REGIONAL POLICY ON COMMERCIAL AQUACULTURE: SEAFDEC INITIATIVE

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Introduction

The Southeast Asian Fisheries Development Center (SEAFDEC) is an autonomous intergovernmental organization established in 1967 as a regional treaty organization to promote fisheries development in Southeast Asia. SEAFDEC specifically aims to develop fishery potentials in the region through training, research and information services to improve food supply for food security in the region. SEAFDEC currently comprises 11 member countries, namely, Brunei Darussalam, Cambodia, Indonesia, Japan, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam.

SEAFDEC has its Secretariat based in Bangkok, Thailand serving as coordinator among the SEAFDEC member countries and the four technical departments. The Training Department (TD) in Thailand is in-charge of marine capture and coastal fishery management; the Marine Fisheries Research Department (MFRD) in Singapore for fishery post-harvest and fish processing; the Aquaculture Department (AQD) in Iloilo, Philippines for aquaculture research and development; and the Marine Fishery Resources Development and Management Department (MFRDMD) in Kuala Terengganu, Malaysia for research and development in the management of fishery resources. The SEAFDEC Council, with members represented by the Fishery Directors appointed by respective Member Countries, is the supreme governing body to make decisions on important SEAFDEC policy issues.

For its almost 40 years of operation, SEAFDEC has continued to work towards the development of fisheries and aquaculture in the Southeast Asian region. Through a collaborative mechanism between SEAFDEC and the Association of Southeast Asian Nations (ASEAN), several programs on sustainable fisheries and aquaculture have been carried out in the ASEAN region using SEAFDEC's technical expertise. Among these was the promotion of the FAO Code of Conduct for Responsible Fisheries (CCRF) adopted in 1995.

During the ASEAN-SEAFDEC Conference on Sustainable Fisheries for Food Security in the New Millennium: "Fish for the People" organized in 2001, the Ministers and their senior officials responsible for fisheries in the ASEAN-SEAFDEC member countries adopted the Resolution and Plan of Action on Sustainable Fisheries for Food Security. These two documents were developed with the CCRF as the guiding principles and its thematic issues were used as guidelines in promoting sustainable fisheries and aquaculture to ensure food security in the ASEAN region.

The Regionalization of the Code of Conduct for Responsible Fisheries by SEAFDEC

Since the adoption of the global Code of Conduct for Responsible Fisheries (CCRF) in October 1995, many international, regional, sub-regional, or even national fisheries bodies acted accordingly to the challenges posed by the CCRF. In the ASEAN region, SEAFDEC initiated a program on the Regionalization of the Code of Conduct for Responsible Fisheries (RCCRF) starting in 1998 in order to come up with supplementary guidelines that would accommodate specific regional concerns that the global CCRF might have failed to highlight. In the regionalization process, efforts were made by SEAFDEC to take into consideration the Southeast Asian region's specific context encompassing its varied culture, fisheries structure and fishery ecosystems. With the understanding that there can only be one Code of Conduct for Responsible Fisheries and one set of standards that should apply globally, the "regionalization" effort of SEAFDEC was therefore a means to prepare regional guidelines

where the issues of particular importance to Southeast Asia are amplified and elaborated on under the framework of the global CCRF.

The SEAFDEC RCCRF program was intended to bridge the gap between the internationally-driven initiatives such as the CCRF and the actual implementation of the CCRF at the regional, national and local levels. Thus, the regionalized CCRF covered a wide range of fishery issues and sub-sectors , i.e., fishing technology, aquaculture, fisheries management, post-harvest practices and trade, co-management of fisheries, fishery statistics, indicators, and fisheries refugia.

The RCCRF has been promoted in the region through a wide spectrum of stakeholders – from the high-level policy-makers, managers, scientists/researchers, the private sector down to the fishers. This resulted in the adoption and implementation of national directives by the respective governments and the private sector as well as by individuals at the national and/or local levels, based on the RCCRF frameworks. With the existing regional collaborative mechanism between SEAFDEC and the ASEAN, efforts to promote the regional guidelines are intensified ensuring sustainability of their implementation in the Member Countries that could lead to the improvement of fisheries management and promotion of sustainable aquaculture in the region.

The Regional Guidelines for Responsible Fisheries in Southeast Asia

Since its implementation in 1998, the RCCRF Program has come up with the following regional guidelines and supplementary directives:

1. Responsible Fishing Operations

Published in November 2000, the ***Regional Guidelines for Responsible Fisheries in Southeast Asia: Responsible Fishing Operations*** was developed to support the implementation of Article 8 (Fishing Operations) of the global CCRF in the ASEAN region considering the current situation of the region's fishing operations and practices. Coordinated by SEAFDEC/TD, the Regional Guidelines provide general annotations to the global CCRF with specific considerations on the regional applications for capture fisheries.

2. Responsible Fisheries Management

The ***Regional Guidelines for Responsible Fisheries in Southeast Asia: Responsible Fisheries Management*** support the implementation of Article 7 (Fisheries Management) of the CCRF, and provide suggestions for the improvement of fisheries management with emphasis on human capacity enhancement for all levels of stakeholders involved in inland, coastal, and marine fisheries. The Guidelines, coordinated by SEAFDEC/TD and SEAFDEC/MFRDMD comprise two parts: industrial fisheries and coastal fisheries.

