Toward Environmental Responsibility of Thai Shrimp Farming through a Voluntary Management Scheme

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Abstract

The implementation of voluntary adoption of the Code of Conduct (CoC) to promote environmental responsibility and sustainable development of Thai shrimp industry is examined. Farmers' perceived- benefits, risks and uncertainties associated with the adoption and their perceived extra fixed cost are found to be the critical conditions to the success of the program. Improvement of farmers' perception through increased information and knowledge, development of supportive policies and mechanisms (i.e. a "Group CoC" system, insurance program, a combination of environmental policy approaches) and strengthening farmer organizations and networks among and between the players throughout the market chain are suggested as to enhance the adoption and implementation of the scheme.

Keywords: Thai Shrimp, Coastal Land Environment, Voluntary Approach, Code of Conduct

JEL classification: Q22, Q24, Q55

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1. Introduction

Aquaculture contributes around 30% of world seafood production (capture and culture combined). The global production of aquaculture shrimp alone was 1.6 million tons in 2003 (FIGIS, 2005). Asian producers supply around 75% of the farmed shrimp. The rest is produced mainly in Latin America. Currently, Thailand is the second largest producer after China. Other main producers are Vietnam, Indonesia, India, Bangladesh, Brazil and Ecuador. While China consumes most of its production, Thailand exports nearly all of hers (90%) and remains as the leading exporter with 30% market share. Major markets are USA, Japan, and EU. Thailand earns more than 800 million USD annually from frozen shrimp alone. Earning of income from export has been the main driving force to the rapid expansion of the industry all over the world. Since the late 1990s, however, it has faced increasing pressures and difficulties. Some of the serious issues are bans on products found with traces of banned antibiotics and chemicals, accusation of dumping (imposition of antidumping tariffs in the USA market), disease outbreaks and spread (the later was caused by transboundary movement of live animals including the exotic species), and claims of environmental and social impacts. These lead to a growing concern by governments and farmers that responsible shrimp farming and better management practices are needed in order to maintain the sustainable growth of industry.

Article 9 of the Code of Conduct of Responsible Fisheries (CCRF) provides the general guidelines in support of responsible aquaculture (FAO, 1997).[1] The Code addresses externality issues and other aspects associated with sustainable development of shrimp industry. While it is internationally accepted, the Code is a voluntary non-binding instrument. However, it has been used as the basis for the formulation of regional and national code of conducts such as those developed by the Federation of European Aquaculture Producers (www.feap.org), Australian aquaculture (www.pir.sa.gov.au), SEAFDEC (www.seafdec.org),

1 Food and Agriculture Organization of the United Nations (FAO).

and Thailand shrimp farming (www.thaiqualityshrimp.com). The offshoot of the Code has included the code of practices for shrimp farming by the Global Aquaculture Alliance (www.gaalliance.org) and the Government of Malaysia (www.agrolink.moa.my/dof/). Furthermore, in 1999 the World Bank, NACA, WWF, FAO and UNEP (joined in 2003) formed a consortium program to develop a set of International Principles for Responsible Shrimp Farming for worldwide adoption. The Principles address the following issues: site selection, pond design, water management, stocking, feeding, shrimp health management, food safety, and social equity. The set of Principles aims to provide specific guidance for implementing the CCRF and a basis for development of Better Management Practices (BMPs) as well as certification standards. The draft Principles (World Bank et al., 2005) is the product of global consensus among important players including farmer groups, industries, governments, NGOs and international organizations. It is being disseminated for public comment to be finalized in 2006.

Thailand was an early mover in shrimp farming. Department of Fisheries (DOF) reported that in 2003 total shrimp farm area was 82,000 ha; total production was 330,000 tons from 35,000 farms (DOF, 2005). The rapid growth of the industry in the past was achieved at the expense of coastal integrity. The widely acknowledged environmental impacts of mangrove conversion, abandonment of farms and effluent discharges, among others, should be accounted as part of the production cost (Pongthanapanich, 2005a).

In Thailand, there are attempts to protect the environment through the use of mandate control. The main requirements concerning water pollution are provided for under the Enhancement and Conservation of National Environmental Quality Act (1992). Under the Fisheries Act (1947), the notification imposes conditions (e.g. farm registration, effluent treatment) on shrimp farmers to control the quality of water and solid effluent. The prohibition of waste discharge into public receiving waters is also executed under the Navigation in Thai Waters Act (1913). This includes the recent effort to designate coastal aquaculture as a pollution point source, which requires waste treatment to meet aquaculture effluent standard.[2] It only applies to an aquaculture farm with pond area of 1.6 ha or larger. This would entail the monitoring of farm effluent of half the country's shrimp production area (or 41,000 ha). Mangrove clearing throughout the country is now prohibited under the cabinet resolution. Farm registration has become a precondition of providing the movement document (MD). With MD, a farmer is allowed to transport each batch of harvested shrimp to the market. This procedure serves the traceability requirement.

Using solely the command-and-control scheme such as the measures described above, is unlikely to effectively reduce environmental impacts and promote responsible shrimp farming. Thus, the government, since 2002, has also promoted the development and encouraged the adoption of voluntary management practices through the Code of Conduct (CoC) and Good Aquaculture Practice (GAP) schemes. Broadly, GAP focuses on assuring product safety, while CoC covers product safety as well as environmental and social responsibilities (the details are discussed later).

Discussion in this paper centers on the environmental improvement role of Thai CoC in shrimp farming. It is observed that although the government has been using a lot of efforts to encourage its adoption, the number of adopters is still small (as shown later) to significantly reduce environmental damages.

The success of the program clearly depends on farmers' acceptance of the practices prescribed by the Code. The small number of adopters suggests some key questions, as follows: Why are Thai shrimp farmers seemingly reluctant to adopt the Code? What are their expectations? What factors can affect their decisions? What mechanisms and policies can stimulate adoption and improve on

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2 Notification of the Ministry of Natural Resources and Environment: Designated Coastal Aquaculture as Pollution Point Sources dated November 14, B.E.2548 (2005) published in the Royal Government Gazette, Vol. 122, Part 129 D; and Notification of the Ministry of Natural Resources and Environment: Effluent Standard for Coastal Aquaculture, dated March 19, B.E. 2547 (2004) published in the Royal Government Gazette, Vol. 121, Part 49 D, dated May 1, B.E.2547 (2004). The details are available at www.pcd.go.th/info_serv/en_reg_std_water04.html#s11.

its effectiveness? These issues are explored in this paper. This paper, however, does not reexamine political debate and discourse associated with voluntary adoption (see Béné, 2005). The critical conditions to the success of voluntary management scheme are explored. This brings in some supportive policies and mechanism to be suggested for decision making for further development of the scheme to cope with the externalities.

