. Land Law Code	29. Public Health Act, 1992
15. Law on real Estate Development Control (RD No. 286)	30. The Town and Country Planning Act, 1975
<b>Institution/Administration Laws</b>	
1) Constitution of the Kingdom of Thailand, 1997 2) Public Administration Act, 1991 3) Ministry Adjustment Act, 1991 4) Local Administration Act, 1914 5) Municipal Act, 1953 6) Sanitary District Act, 1952 7) Provincial Administration Organisation Act, 1997 8) Sub-district Council and Sub-district Administration Organisation Act, 1994	



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