As an offshoot of this Regional Guidelines, Supplementary Directives were developed by SEAFDEC in collaboration with the SEAFDEC Member Countries in order to substantiate the said Guidelines. Thus, the Supplementary Directives were promoted as contained in the ***Supplementary Guidelines for Responsible Fisheries Management in Southeast Asia***, which was published in 2006 supplement the said Regional Guidelines, comprising four major parts, namely:

2.1 Co-management Using Group User Rights for Small-scale Fisheries in Southeast Asia

In this Supplementary Directives, the delegation of fisheries management powers on coastal fisheries to the local fisheries organizations is elaborated on. Specifically, the Directives aimed to encourage the small-scale fishers to take part in the management activities

in conjunction with their respective governments' policies and requirements. As Supplementary Directives to the Regional Guidelines, it is intended to provide a regional reference for member countries interested in implementing and improving the management of their small-scale fisheries adopting the group-user approach.

2.2 Fishery Statistics for Capture Fisheries in Southeast Asia

The Directives aimed to provide an important framework for the implementation of the ASEAN-SEAFDEC collaborative program on fishery statistics by the countries in Southeast Asia. In the actual implementation of this Supplementary Guidelines, efforts should be made to adjust or modify where applicable, some directives that would suit the respective national and local specifications based on their geo-political, social, economic and legal situations.

2.3 Use of Indicators for Sustainable Development and Management of Capture Fisheries in Southeast Asia

The Directives incorporate some mechanisms for collecting data and information supporting the indicators in routine (fishery statistics) and non-routine (research) exercises, and explain the use of fishery indicators in the management of fisheries stressing on the importance and roles of the stakeholders. The main objective of this Supplementary Guidelines is to provide a regional reference, which the ASEAN member countries may adopt in applying indicators for sustainable development and management of their fisheries in inland as well as in marine waters. Considering the nature of fisheries in the region, which is small-scale multi-species/multi-gear fisheries, the use of indicators for fisheries management in an adaptive manner could be practical and easily understood by the stakeholders.

2.4 Use of Fisheries Refugia for Capture Fisheries Management in Southeast Asia

This Supplementary Guidelines aimed to enhance the use of spatial approaches to fisheries management that focus on fishery and habitat linkages, and the benefits associated with effective fisheries and habitat management at the local level. The concept of refugia is based on the emerging body of evidence that refugia is a basic element explaining the resilience of commercial fish stocks to exploitation. Since commercial fisheries in the region are subject to high levels of fishing effort, the maintenance of refugia or creation of refugia is a strategy in fisheries management as it serves as effective buffer against uncertainly and recruitment failure especially important in order to attain food security.

3. Responsible Post-harvest Practices and Trade

The ***Regional Guidelines for Responsible Fisheries in Southeast Asia: Responsible Post-Harvest Practices and Trade*** was prepared with the aim of using it as reference in identifying directions and priority actions for the implementation of Article 11 (Post-harvest Practices and Trade) of the CCRF. Coordinated by SEAFDEC/MFRD, the Guidelines also aimed to harmonize the regional specificities and current situation of the ASEAN region as far as fisheries post-harvest practices and trade are concerned. Considering that traditional fish products in the ASEAN still represent a significantly high amount of total fish utilization, the Guidelines also aimed to address this concern under its three main topics: responsible fish utilization; responsible international trade; and laws and regulations related to fish trade.

4. Responsible Aquaculture

The ***Regional Guidelines for Responsible Fisheries in Southeast Asia: Responsible Aquaculture*** provide supplementary guidance to Article 9 of the CCRF, accommodating regional requirements to promote the implementation of responsible aquaculture in marine, brackishwater, and freshwater environments, e.g., lakes, reservoirs, rivers. The Guidelines, coordinated by SEAFDEC/AQD also provide guidance on efficient use of inputs, e.g., fry,

broodstock, feeds, etc., to improve production and facilitate responsible practices (SEAFDEC, 2005).

Since the issue related to sustainable commercial aquaculture is also covered in this Regional Guidelines, this publication is therefore being used as the main reference for this paper. References are also made on the global CCRF (FAO, 1995), the FAO Technical Guidelines for Responsible Fisheries, No. 5: Aquaculture Development (FAO, 1997), other publications of SEAFDEC/AQD as well as other related publications on sustainable aquaculture. The key technical issues discussed in this paper are within the context of commercial aquaculture in the ASEAN region following the frameworks of the Regional Guidelines for Responsible Fisheries in Southeast Asia: Responsible Aquaculture.

4.1 Definition of Aquaculture vs. Commercial Aquaculture

The widely accepted definition of aquaculture by FAO (1988), which is used in the Regional Guidelines, follows: "Aquaculture is the farming of aquatic organisms including fish, mollusks, crustaceans, echinoderms, and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding and protection from predators. Farming also implies individual or corporate ownership of or rights resulting from contractual arrangements to, the stock being cultivated primarily for livelihood and business activities. For statistical purposes, aquatic organisms harvested by an individual or corporation, which has owned them throughout their rearing period contribute to aquaculture, whereas aquatic organisms exploited by the public as a common property resource, with or without appropriate licenses, are the harvest of fisheries."

From the above definition, aquaculture is not limited to small-scale or rural aquaculture but it also encompasses business-type of aquaculture operations either owned and/or operated by individual owners or corporation. Thus, commercial aquaculture is defined by FAO (2001) as: "Commercial aquaculture comprises fish farming operations with the goal of maximizing profits, where profits are revenues minus costs. Such operations are determined by their profit-maximizing goals but if unprofitable at least losses are minimized. Commercial aquaculture is not an alternative but a complement to rural aquaculture. Considering the whole aquaculture systems as a continuum of economic activities from those exclusively oriented towards self-consumption to those that are exclusively for sale, commercial aquaculture would be operations whose output is for sale while from the other extreme would be the rural or subsistence aquaculture."