In the following discussion, the major environmental impacts from common farm practices are described followed by the response to these impacts by government through the program of voluntary management. The consequences of the program are investigated by reviewing farm-survey studies. Next, the critical conditions and barriers to adoption are evaluated. The experiences on voluntary adoption from other countries are also cited to provide other perspectives. Challenges of voluntary adoption as well as practical solutions to encourage adoption are then discussed. Suggestions on environmental policies and mechanisms in support of the implementation are provided.

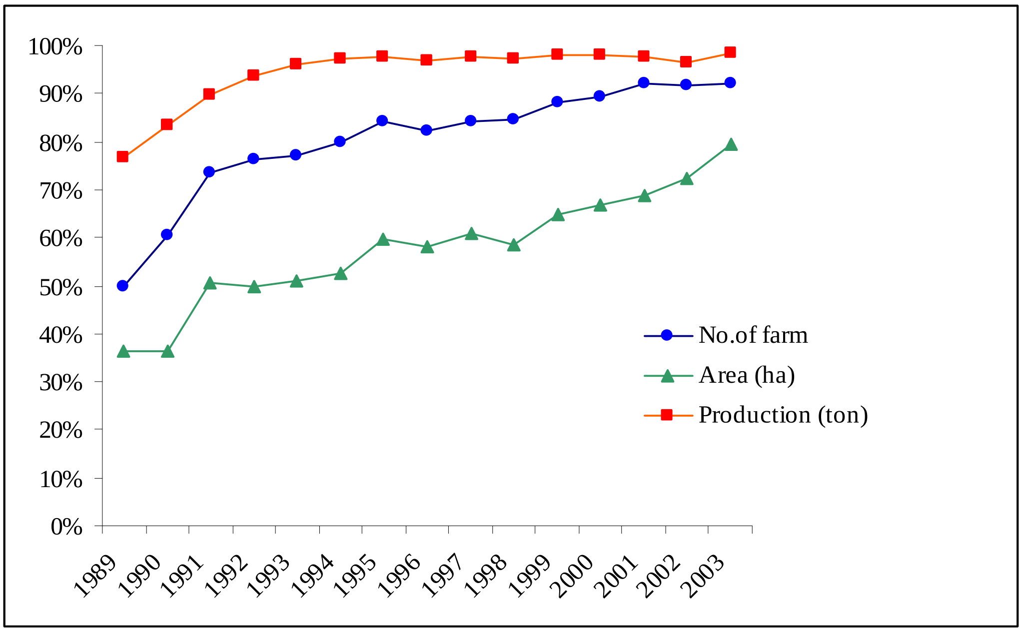
2. Common Practices and Environmental Problems

Generally, shrimp farming systems are of three types, namely, extensive, semi-intensive and intensive, according to intensity of input use and farm management. Extensive farming is a traditional low-density practice. It is invariably located nearest to the sea as it primarily relies on natural seed and feed. This system is labor extensive and requires low capital investment, but usually requires a large piece of land. In contrast, intensive system requires less land but a high investment, characterized by a high stocking density and needs of good pond management techniques. It relies on artificial feed and usually chemicals, and needs pond aeration equipment. Pond soil condition needs to be maintained and water and effluent management is a requirement.

In Thailand, intensive farming has rapidly increased in terms of number of farms, area, output (see Figure 1) and therefore environmental impacts. Around

90% of the farms apply this system, which covers 80% of the total culture area and contributes 98% to total production. Due to high stocking, feed is the main cost item ranging from 40 to 60% of total cost (see the survey results in Tokrisna, 2004, for instance). Intensive farming requires 1.2 to 2 kilos of pellet feed, which contains high protein (20-40% by weight),[3] to grow a kilo of shrimp.[4] The main source of protein is fish meal (15-35%). Although feed quality is being improved, feed loss is unavoidable. Clay (2004) stated that the loss is as much as 33%. The uneaten feed and shrimp waste lead to the accumulation of nutrient load in water effluent and bottom pond sludge.

Figure 1. Proportion of intensive shrimp farming in Thailand



Source: Data from DOF (2005).

The common practices (characterized by the non-adoption of good management practices) in intensive farming are usually claimed as a source of water pollution as a result of discharges of untreated farm effluent to public receiving waters. This can cause self-pollution and disease outbreak, which has resulted in

3 Depending on shrimp species, i.e. 20-35% for *Penaeus vannamei* and 36-42% for *Penaeus monodon* or *Penaeus stylirostris* (Briggs et. al., 2004: 15).

4 Farmers simply use this basis to estimate shrimp food conversion ratio (FCR).

the collapse of business and abandonment of farms. Disease outbreaks have been triggered by such factors as the deterioration of pond sediment quality, loss of essential minerals from pond soil, and poor pond management (Dierberg and Kiattisimkul, 1996). Farmers usually deal with disease outbreaks with higher dosage of drugs and chemicals and sometimes with non-prescribed drugs. This results in the increase of production cost and prompts importing countries to ban products found with traces of banned chemicals or drugs by importing countries.

Hossain and Kwei Lin (2001:4) cited that 20,800 ha of shrimp farms in Thailand were left abandoned in 1996; unofficial estimates placed the figure as high as 70% after a period of shrimp production. Abandoned farms entail an environmental cost of around 1,000 USD/ha in converted mangrove area (adapted from Sathirathai and Barbier, 2004) and 220 USD/ha in converted agricultural area (based on Kantangkul, 2002). See more details in Pongthanapanich (2005a).

Poor farm siting was considered as the largest source of conflict with local communities and other resource users (Clay, 2004: 500). Poor siting can lead to poor quality of water supply and inability to properly manage the effluent. These affect on-farm production and farm management practices. Poor siting is an important issue for Thailand where 80% of the farms are small-scale (less than 1.6 ha). Small farms usually have low investment fund and less flexibility for site selection. Loss of mangrove due to shrimp farms is prevalent, particularly during the boom period of the industry. Charuppat and Charuppat (1997) reported that around 17% (65,000 ha) of total mangrove area had been converted to shrimp farms. This common practice generates economic loss of around 3,260 UDS/ha in mangrove forgone benefits (adapted from Sathirathai, 1998; Sathirathai and Barbier, 2004). Poor siting can have negative impacts on agricultural crops mainly due to dispersal and seepage of saline water to nearby crops as in the case of inland low-salinity shrimp farming in central Thailand (see discussion in Pongthanapanich, 1999, for instance).