Furthermore, the development of subsistence aquaculture is always constrained by many factors including inadequate financial and technical inputs. While corporations or individuals operating commercial aquaculture have easy access to credit, technological inputs, etc., rural aquaculture usually makes use of family-based resources. Shrimp farming, which has developed fast in the region, is a good example of commercial aquaculture. The definition of commercial aquaculture could also be gleaned from the point of view of the technology applied by the shrimp industry. Since small-scale shrimp culture operation adopts extensive or semi-intensive technologies, it can be considered subsistence aquaculture. But operations using the semi-intensive to high intensive systems as practiced by the region's shrimp industry are surely commercial aquaculture.

In summary, FAO (2001) defined "non-commercial" aquaculture as small-scale subsistence, small-scale artisanal or integrated aquaculture operated by resource-poor framers. Non-commercial operations rely mainly on cheap family labor and on-farm sale of produce while commercial aquaculture avails of hired labor from local or distant areas. The definition of non-commercial compared with commercial aquaculture based on their main characteristics is presented by FAO (2001) adopted from Little (1998) in the following table:

Main Characteristics	Non-commercial Farms	Commercial Farms	
		Medium	Large
Main Goal	Maximize family utility; risk diversification	Maximize profits	Maximize profits
Main Location	Rural/Suburban/Urban	Suburban/Urban/Rural	Suburban/Urban/Rural
Main Market	Domestic (Family/Rural)	Domestic (Middle Income/Urban)	Exports, Domestic Urban
Inputs			
Main Labor	Unpaid Family Labor	Paid labor/Local area	Paid/Local and distant areas
Capital	Equity	Debt and Equity	Equity and Debt
Seeds	Mostly External	Others' Hatcheries	Own Hatcheries
Fertilizer	None/organic	Organic	None or limited
Feeds	None/wastes	Wastes/supplement	(inorganic) Balanced
Pond/System Size	Small ponds	Larger ponds	Larger ponds
Dependence to others' hatcheries	Low to medium	Medium to high	Low
Main beneficiaries	Family	Owner, traders, urban consumers, local population	Shareholders, processors, governments, contract farmers, local population
Some other stakeholders	Fish seed traders	Transporters	Co-users of inputs
Main constraints	Seeds and feeds	Seeds, feeds, credit	Costs of inputs, environmental quality control
Average employment per unit of land/water (L/N)	High	Average	Low
Average Capital-Labor Ratio (K/L)	Low	Average	High
Average Output-Labor Ratio	Low	Average	High
Average Wages	Low (imputed)	Average	High
Average Yield per unit of land/water (O/N)	Low	Average	High

Commercial aquaculture could therefore be medium or large-scale aquaculture. Although there are many factors that are used in grouping aquaculture operations, for this paper and for convenience, medium could vary from operations involving 5 to 20 ha, while large-scale aquaculture could be operations involving more than 21 ha. However, discussions in this paper deal with commercial aquaculture in general, and could be medium or large-scale. Based on the experience in the region, shrimp aquaculture is generally commercial with operations involving a wide range of farm areas. Medium-scale may be those farms found in

Thailand, Philippines, Malaysia, Myanmar, Vietnam, but large-scale operations existed in the 80s and 90s in Indonesia and to some extent in Thailand.

It should be noted however, that although initially not sustainable in some aspects, the region's shrimp industry as a form of commercial aquaculture operation, has steered the economic development of the countries in the region to high degrees during the past two decades.

4.2 Rationale and Objectives of the Regional Guidelines

The ***Regional Guidelines for Responsible Fisheries in Southeast Asia: Responsible Aquaculture*** was prepared taking into consideration the diversity as well as specific social, economic, cultural, ecological and institutional context of ASEAN aquaculture. This Regional Guidelines is directed not only to small-scale or non-commercial aquaculture but most especially to large-scale or commercial aquaculture whose operations could have impacts on the environment.

Although the traditions and culture of the ASEAN countries may be varied, the peoples of these countries are fish-eating and fish is their main source of protein. Aquaculture has a long tradition in the region forming part of the countries' economies. However, the need to rationalize aquaculture in the region is deemed necessary in order to attain sustainability and ensure food security.

The structure of the region's aquaculture industry is heterogeneous in terms of species being farmed and the scales of operation. Aquaculture operations range from small fish cage owned and run by a family to augment their fish supply and income, to several hundreds of hectares (e.g., shrimp farms) owned by companies and run by hired workers. Marketing is done either on farm-gate where buyers pick up freshly-harvested fish or may involve processing, cold storage and eventual shipment to importing countries. The region's aquaculture industry is multi-tiered, consisting of pond, pen, and cage builders, feed and other input suppliers, harvesters, processors, and buyers and sellers at different levels.

As regards to ecosystems, the region is largely tropical and monsoonal making it possible to breed and grow aquatic species the whole year. The region's inland and coastal ecosystems and the component flora and fauna are highly diverse allowing for the diversity of aquaculture practices. The complexity of the ecosystems also makes the introduction of exotic or non-native species dangerous, while disease agents in introduced species can be lethal to non-immune native species and can be difficult to eradicate from the ecosystem. A greater amount of caution is therefore needed before introduction of exotic species is allowed in the region's ecosystems.

Specifically, the Regional Guidelines aimed to: (1) clarify the requirements of the CCRF; (2) facilitate the formulation of regional policies to enable the implementation of the CCRF in the ASEAN member countries; and (3) facilitate the formulation and implementation of national codes of practice for responsible aquaculture by the ASEAN member countries. As a means to facilitate the implementation of the CCRF, this Regional Guidelines applies to commercial and non-commercial aquaculture in marine, brackishwater and freshwater environments. Although prepared by and for the ASEAN member countries, the Regional Guidelines could be used as reference by other Asian countries having the same sets of circumstances.

Since the articles in this Regional Guidelines make mention of culture-based fisheries, an accepted definition of culture-based fisheries is given in the Guidelines as: "Culture-based fisheries is the capture or harvest of aquatic organisms grown in open waters from artificially stocked seeds produced from hatcheries" (SEAFDEC 2005).

4.3 SEAFDEC Initiatives in Addressing the Directives in the Regional Guidelines

In the Regional Guidelines, elaborations on the original Article 9 of the CCRF (FAO, 1995) on Aquaculture Development and specifically on the FAO Technical Guidelines for Responsible Fisheries No. 5: Aquaculture Development (FAO, 1997) have been made serving as Directives for the region's aquaculture industry. The initiatives undertaken by SEAFDEC and the Member Countries in addressing the Directives corresponding to the CCRF and the Technical Guidelines as indicated in the Regional Guidelines, are discussed briefly as follows:

Article 9.1: Responsible development of aquaculture, including culture-based fisheries, in areas under national jurisdiction

This article includes directives for the countries to compile, evaluate, improve and update information especially their national statistical systems to include aquaculture using a format compatible with regional and global databases. SEAFDEC has been compiling national statistics from countries in the region and annually publishing such information in the ***Fishery Statistical Bulletin for the South China Sea Area***, the latest issue covering the year from 2002 to 2003 (SEAFDEC, 2006) . Initially, the Bulletin covered only capture fisheries, but recently data from aquaculture have been included. Inputs on national statistics provided for the Bulletin by the ASEAN member countries, are also utilized for the FAO fisheries and aquaculture databases.

This article also directs the member countries to ensure that there is no conflict in their existing laws and that such laws/regulations are properly implemented. Countries in the region have their own laws/regulations pertaining to aquaculture development. Thailand for example, has its National Fisheries Policies on Aquaculture (SEAFDEC, 2003), which aims to increase production from aquaculture and increase the income of fish farmers. Vietnam implements its National Program for Aquaculture Development (SEAFDEC, 2003) to address the need for ecological sub-zones for aquaculture and promote the development of sustainable aquaculture. The Philippine Fisheries Code of 1998 (DA, 1999) directs the Bureau of Fisheries and Aquatic Resources to establish a code of practice for aquaculture that would promote environmentally-design and operations, and empowers the fisherfolk to assist in the formulation of policies for the sustainable development of fisheries and aquaculture. The Malaysian Agriculture Plan, which includes fisheries, promotes the commercialization of aquaculture by overcoming major constraints (e.g., capital, suitable land, technologies, etc.) and turning these into opportunities (SEAFDEC, 2003).

Through the Aquaculture Component of the Special Five-Year Program on Sustainable Fisheries in the Southeast Asian Region, which was implemented in the region from 2002 to 2006, SEAFDEC has extended technical assistance to the countries in order to achieve sustainable aquaculture in the region (SEAFDEC, 2006a).

Another directive under this article focused on the need to study ecological and socio-economic impact of aquaculture. SEAFDEC through AQD has implemented R&D on environment-friendly aquaculture the results of which were compiled into manuals and disseminated to the region to serve as guides for the countries' aquaculture development. The ASEAN-SEAFDEC Project on the Promotion of Mangrove-Friendly Shrimp Aquaculture in Southeast Asia, which was implemented by AQD from 2000 to 2005 with funding support from the Government of Japan through the Japanese Trust Fund, has published manuals for the sustainable development of shrimp culture in the region (SEAFDEC, 2004).

Giving importance on mangroves as a coastal ecosystem utilized for aquaculture, this article directs that regional guidelines should be prepared for the responsible use of mangroves for aquaculture. Thus, the ***Code of Conduct for Sustainable Use of Mangrove***

Ecosystems for Aquaculture in Southeast Asia was prepared by AQD in collaboration with aquaculture experts in the ASEAN region. The Code of Practice (SEAFDEC, 2005a), which includes concepts, principles and policy statements prescribing the preferred ways of using mangrove ecosystems for aquaculture in the region, aims to provide directives to all stakeholders with both responsible aquaculture, and the conservation and sustainable use of the mangrove ecosystems. Specifically, the Code includes recommendations for key legislation and enforcement mechanisms to ensure both responsible aquaculture and sustainable use of mangroves, considering that in the region, mangrove losses stemmed from the failures of policy as well as management and enforcement of protection measures.

Another important directive under this article is related to the development of expertise and competence for risk assessment, environment impact assessment and monitoring in aquaculture. Aquaculture operations, especially commercial aquaculture, have a number of biosecurity concerns that pose risk and hazards to its sustainable development as well as to the aquatic environment. One of the most important risk factor is pathogen, which is easily transmitted through the movement of live plants and aquatic animals. Conducting risk assessment is part of the R&D activities carried out by AQD especially under its fish health management program. AQD's fish health management program promotes health management of aquatic products including research on pathogens and other factors related to biosecurity in order that the countries in the region will be able to comply with safety and quality requirements of fish importing countries.

As defined in the Regional Guidelines, risk assessment is a scientific process of hazard identification and characterization, exposure assessment, and risk characterization. Bueno PB et al (2007) outlined some health benefits and risks associated with aquaculture as pathogens and the spread of diseases could be caused by abuse of antibiotics, agricultural chemicals, pesticides, etc. SEAFDEC in 2004 published the Proceedings of the Meeting on the Current Status of Transboundary Fish Diseases in Southeast Asia: Occurrence, Surveillance, Research and Training, Manila, Philippines, 23-24 June 2004. The Meeting was aimed at creating and emphasizing awareness among Southeast Asian countries on the implications of the movement of fish pathogens in aquaculture (Lavilla-Pitogo and Nagazawa. 2004). The Meeting was part of the activities under the Regional Fish Disease Project implemented by AQD with funding from the Government of Japan through its Trust Fund Program.