These environmental problems are widely recognized in Thailand. There are growing concerns over the problems of traditional farming practices. As described, some types of pollution directly affect the shrimp industry at on-farm level, some at the market level. Better management practices in shrimp farming are therefore expected to reduce environmental damages, stabilize farm incomes, improve market access and reduce social conflict of resource use, all of which promote the sustainability of the industry.

3. Management Responding to the Problems with Voluntary Scheme

The voluntary adoption of CoC and GAP has been encouraging by the Thai government in response to the problems. In 1998, the DOF initiated the formulation of Thai CoC with assistance from the World Bank. In 2000, the Department launched the pilot COC project in the provinces of Rayong and Songkla. The formal guidelines, including certification process and inspection guidelines have been implemented since 2002. The policy statements address environmental protection, regulatory compliance, quality and safety, efficiency, social responsibility, education and training, public consultation, location, continual improvement, research and development, monitoring and auditing, and international trade.

The guidelines for Thai CoC shrimp farming were developed in accordance with Article 9 of the CCRF, which supports responsible aquaculture, and ISO14001 or Environmental Management System (EMS). The CoC also provides harvest and transportation guidelines thus enabling traceability. The components of the Code comprise operational guidelines and manuals for all operators in the market chain (from hatchery operators to exporters), certification process for the operators, and incentives such as price differentiation through certified products. The CoC seal of quality, “Thai Quality Shrimp” label, assures standard production method, high quality and safe product and environmentally friendly production (Marine Shrimp Culture Research Institute, www.thaiqualityshrimp.com). The certification process for quality product labeling is presented in Appendix 1.

The operational guidelines of CoC, on which the development of farm manuals and farm evaluation were based, are classified into 11 standards: 1) site selection such as outside mangrove zone and legal land with the farm being registered, 2) general pond management such as farm layout, pond preparation, water and pond soil quality check, water management, and other daily farm operations, 3) stocking such as proper density, qualified seed size and quality seed, 4) feed management such as reduced feed and proper feeding, feed storage, efficient food conversion ratio, 5) shrimp health management such as daily health check, disease control and prevention, 6) therapeutic agents and chemicals, in which only specified therapeutants are used and only when absolutely necessary, 7) effluent management such as water effluent and sludge treatment including farm sanitation methods, 8) harvesting and distribution such as harvesting plan and methods, quality and anti-biotic residue checking, 9) social responsibility concern over labor welfare and participation with local community, 10) farmers association and training, and 11) farm record keeping to facilitate evaluation. Farm evaluation guideline assigns different weights, ranging from 5-15%, to each standard. Details are available at www.fisheries.go.th/coastal/ and DOF (2003). The guidelines for GAP are less stringent than CoC. These cover 7 standards: site selection, pond management, feed management, shrimp health management, cleanliness of equipment, and necessary farm record. DOF expects that the GAP will prepare farmers for adoption of CoC.

Under CoC quality shrimp project (2002-2006), DOF received almost 1 million USD of budget for the first year and an additional 3.75 million USD was planned (www.thaiqualityshrimp.com/coc/). The project provides technical advice including trainers to help farmers develop farm manuals under CoC. Other forms of assistance are free services such as shrimp disease, water and soil quality check. Farm registration is required as a precondition of participation. The certification process includes farm evaluation, scoring and inspection. The certificate is valid for 6 months, 1 or 2 years depending on the degree of adoption performance evaluated. The procedure of certifying the CoC farm is presented in Appendix 2. The expectation was for all 1,000 hatcheries, 50% of farms (15,000 farms at that time), 120 harvested shrimp distributors, all feed and chemical enterprises (300 traders) and 10 processing factories (0.05%) to participate in the program.

4. CoC Farm Performance and Farmers' Expectations

In 2002, the Office of Agricultural Economics (OAE) conducted a survey of CoC and non-CoC farms in the provinces of Rayong and Songkla (OAE, 2004). The survey showed that the practices under CoC, which contribute directly to reduce environmental impacts were: 1) farm sites — located in promoted coastal land and non-mangrove area, and 2) management of farm effluent—provision of sufficient water treatment pond and sludge dumpsite, use of organic treatment, and closed or semi-closed or recycled water system to reduce water exchange and discharge. It was found that CoC farms allocated farm land for water treatment in a higher proportion than non-CoC farms. CoC farms thus had a lower proportion of culture area (see Table 1). Other management practices such as stocking, feeding, chemical use were also improved.

Based on the same survey, farmers' expectations from CoC adoption were lower production cost (due to reduced seed, feed and chemical use), higher survival rate, less frequency of disease occurrence, and larger shrimp. On the other hand, inadequate farm land and lack of information on the program were given as the main reasons for non adoption. However, it turned out that shrimp yields were not that different between CoC and non-CoC farms. Although survival rate in CoC farms was lower, the size of harvested shrimp was significantly larger than those from non-CoC farms (See Table 1).

Table 1. ***CoC and non-CoC farms performance in Rayong province, 2002***

Items	CoC	Non-CoC
1. Farm structure (area in hectare)	7.7 (100%)	3.6 (100%)
- Culture area	3.3 (43%)	2.0 (55%)
- Water treatment pond/ reservoir	1.6 (22%)	0.4 (11%)
- Sludge dumpsite	0.4 (6%)	0.2 (6%)
- Others (dike, road, etc.)	2.3 (29%)	1.0 (28%)
2. Number of crop per year	2	2
3. Culture period (days/crop)	120	120
4. Stocking (PLs/ha-culture area)	388,000	400,000
5. Survival rate	59%	69%
6. Yield (kg/ha-culture area)	4175	4137
7. Size of harvested shrimp (pieces/kg)	55	67

Note: The analysis was based on the survey of 10 CoC farms and 10 non-CoC farms of *Penaeus monodon* (Black Tiger Shrimp) culture.

Source: Adapted from OAE (2004).

Additionally, based on farm area, the CoC farms incurred lower cost but had lower yield and lower profit per hectare than those non-CoC farms. This is not surprising since the CoC farms had relatively larger total farm areas, but a smaller proportion of culture areas. However, the average production cost per kilogram of the CoC farms was 0.15 USD higher. Obviously, larger fixed cost was the main item that contributed to this outcome. Furthermore, due to the larger shrimp size obtained, the CoC farms received a higher price by 0.63 USD/kg on average than the non-CoC. This resulted in a higher net profit of 0.48 USD/kg. See Table 2. It should be noted that the higher price was simply from having a bigger size shrimp, not from a premium farm-gate price for a CoC product.