Another example of pathogen transfer in the region is the occurrence of the Koi herpesvirus (KHV), which was detected in Indonesia in early 2002. The region's ornamental fish industry was initially blamed for the transmission of KHV in the region. In response to such issue, SEAFDEC through AQD conducted a study on the mode of transmission of KHV and the pathology of the infected fish under the project on Development of Fish Disease Surveillance System, which comprises phase II of the Regional Fish Disease Project. Nagazawa (2004) reported that KHV is a threat to fish culture especially to the common and koi carps, the culture of which is a major industry in many countries of the region. The spread of KHV in the region has since then been controlled after a devastation of the region's carp industry. The early monitoring of the occurrence of the disease made it possible to control its spread in the region.

Environment Impact Assessment, as discussed in the Regional Guidelines, is a method of analysis which attempts to predict the likely repercussions of a proposed major development (usually industrial) upon the social and physical environment of the surrounding area. Thailand has implemented a simpler method in lieu of a forma environmental impact. Known as Initial Environment Examination for Intensive Marine Shrimp Farms in Thailand, the guidelines aimed to minimize the impact of intensive marine shrimp farms on coastal

environment. This was issued in relation to the Code of Conduct for Marine Shrimp Farming of Thailand (Tookwinas et al, 2000).

Article 9.2: Responsible development of aquaculture, including culture-based fisheries within transboundary aquatic ecosystems

This article contains directives in identifying transboundary ecosystems and in conserving aquatic animal and plant diversity in the transboundary aquatic ecosystems. The article specifically directs the minimization of risks in introducing non-indigenous species for aquaculture where there is a significant risk for spreading into the waters of other countries.

Recent studies have indicated that ballast waters discharged by water crafts and vessels in ports of call can also possibly lead to introduction to some extent of non-native aquatic species. Such introduction could have major ecological consequences affecting aquaculture activities. One of the significant impacts brought about by waters discharged from vessels ballasts include the introduction of dinoflagellates from Southeast Asian countries into Australian waters leading to the occurrence of Paralytic Shellfish Poisoning. A very significant event in the ASEAN commercial aquaculture is the recent introduction of the fast growing white shrimp, *Peneaus vannamei*. Since it has become well known that some countries in the region have already been farming the non-native white shrimp as alternative to the black tiger shrimp, *P. monodon*, SEAFDEC/AQD convened the Regional Technical Consultation on the Aquaculture of *P. vannamei* and other Exotic Shrimps in Southeast Asia in March 2005 with funding provided by the Government of Japan through the Japanese Trust Fund Program, in order to assess the status of *P. vannamei* culture in Southeast Asia.

The Consultation has paved the way for some countries in the region to weigh the benefits versus risks in the culture of the white shrimp. In early 2000s many countries in the region have legislation against the introduction and culture of *P. vannamei* and other exotic shrimp species for fear that they may be carriers of diseases that could be transmitted to native wild penaeid shrimp populations through pond effluents. But other countries had already started to reap economic benefits from the introduction of the white shrimp. Since SEAFDEC did not want to ignore this shift in the preferred shrimp species for farming, it intended to come up with Plan of Action through the Consultation in order that the other countries in the region could be guided accordingly. Thus, it was the consensus of the Regional Consultation that the member countries should follow the international guidelines for the importation of live shrimps and the country-to-country rules and regulations. Since the Plan of Action adopted during the Regional Consultation included strategies in addressing problems and constraints on the introduction of *P. vannamei* and other exotic shrimp species in the region, it was therefore recommended that future shrimp farming activities in the region be based on such Plan of Action in order to attain sustainability in shrimp aquaculture.

The article also directs the countries in the region to establish appropriate mechanisms for quality control and monitoring of all inputs used in aquaculture. This is aptly implemented in the region through SEAFDEC's efforts to promote ecolabelling and traceability. Since these efforts entail a large amount of money, the countries may opt to implement these systems or not. SEAFDEC has been implementing a study on ecolabelling not only for capture fisheries but specifically for aquaculture where there are concerns raised by major fish importing countries whether fish products traded are produced through sustainably managed aquaculture. In a way, ecolabelling is a way of rewarding producers who practice environment-friendly production methods. However, ecolabelling in the region is still voluntary in nature, except for some products and certain countries where producers want to maintain good standards for their products. In voluntary ecolabelling, the producer may also decide whether to seek certification for his product, based on the Codex Guidelines for

Generic Official Certification Formats and the Production and Issuance of Certificates (GAC/GL 38-2001, Rev. 1-2005).

Another system which is used to monitor all inputs used in aquaculture is traceability. Like ecolabelling, traceability is another issue that acts as barriers to trade for fish products. This has been required by EU for foodstuff including fish and fishery products traded in the EU. This system requires that all fish and fishery products should be labeled with information such as whether the fish is farmed or from the wild, the country of origin or catch area. Other information such as inputs used in the culture of the fish or gear used to catch the fish, etc. are also included in the label of the products.

As a major exporter of fish and fishery products to the EU, Thailand has implemented TraceShrimp, a computerized traceability system for the Thai shrimp supply chain "From Farm to Table." It is in this system that the Department of Fisheries of Thailand intensify promotion of its CoC program to the shrimp industry producers in order to get better access to world shrimp market. TraceShrimp covers the whole production line from farm to processing including feed utilization, hatchery and grow-out operations, shrimp collectors/distributors, and processors.