Table 2. Cost and return of CoC and non-CoC farms in Rayong province, 2002 (Black Tiger Shrimp)

Items	CoC [1]		Non-CoC [2]		[1]-[2]
	Total	%	Total	%	(USD/kg)
1. Variable costs (USD/ha)*	**4947**	**86.7**	**6362**	**92.2**	**-0.04**
Seed	496	8.7	582	8.4	0.02
Pond preparation	84	1.5	134	1.9	-0.01
Feed	2122	37.2	3118	45.2	-0.19
Labor	605	10.6	666	9.6	0.04
Chemicals	79	1.4	185	2.7	-0.04
Gasoline	511	9.0	435	6.3	0.09
Electricity	274	4.8	766	11.1	-0.18
Equipment and repair	137	2.4	95	1.4	0.03
Interest	210	3.7	257	3.7	0.00
Others	429	7.5	126	1.8	0.18
2. Fixed costs (USD/ha)*	**762**	**13.3**	**538**	**7.8**	**0.19**
Tax and land rent	236	4.1	339	4.9	-0.02
Depreciation & opportunity cost	526	9.2	200	2.9	0.20
3. Total cost (USD/ha)*	**5709**	**100.0**	**6900**	**100.0**	
4. Production (kg/ha)*	**1800**		**2281**		
5. Size (pieces/kg)	**55**		**69**		
6. Price (USD/kg)	**5.63**		**5.00**		**0.63**
7. Return (USD/ha)*	**10134**		**11405**		
8. Net profit (USD/ha)*	**4416**		**4506**		
9. Cost (USD/kg)	**3.17**		**3.02**		**0.15**
10. Net profit (USD/kg)	**2.45**		**1.98**		**0.48**

Note: 1) The analysis was based on the survey of 10 CoC farms and 10 non-CoC farms of *Penaeus monodon* (Black Tiger Shrimp) culture.

2) * On the basis of farm area.

3) 1 USD = 40 THB.

Source: Adapted from OAE (2004).

Farmers' expectation of the CoC program significantly relates to some variables that reflect technical and economic efficiency. This was revealed by a survey of 30 CoC farms (40% of respondents with 1-4 ha of farm area, and 60% with 4-32 ha) in Rayong province (Ampornpong, 2002). Small farmers whose ownership of the land is less secure, had lower investment and less experiences tended to have a higher expectation of the CoC program than larger farmers. The latter can adapt better to the changes in market requirements and environmental improvement norm. They are better able to adjust their practices in accordance with CoC requirements. In contrast, small farmers individually are more vulnerable to risks that the changes may bring, as discussed next.

5. Critical Conditions and Barriers to CoC Adoption

There are around 35,000 total shrimp farms and more than 1,000 hatcheries throughout Thailand. Only 146 farms and 140 hatcheries are certified CoC producers (www.thaiqualityshrimp.com, accessed 12 February, 2006). On the other hand, the adopters of GAP, which focuses on product safety, include 28,719 farms and 1,679 hatcheries. It appears that farmers are more responsive to the product safety requirements of the market, which is what GAP targets, than CoC's environmental standards. This indicates that farmers are likely to adopt a practice if the benefit is well perceived, in this case consumer recognition or acceptance of the GAP product. On the other hand, market-related benefits from environmental improvements, such as from the adoption of CoC's more stringent standards, are less easy to perceive. In this regard, it is logical to expect, and the number of adopters show, that farmers would be more difficult to convince to adopt CoC than GAP.

Evidences from voluntary adoption of BMPs that reduce non-point source pollution in the agriculture sector indicate that BMPs reduce input use. This saving covers the cost of adoption, yet farmers do not readily adopt the practices (Mitchell and Hennessy, 2003). In addition to cost, other factors such as profit uncertainty and farmers' risk aversion behavior[5] influence adoption decision. In support of the above findings, Pannell (2003) stated that uncertainty about economic performance and biological productivity of sustainable farming practices inhibits adoption. Due to risk aversion, farmers place greater weight on potential negative outcomes than on positive outcomes of adoption. In some cases of uncertainty, farmers are better off by waiting to adopt. Therefore, their final de-

5 Farmers are prepared to forgo some income as to avoid risk and uncertainty outcome.

cision is based not only on perceived benefits (i.e. perceived return enhancing or perceived cost reduction) but also perceived risks and uncertainties associated with adoption and industry *per se*. These factors would explain the slow adoption of environmentally friendly practices in shrimp farming as the details described below.

Risk from diseases considerably adds to the uncertainty of making a profit; it would also affect the effectiveness of CoC. Culture of indigenous species, *Penaeus monodon (*Black Tiger Shrimp) has been frequently hit by diseases, in particular Yellow Head Virus and White Spot Syndrome Virus. In 1998, a new species, *Penaeus vannamei* (Pacific Whiteleg Shrimp), was introduced to Thailand. The production of this species started growing considerably in 2003. It normally commands a lower price compared size-by-size with *P. monodon.* But it has some advantages over *P. monodon* such as rapid growth rate, tolerance of high stocking density, lower protein requirement and therefore feed cost, certain disease resistance (if specific pathogen resistance, SPR, stocks are used), and high survival during larval rearing (Briggs et al., 2004). This can result in a higher profit, if not per kilogram, per volume of production (see Appendix 3). Additionally, specific pathogen free, SPF, stocks are commercially available from the USA, while the breeding of *P. monodon* still relies on wild broodstock and SPF/SPR stocks are not yet available. However, the use of cheaper non-SPF stocks of *P. vannamei* have brought in new diseases to Thailand such as Taura Syndrome Virus as well as a LOVV[6]-like virus suspected to cause the slow-growth syndrome in *P. monodon.* Other long-term negative consequences have not yet been studied (Briggs et al. 2004). Although CoC adoption can contribute to reducing the disease risk (mainly through good pond and water management, and therefore, improvement of farm environment) and thus reducing the uncertain production outcome, this could be perceived as a long-term consequence. A large number of farmers are still waiting to see its proven effectiveness.

6 Lymphoid Organ Vacuolization Virus (LOVV).

Other than the disease risk, the profitability of shrimp farming is very susceptible to market condition. The production of *P. vannamei* first appeared in DOF statistics in 2003. It increased from 50% of total farm production in 2003 to 75% in 2004. This created some market problems because of non-established market routes and thus uncertain orders for this new species. Thai processors/exporters did not accept *P. vannamei* until they identified marketing channels (Briggs et al., 2004: 32). They also paid lower prices than for *P. monodon*. The differences in wholesale prices can vary up to nearly 1 USD/kg depending on the sizes and season.[7] In addition, the product highly competes in the US market with those from Latin America, which mainly produces *P. vannamei.* Meanwhile, other negative impacts, especially on the environment, of this exotic species are not yet known. Thailand currently restricts broodstock importation through registration. However, there has been no clear decision as to whether the country should promote, inhibit, or stop this species. This additional uncertainty could impede further development of important facilities such as market, breeding and genetic improvement techniques, and disease control. The uncertain condition in the industry would also tend to delay farmers' deciding to make an extra investment by adopting CoC.

Other than the perceived production uncertainty, perceived fixed cost is another real obstacle to the voluntary adoption (Stanley, 2000). Compliance with CoC increases production costs by voluntary internalization of the environmental costs as adjusted to the standard. Cost of adoption is the primary impediment to voluntary adoption that aims at environmental improvement. Technically, farmers need to sacrifice part of their farm land for a water treatment pond and sludge dumpsite. For example, using biotechnology-based CoC, the system requires 25% of the culture area for water treatment pond and water recycle system (See Coastal Fisheries Research and Development Bureau). This requirement could be seen as the main technical barrier in promoting CoC, particularly to small farms (less than 1.6 ha). A survey by the Pollution Control Department

7 The average wholesale price for all sizes of *P. monodon* and *P. vannamei* were 4.35 and 3.58, respectively, during April-December 2004 (calculated based on data from www.geocities.com/kanusorn/today.htm accessed on 1 February, 2006).

(PCD) of more than 600 shrimp farms in 2000 showed that small farms allocated 75% of their farm area for culture ponds and 25% for other uses, e.g. reservoir, sludge pond, disk, storage house, etc.(PCD, 2002). By comparison, larger farms allocated a higher proportion of the land for other uses, and thus less proportion for culture area, i.e. 66% for 1.6-8 ha farms and 58% for larger than 8 ha farms. This survey also showed that 61% of farms used water treatment pond, only 6.5% of farms had effluent treatment pond, 39% did not have any of these, and 12% did not have even a sludge dumpsite. These figures indicate that for large farms compliance with CoC means having to reset their farm structure and probably readjusting existing farm management techniques. For individual small farms, this means also substantial investment in additional farm land and water system, which are the main technical protocols of CoC in reducing disease risk and environmental damages.

Eventually, farmers' decisions will lean on economic performance, specifically in terms of perceived farm profitability. Increase in shrimp prices, improved yields, and reduced input use are expected from adoption. Nonetheless, obtaining a premium price through certification of product quality and eco-labeling is subject to consumer awareness, especially of importing countries. At the present stage, the effectiveness of Thai CoC implementation is still prone to some disease risks and market uncertainty.

Lastly, the adoption is unlikely to guarantee profit-neutral in the short-term perspective in particular for individual small farms. Studies in agriculture on the adoption of BMPs that are meant to promote environmental protection revealed that relationships between the extent to which a farmer adopts the practices and the farm profit are not positive in all cases (Valentin et al. 2004). For example, the adoption of nutrient BMPs (i.e. split application, reduced application rate, soil testing, and site-specific management) to reduce the nutrient movement into surface water had a positive effect on profit for wheat and corn, but not for soybean and sorghum. Empirical testing of profit-neutral of shrimp CoC adoption could provide evidence to support decision-making.

6. Lesson Learned from Other Countries

The adoption can be country specific, or developed for a particular location, taking account local farming systems, social and economic context, markets and environments. Two examples of fast progressing shrimp industry and BMPs adoption from India (Bueno, 2006) and Vietnam (NACA et al., 2005) are cited here. More cases and details are available at www.enaca.org/shrimp.

Shrimp farmers in India are, like other shrimp farmers in the region, repeatedly hard hit by virus diseases. They are the most vulnerable to shocks and least able to rebound from adversities. A shrimp health management project developed best health management practices for small farmers organized into "aquaclubs" (a group of 15-20 farmers). The project eventually evolved into a community development pilot with health management as the core technology. A project evaluation in 2004 found that the shrimp farmers that formed aquaclubs and adopted BMPs have increased yield by 33%, harvested shrimp that were 1.5 times larger, and were visited 20% less frequently by diseases than surrounding non-adopting farmers. Moreover, their products became more attractive to buyers because the shrimp had no antibiotic residues as the farm management practices they adopted exclude the use of banned drugs and chemicals. The project was subsequently expanded; another evaluation, of the 2005 crop results from 930 demonstration ponds spread over 484 hectares of area in 15 villages, showed an increase in production by two-fold, 34% increase in size of shrimp, and 65% reduction in disease prevalence compared to surrounding non-adopting ponds. There was a remarkable improvement in quality of the shrimps due to non-use of any banned chemicals and better practices during harvest and post-harvest handling. Another outcome is the contract seed production system, in which the organized small farmers could procure high quality of seeds at reasonable price, and even offering premium price to hatchery owners for quality and reliable seed supply.

Vietnam witnessed an outstanding 2-fold increase in aquaculture production only in the 5-year period 1998-2003 (1,150,000 tons in 2003). Shrimp farming played a major role in this rapid development. According to FAO data, the production over the same 5 year period registered 4-fold increase reaching over 220,000 tons and that, according to national statistics, grew constantly to reach 350,000 tons in 2005.

Although continuously higher production could be an indicator of the healthy growth of the sector, the increased production observed in recent years was due more to an increase in the number of farms, than to improved productivity. This sharp increase in production came at a cost. Increasing environmental deterioration and the associated shrimp health problems, which in 2004 led to an estimated loss of more than 11% of the total shrimp production, began to damage the sector. Farmers usually deal with these health problems by increasing the use of chemicals, involving sometimes the application of banned substances, which led importing countries to impose restrictions on Vietnamese aquaculture products.

The government of Vietnam recognized the need for promoting a more sustainable development of the sector and initiated several activities in this direction. Among these is a project that supported coastal aquaculture, which demonstrates the private and social benefits of adopting BMPs. BMPs were developed for broodstock traders, hatcheries, seed traders and farmers. Focus was given on the development of simple and practical BMPs, which addressed the needs of less resourced small-scale farmers. Ten sets of extension material were developed and disseminated in close collaboration with the Ministry of Fisheries. The tangible outcomes include the following:

- Implementation of BMPs for hatcheries was supported in six hatcheries and resulted in seed production up to 1.5 times higher and a price per unit seed of about 30-40% higher than non-BMPs seed.
- BMP implementation was also supported in 7 pilot farming communities (655 direct beneficiaries). The implementation led to a remarkably lower risk of mortality, higher production and higher probability of making a profit.