Article 9.3: Use of aquatic genetic resources for the purposes of aquaculture including culture-based fisheries

This article also includes directives on the need to recognize potentially serious impact of introduced species on the local aquatic biodiversity. An initiative of SEAFDEC related to this directive is discussed in the previous paragraph. The article also includes directives related to the formulation of guidelines for the development and use of genetically modified organisms (GMOs) and other products of biotechnology to ensure human safety and environment protection. While R&D works are being implemented by SEAFDEC/AQD to minimize the harmful effects of introduction and propagation of non-native species and biotechnology products, through this Regional Guidelines the countries in the region were already made aware of the need to comply to the ASEAN Guidelines for Risk Assessment of Agriculture-Related Genetically Modified Organisms.

This article also includes directives related to the implementation of the Asian regional Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals (FAO/NACA, 2000). This is also being promoted by SEAFDEC through the Regional Fish Disease Project implemented by AQD.

Article 9.4: Responsible aquaculture at the production level

This article covers the whole aquaculture production continuum, from broodstock development to seeds, grow-out and harvest, and all the inputs used to produce the fish. Platon et. al (2007) provides a summary of the issues and concerns for sustainable aquaculture. Although the summary is for aquaculture in general Platon et al (2007) had the shrimp industry as their target and thus, could be taken as reference for commercial-scale aquaculture. The review includes recommendations on seeds, culture and grow-out, feeds, fish diseases, biotechnology and institutional support.

To summarize this article, it should be noted that the ASEAN region has experienced the success and failures of commercial aquaculture. Shrimp aquaculture as a form of commercial aquaculture has provided protein to the region's peoples directly and indirectly. Directly, shrimp culture is a source of food fish and protein for the people, and indirectly in the form of employment and income for the purchase of food and other necessities. Commercial aquaculture generates jobs in secondary industries such as in the manufacture of farm implements and equipment, and in intensive fish feed production. Since commercial

aquaculture, especially shrimp culture demands a high level of technology and management, it has advanced the development of progressive farming techniques, modern equipment, and other key aquaculture support industries. The whole shrimp farming has been credited for having rapidly advanced the technologies for intensive pond culture, feed milling, hatchery management and value-adding (Samonte-Tan and Cruz, 2006).

In early 1990s. the Philippine shrimp industry, which was in a way, commercial in nature, was the first victim of unsustainable shrimp farming practices. Fueled by the urge to maximize profits rather than long-term enterprise development, the Philippine shrimp farmers were caught in a high-risk venture as their stocks were threatened by serious disease problems. This resulted in many large-scale farms abandoned or closed as these became too costly to re-operate even after the legislation by the Philippines Government to comply farmers to adopt the Code of Conduct for Responsible Aquaculture and the RCCRF of SEAFDEC. Shrimp farmers who opted to re-open their farms are now adopting environment-friendly technologies as evidenced from the large investments that farmers now take to improve the environmental conditions of their ponds as well as the quality of inputs that they use especially seeds and feeds. This leads to the need for imposing regulations in aquaculture especially large-scale or commercial aquaculture.

Many lessons have been learned and technologies have been developed throughout the region from the experience of the Philippines and other countries that were similarly hit by shrimp diseases such as Indonesia and Thailand. In a way, the RCCRF for Responsible Aquaculture aims to regulate aquaculture in order to provide a sustainable environment for its sustainable development. One way of regulating aquaculture is the obligation of acquiring permits to establish an aquaculture farm. The issuance of permits to operate aquaculture farm is one way of eliminating conflicts on land and water uses. The promotion of CoC and GAPs and to some extent farm data gathering could be built-in in the approval of the farm permits. In most countries in the region, a form of environmental impact assessment is required in order that aquaculture operations permit is granted. In some countries, requirement for the provision of data on inputs and production to the government is included as a requirement in the granting of permits. However, data gathering is not fully implemented because of producers concerns on taxation. As a remedy, some countries require information on total production, sales, inputs used, etc. as requirements for renewal of permits.

Regulations are necessary in order that producers would be able to comply with the safety and quality standards and requirements imposed by importing countries. The issues that emerged as new challenge for aquaculture industries include the proposed mandatory requirement for Hazard Analysis and Critical Control Point (HACCP) for consumer information and protection. Although not yet fully implemented in the region, this strategy is discussed in the Regional Guidelines for countries in the region to implement as and when necessary.

There has been an expansion of many requirements brought about by the globalization and liberalization of international fish trade. Although difficult for some countries to comply with, such globalization has created opportunities for developing countries to have greater access in the world market. Given enough time and with proper guidance, there is no question why the countries in the region could eventually comply with the safety standards and other trade issues and requirements.

Beyond the Publication of the Regional Guidelines

In the process of implementing the Regional Guidelines, the Member Countries acknowledged the need for follow-up actions especially at the national level in order for the Regional Guidelines to be fully understood, appreciated and implemented by all stakeholders,

and eventually developing national frameworks for the implementation of the global CCRF. It is at this point that Human Resource Development (HRD) is necessary to support of the implementation of the CCRF. The HRD could include awareness building and training activities, especially on CoC, BMPs, GAPs, as well as on fish trade issues.

Another factor that should be taken into consideration for sustainable commercial aquaculture is the need to strengthen institutional support, as it has a very important role to play in the development and management of aquaculture by providing the structure by which aquaculture related activities are governed (Platon et. al, 2007). Such institutional support should provide mechanisms for the involvement of the private sector, farmers, etc. in the enforcement of laws and regulations applicable to aquaculture. Their recommendations for institutional support include: improvement of quality R&D for aquaculture development; encouraging fish farmers to take greater responsibility in resource conservation; and developing aquaculture plan with the participation of and/or in consultation with all stakeholders.