- Farming communities that introduced seed testing increased their chances of making a profit of over 7 times.
- BMP application led to average yields that were sometimes more than 4 times higher than in farms where BMP had not been adopted.
- The project BMPs were also incorporated into the draft standards for the production of organic seed.

The project also strengthened the institutions involved with seed health management by conducting training courses and by supporting the development of national and provincial-level legal documents to improve the process of seed screening and certification. While there was no formal farmers' association, the Vietnamese farmers were informally organized at the village level and, through periodic meetings, the farmers in the same village became involved as a group in the adoption of BMPs. Because hatcheries and broodstock traders also adopted BMPs that pertained to their sectors, the overall benefit was mutually beneficial relations and trust among them.

The projects are providing indications that BMP adoption is not a problem for well organized small-scale farmers. Being organized enables them to attain economy of scale to be able to comply with the best practices requirements. It is obvious that successful BMPs implementation in these two countries do not focus only on technical solutions, the projects have engendered harmony and cooperation among players in the market chain. More fundamental than the small farmers and the environment benefiting from BMPs is the social harmony it engenders. The above projects have arguably served to enhance trust and cooperation among the players in the market chain. The logic of this proposition is that the players stand to gain more from each one behaving responsibly towards one another than by taking advantage of each other.

7. Challenges and Practical Solutions

The big challenge with voluntary adoption relates to the issue of trust among players in the market chain. The adopters may not be totally convinced that they are the beneficiaries, and farmers may doubt that the program will effectively improve the environment if some adopt but many others do not. In short, this is a concern over free-riders. On the other hand, as the above projects illustrate, engendering trust among operators and stakeholders, for instance, between farmers and hatchery operators, farmers and feed/drug suppliers, and among resource users including shrimp farmers and other users of coastal resources (water in particular), would encourage adoption. Importantly, farmers are in a stronger position to deal with other players if they are organized.

In Thailand, industry associations of shrimp farmers, hatchery operators, input suppliers, and processors/exporters exist. However, a more cohesive network among the stakeholder groups (farmers, input suppliers and processors/exporters) and between them would make the industry stronger in dealing with persisting problems such as disease risk and market uncertainty. This mechanism would support CoC adoption in terms of sharing and exchanging information and knowledge, reducing profit uncertainties, sharing the cost of adoption, and perhaps reducing the cost of implementation. An example of the latter is for group members to share the water and effluent treatment and disposal systems. A “Group CoC” certification could be given to a qualified association or group rather than to individual members. This would facilitate monitoring as farm inspection could be conducted randomly among group members. Groups of small farms participating in the seawater irrigation projects can be candidates for this scheme since a common water system has already been provided by the government.[8]

8 Thai Government has invested the seawater irrigation system (SWIS) to facilitate shrimp farming. Two big projects have been implemented by DOF in Kung Krabaen Bay, Chanthaburi province and in Pak Phanang, Nakhon Sri Thammarat province. The SWIS comprises three main components: 1) pumping of quality water from the sea through the inlet and pumping of water effluent back to the sea through the outlet, 2) treatment of water supply, and 3) treatment of water effluent. Farmers share water supply and are responsible for the operation and mainte-

Managing the biophysical factors associated with risk and uncertainty (e.g. disease, seed quality, stocking, feeding, water and pond soil quality), in practice, varies by site and by farm. The development of individual farm manuals following the CoC guidelines could be another challenge for achieving a mutual standard and gaining acceptance by farmers at the same time. CoC knowledge transfer from DOF's farm trainers to farmers needs to be done with a clear understanding of the problems existing in each particular farm. Fundamentally, large farms usually have a high capacity to develop their own management techniques. The collaboration between DOF and large farms in developing suitable techniques under CoC could enhance the relevance of the practices to the farming localities.

Uncertainty is high in the early stage of the adoption process of any innovation (Pannell, 2003: 74). If the CoC process is further developed and demonstrated in put in trials, the adoption process will potentially reduce risk and uncertainty over time by collection, integration and evaluation of new information obtained. This adaptive manner of CoC implementation could be deemed as a risk management process, although it is never reached zero-risk and nil-probability of uncertainty.

8. Other Supportive Policies

This section suggests some supportive policies and measures for decision makers to consider as complement to voluntary management scheme. The further development of CoC that focuses on improving farmers' perceptions of long-term benefits and reducing perceived risks will increase adoption. The latter will reinforce the former since it makes long-term profitability more predictable. As described above these are critical to the success of voluntary adoption. They are relevant particularly that the scheme aims to promote environmentally friendly practices.

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nance costs. DOF also trained farmers in farm management techniques and formed a farmers' association to operate the system. See Chuaduangpui and Ikejima (2005).

An insurance scheme would reduce perceived risks associated with CoC adoption. In the USA, green insurance policy has been used to promote some BMPs aimed at environmental protection. For example, a corn root-worm integrated pest management (IPM) insurance is sold to a farmer following a certified crop consultant's recommendation to not treat with insecticides. If the IPM recommendation fails, indemnity is paid based on the observed root rating and lodging (Mitchell and Hannessy, 2003). Other policies include a nitrogen fertilizer insurance against excess rainfall that would prevent side-dress nitrogen application on corn; a Bt corn refuge insurance that insures against yield loss due to insect damage; and other specific nutrient BMPs insurance (Mitchell, 2004). The studies advocate insurance as a tool to increase the incentives for farmer to adopt a BMP. Like other types of single peril insurance, green insurance could be privately provided without premium subsidies, and so attain the efficiency of market-based provision of adoption incentives (Mitchell and Hannessy, 2003: 53). At the same time, the same authors warn of associated issues of insurance policy such as moral hazard and adverse selection. The opportunity presented by a scheme for beneficiaries to influence the likelihood of a loss to occur so they can claim indemnity is a moral hazard. Documentation requirements and a certified crop consultant to develop the practices were suggested as means to reduce the problem. Adverse selection can occur when a certain insurance premium is based on average yield, when in reality there are differences in yields among farms (i.e. differences in risk expectations). Farmers with a higher average yield have a greater incentive to buy insurance since they are likely to receive a higher indemnity than the premium they paid. Premium subsidies to farmers with lower yield and multiple-peril insurance premium have been suggested to mitigate this problem. Lastly, Babcock et al. (2003) added that insurance programs may exclude small farms as paying premium increases their production costs. The offer of group insurance under "Group CoC" (see above discussion) may facilitate farmers' decision to participate in the program.