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STANDARDS FOR GOOD AQUACULTURE PRACTICES (GAP) FOR MARINE SHRIMP FARMING IN THAILAND

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Abstract

Shrimp aquaculture industry has an excellent record for a production of safe products of consistent quality. However, as aquaculture production expanded, the industry and regulatory agencies are reliable to give more awareness to the factors, which may adverse toward the environment and public health.

Under good aquaculture practices (GAPs), aquaculture shrimp can be produced in a proactive responsible manner. GAPs concept can be applied into all steps of farm operations, including pond preparation up to harvest. This approach maximizes a reliance on analytical tests for chemical contaminants and reduces a need for comprehensive inspection of raw aquaculture shrimp prior to processing plant.

Based on identification of potential impacts, applying of control measures under GAPs concept, and periodical monitoring, it enables to obtain the assurance of product safety during a culturing period.

1. Introduction

Shrimp aquaculture industry in Thailand has been developed since mid 1980s. The production increased from 2 million tons in 1986 to 3.3 million tons in 2003 (Fisheries Information Center, 2004). The industry involves 80% small-scale farmers and 20% intensive scale aquaculture. Shrimp becomes a major export commodity as well as major source of economic incomes of people involving in this industry. The success of shrimp aquaculture industry in Thailand is based on, (Tookwinas and Keerativiriyaporn, 2004).

- Suitability of site and climate
- Availability of wild brood stock
- Experience in aquaculture
- Well-established infrastructure and supporting industries.
- Small-scale shrimp farmer cooperation.

Potential impacts of shrimp aquaculture can be identified (Tookwinas et al., 1999)

- Conversion of mangrove and other coastal wetlands to ponds
- Nutrient enrichment and eutrophication of coastal waters by pond effluents
- Discharge of potentially toxic and bio-accumulative chemicals into natural ecosystems
- Sedimentation in coastal waters because of erosion from ponds and other earthen infrastructure
- Salinization of freshwater sources by pond effluents or seepage
- Reduction in biodiversity of coastal ecosystems caused by water pollution, sedimentation, and toxicity of effluents
- Introduction of non-native species or new shrimp diseases into coastal waters
- Competition with other activities for natural resources

2. Good Aquaculture Practices

Good Aquaculture Practices defined here as the practices are thought to be effective, practical, potentially eliminating or reducing environmental and social impacts: GAPs may include farm structural (e.g. a settling basin to remove suspended solids), biological unitization (e.g. wetland plants to remove nutrients in effluent) or farm management (e.g. minimize use of chemicals) to solve a particular problem.

Recently, Shrimp aquaculture in Thailand is conducted over a wide range of coastal environments within of which physical, chemical, and biological conditions and patterns of resource use are different. A flexible system of GAPs has, therefore, been formulated, and then the preferred combinations of GAPs can be used to optimize the operating systems for site-specific conditions in a given – and/or individual farm.

This is the first in a series of operating guidelines and procedures manuals that will be developed for the marine shrimp farming in Thailand. In particular, manuals covering the following sectors have been developed:

Volume 1 - Hatcheries

Volume 2 - Shrimp farms.

3. Operating Manuals for Hatcheries

1) Site Selection

Proper location of a shrimp farm is important to minimize adverse environmental and social impacts and to maximize production rates.

GAPs for site selection are included as:

1.1 Shrimp farm owner should have clear title or right to their property or other legal land concession agreements.

1.2 Hatchery should be easily access to road and having public electricity.

1.3 Water quality should be suitable for shrimp aquaculture, and hatchery should be located far away from pollution sources.

1.4 Farmers should be registered with the local government fisheries agencies.

2) General Management

Good hatchery management helps prevent water pollution, loss of biodiversity, and other negative environmental impacts, and it will improve the efficiency of shrimp fry production.

GAPs for general management are included as:

2.1 Hatchery infrastructure and supplies should be in good condition and can be used very effectively.

2.2 Layout should be made along the technical guidance for marine shrimp hatchery.

2.3 Good quality of water should be maintained for proper use in shrimp fry nursing.

2.4 Nursing pond and related equipments should be routinely kept clean by the appropriate methods.

2.5 Spawners and nauplii should be healthful checked before breeding and nursing, respectively.

3) Feed management

Good quality of feed and management with care are essential for efficient shrimp fry production. As using high quality feeds with reasonable quantities of both artificial and live feed, water quality in nursing pond is protected and reduces stress on shrimp as well as less

likelihood of disease. These practices also improve a feed conversion ratio and minimize feed cost.

GAPs for feed management are included as.

3.1 Farmers should use only registered feed, in fresh and not store for more than a few months.

3.2 Farmers should select method for the best efficiency of feeding

3.3 Live feed should be fed to a suitable age of larvae with an appropriate feed management.

3.4 Farmers must use only registered premix, probiotics and other additional artificial diets altogether with an appropriate management.

4) Shrimp fry health management

GAPs recognize shrimp health management that a stress reduction through a better handling, reasonable stocking density, good nutritional management, and maintenance of optimal environmental conditions in shrimp ponds can prevent most infections and non-infections diseases. Treatment should be under taken only when a specific disease has been diagnosed and it is known that this disease is treatable. In addition, effective measures must be taken to minimize the spread out of disease between hatchery's and natural stock.

GAPs for shrimp fry health management are included as:

4.1 Shrimp fry health monitoring should be daily done. When a disease occurred, a proper diagnosis should be made. The preventive measures for disease outbreak should be taken in places.