Encouraging and strengthening farmer organizations would support CoC implementation. This includes the provision of assistance on group basis, rather than on individual basis. This changing of organization boundary can result in self-monitoring and self-inspection within the group. This may further form an implicit social sanction system in the industry, which works by peer or group pressure to assure that everyone in the group behaves responsibly. If this is the case, implementation of a voluntary scheme is likely to be more effective than using legal sanctions, or more acceptable than using market-incentive based tools to protecting the environment. It is widely accepted that the main limitation to the success of implementing regulations is the efficacy of enforcement, which relies on supportive institutional structure. The development of aquaculture regulations does not assure that the regulations will be applied at the farm level, and the effort to enforce compliance would be difficult and expensive (Boyd, 2003). Meanwhile, using incentive-based tools such as green taxation imposed on externalities, in principle, is more effective than mandate command and leads to efficiency outcome. It is however deemed as a tough measure for most developing countries and usually politically unacceptable. See discussion in Pongthanapanich (2005a).

This paper suggests a combination of policy approaches that would offer a number of options to a farmer according to his circumstances, capacities and constraints. This may eventually stabilize the implementation of environmental policies. Pongthanapanich (2005b) showed an evidence of potential vigor of using mixed approaches. The study found that using a combination of incentive-based tool such as green taxation and nonincentive-based tool such as coastal land use zoning (concerning the carrying capacity of receiving waters) optimally leads to both economically and environmentally responsible shrimp farming. In contrast, using effluent standard alone as currently being implemented will not. And a zoning scheme alone does not account for externalities. Although some impacts can be limited by zoning, its effectiveness depends much on the efficacy of control over specific land use. Using voluntary management *per se* has some challenges and conditions for successful application as discussed above. Furthermore, incentive-based approach and mandatory control approach can become a background threat to voluntary approach (Sterner, 2003: 393). For example, if a voluntary approach is not successful in meeting a satisfactory environmental quality, the other approaches will be implemented.

The revenue from a green tax imposed on common practice farms may be used to support voluntary adoption of environmentally friendly farms. However, more clearly specified practices (see Boyd, 2003) under Thai CoC are needed to fulfil each environmental improvement objective; and therefore adoption of these practices can be supported by a green tax. Subsequently, alternative practices and management options can be evaluated (see Engle and Valderrama, 2004).

Finally, total costs including implementation cost, and benefits generated from the entire industry (from each section of the chain from farm to export) based on sustainable development in condition of various policy scenarios should be estimated. The analysis can show whether income generated from the industry under a particular management approach would offset the cost. It would also indicate how the costs and benefits may be redistributed. In principle, the break-even price of a clean and green product must be higher than the current price received. Producers and consumers could share responsibilities. Consumers can encourage adoption by bearing the extra cost of producing a safe product. This can be in a form of a premium price for certified products. Farmers would benefit from a higher farm-gate price. At the same time, farmers should bear the environmental cost. The cost-return comparison between common practice, GAP and COC farming can roughly show these additional payments. It would inform decision makers if a recalculation were made that would show whether or not the industry, by following environmentally friendly practices, brings net benefit to the nation.

9. Conclusion

This paper examines the implementation framework and outcomes of voluntary management scheme, i.e. the Code of Conduct or CoC. The scheme has been promoted by the Department of Fisheries since 2002 as to achieve environmental responsibility and sustainable development of Thai shrimp industry. So far the numbers of adopters is insignificant compared to total shrimp farms and what the implementation program expected. The study aims to provide some suggests for enhancing the scheme.

The analysis shows that the success of the implementation is directly influenced by farmers' perception of future changes in farm profits due to the adoption. This includes the perceived risks and uncertainties associated with the adoption and the industry *per se*. Apart from the uncertain market condition, disease outbreak is the greatest risk that generates high loss of production and thus adds to the uncertainty of making a profit. The perceived additional fixed cost of effluent treatment facility as a main technical requirement of the scheme in reducing pollution is another important barrier. This is relevant to Thailand where 80% is small-scale farms.

Risk management that aims to increase farmers' acceptability to adopt such innovation is an adaptive process. The enhancement of voluntary adoption is thus partly to improve farmers' perception through increased information and knowledge. The mechanisms and policies, which can improve its effectiveness, could be visualized through demonstration projects especially those designed to address the needs of small-scale farmers. Sharing the effluent treatment facility together with a "Group CoC" certification system could be a solution to the experienced high investment costs of individual small farmers. An insurance scheme safeguarding against losses associated with the adoption could be another policy option. Evidently, strong cooperation among players in the market chain has shown to be a powerful mechanism as the individual player stands to gain on the collective action. Strengthening farmer organization would also support the implementation as it would permit self-monitoring, self-inspection and implicit social control system to enforcement on a voluntary basis.

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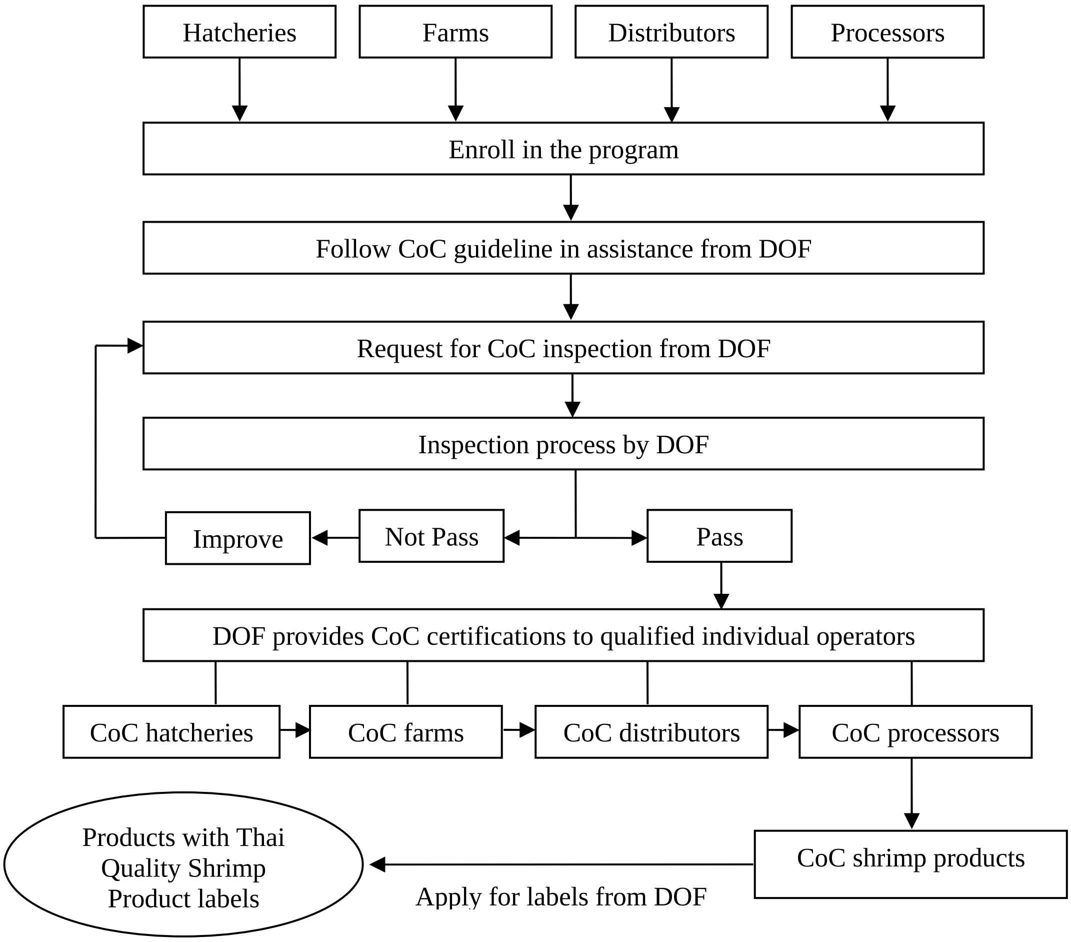
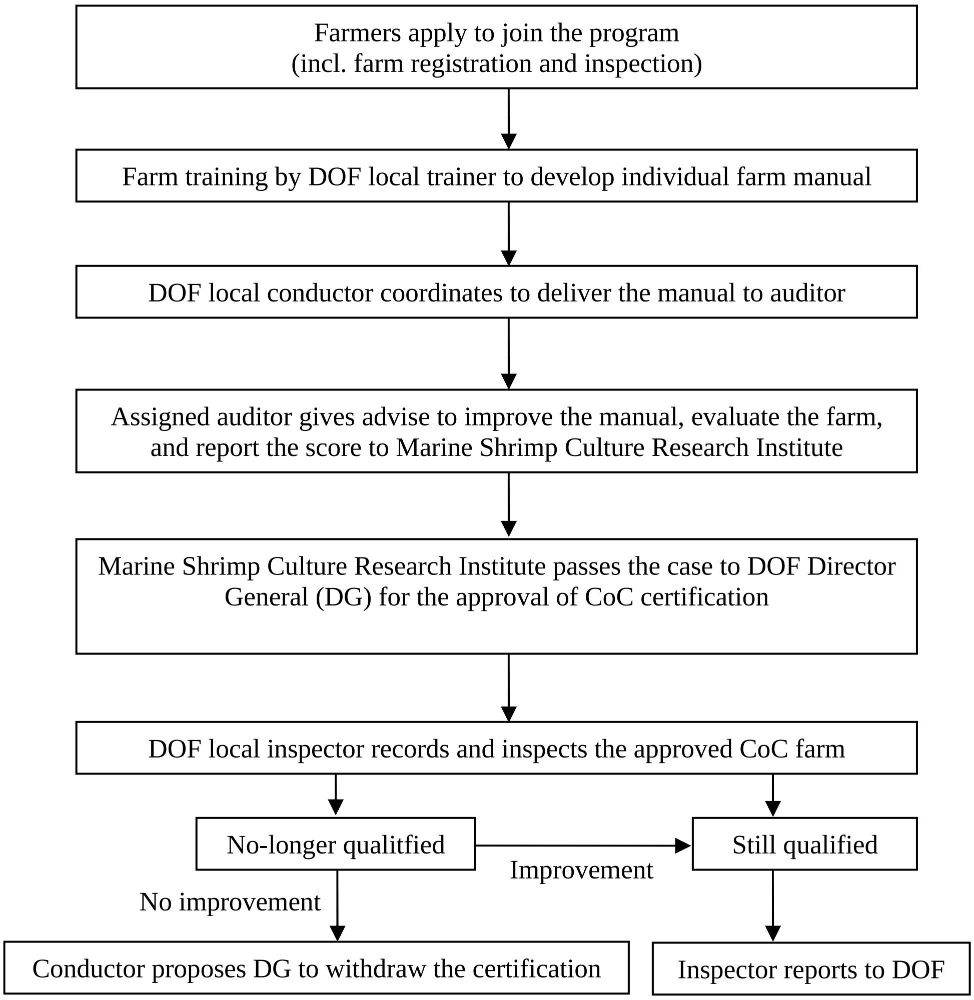
Appendix 1. Certification process for Thai Quality Shrimp Product



Source: Adapted from Marine Shrimp Culture Research Institute.
www.thaiqualityshrimp.com/upload/production_coc/16/plan_th.gif (in Thai).

Appendix 2. Certification process for CoC farms



Source: Adapted from Marine Shrimp Culture Research Institute.
www.thaiqualityshrimp.com/upload/production_coc/18/65_47.pdf (in Thai).

Appendix 3. Cost-return of Thai shrimp farming

Species	*P. monodon*[1/]	*P. monodon*[2/]	*P. vannamei*[3/]
Survey year	2002	2005	2005
Number of respondents (Farms)	10		87
1. Cost (USD/Kg)	3.02	3.02[1/]	2.40
2. Price (USD/kg)	5.00	3.15	3.01
3. Profit=2-1 (USD/kg)	1.98	0.13	0.61
4. Yield (kg/ha-of culture area)	4137	4137[1/]	8629
5. Profit per ha=3*4	8171	538	5272
6. Size (pieces/kg)	69	70	71
7. Survival rate (%)	69		81
8. Culture cycle (days/crop)	120		111

Note: [1/] Data from non-CoC farms from Table 1 and 2.

[2] Proxy value. The calculation is based on the cost and yield of 2002 and use average price data of year 2005 (www.geocities.com/kanusorn/today.htm, accessed on 1 February, 2006).

[3/] Mostly non-CoC farms, but certified as GAP farms.

Source: [1/] OAE (2004).

[3/] OAE (*forthcoming*).

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70/06	Tipparat Pongthanapanich	*Toward Environmental Responsibility of Thai Shrimp Farming through a Voluntary Management Scheme*