4.2 Only registered antibiotics and chemical substances should be applied when necessary.

5) Hatchery sanitation

Good management is a key point for hatchery sanitation. This will lead to the achievement of GAPs and get optimum production. Hatchery owner should have a very clear policy and a transparency of action plan for hatchery sanitation.

GAPs for hatchery sanitation are included as:

5.1 Infrastructure(pond and storage etc) should be cleaned and sanitized. Garbage and other farm wastes should be properly managed.

5.2 Feed and other materials should be properly kept and prevented from rat and other animals.

5.3 Sanitary facilities for disposal of human wastes and other health facilities should be provided separately and avoid to be contaminated into culturing pond.

5.4 The drainage for hatchery and house should be completely separated.

5.5 Total coliform and fecal coliform should be routinely checked and their amount should not be over the standard criteria.

6) Harvesting and shrimp fry transportation

Shrimp fry harvesting should be planned. The fry should be filled in the suitable density and preferably transported in certain distance with an appropriate technique and care of health. The farmer would be required for preparing the movement document of harvested shrimp fry (FMD).

7) Data recording

Data collection on the earlier topics and hatchery records should be done. Shrimp aquaculture affiliates/associations are required to cooperate with the Department of Fisheries in order to collect, organize, and evaluate the available data to demonstrate the adoption of GAPs and documented the benefit of using GAPs.

4. Operating Manuals for Shrimp Farms

1) Site Selection

GAPs for site selection are included as:

1.1 Farmer should be registered with the local Fisheries agencies.

1.2 Farm should be easily accessed to road and have public electricity

1.3 Water and soil qualities should be suitable for shrimp culture and farm should be located far away from pollution sources.

2) General farm management

GAPs for general farm management are included as:

2.1 Farm infrastructure and materials should be in good condition and can be used effectively.

2.2 Farm layout should be made along the technical guidance -of a particular shrimp farm.

2.3 Seawater and pond bottom preparation should be well managed before stocking of shrimp fry.

2.4 Good shrimp health management should be practiced.

2.5 Aerators should be proper positioned and operated efficiently to minimize soil erosion and creation of sediment mounds on pond bottoms.

3) Feed management

GAPs for feed management are included as:

3.1 Farmer should use only registered feed, in fresh condition and not store for over a few months.

3.2 Feed should be kept in ventilated storage, not wet and leakage. The storage should be in good condition.

3.3 Farmer should select method for the best efficiency for feeding.

3.4 Premix, probiotics and other additional artificial diets should be only used which are registered and have the appropriate management.

4) Shrimp health management

GAPs for shrimp health management are included as:

4.1 Water quality evaluation and management should be implemented to avoid stress of shrimp, but when stressful conditions are observed, shrimp should be checked for disease.

4.2 When problem of shrimp healthoccurred, a proper diagnosis should be made. The preventive measures for disease outbreak should be taken in place.

4.3 Only registered antibiotics and chemical substances should be applied when necessary.

5) Farm sanitation

GAPs for farm sanitation are includes as:

5.1 Garbage and other farm wastes should be managed by acceptable methods.

5.2 Storage for farm materials should be kept clean, sanitized, and prevented from rat and other carrier animals.

5.3 Sanitary facilities should be provided and prevented to contaminate into seawater in pond.

5.4 Total coliform and fecal colifrom should be routinely checked and the number should not be over the standard criteria.

6) Harvesting and culture shrimp transportation

GAPs for harvesting and culture shrimp transportation are included as:

6.1 Harvesting of cultured shrimp should be planned and practices in good manner of production freshness and sanitation.

6.2 Cultured shrimp should be checked for residue of antibiotic before harvested.

6.3 Farmer would be required to prepare for issuing a movement document (MD) of harvested shrimp.

7) Data collection

Data collection on the earlier topics and farm accounts should be done. Shrimp farming associations should cooperate with the Department of Fisheries to collect, organize, and evaluate all available data to demonstrate the adoption of GAPs and documented the benefits of using GAPs.

5. Conclusion

The implementation of GAPs for marine shrimp certification has been firstly done in Thailand since late 2002. The steps of work are following farm registration, training and farm improvement. Then, farm auditing would be done for GAPs certification. At present, about 18,000 marine shrimp farmers, or 72% out of totally 25,000 farmers, have been certified under GAPs criteria. In the year 2005, the target of more than 90 percent of farmers will be expected to be partly of GAPs certification. The main purpose is to for the safety product of local consumption and exporting.

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MARINE SHRIMP CULTURE INDUSTRY OF THAILAND; Code of Conduct (CoC) FOR SHRIMP FARMS

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1. Code of Conduct

The marine shrimp industry in Thailand has developed a code of conduct for its operations. This code of conduct is a set of principles and processes that provides a framework to meet the industry's goal for environmental, social, and economic responsibility. The foundation of the code of conduct is the following mission statement:

The marine shrimp farming industry in Thailand is committed to producing high quality, hygienic products in a sustainable manner that provides for environmental, social, and economic benefits to present and future generations.

Policy statements have been formulated to outline actions that the industry will undertake to meet is commitments under the mission statement. These policy statements cover a broad range of topics, including:

Environmental protection	Public consultation
Regulatory compliance	Location
Quality and safety	Continual improvement
Efficiency	Research and development
Social responsibility	Monitoring and auditing
Education and training	International trade

The code of conduct is voluntary, but it has been signed by a wide variety of industry stakeholders. The code commits the signatories to specific actions, including the development of a series of operating guidelines and procedures manuals. These actions will aid the industry in carrying out its operations in a manner consistent with the intent of the code of conduct.

2. Operating Guideline and Procedures Manuals

This is the first in a series of operating guidelines and procedures manuals that will be developed for the marine shrimp culture industry of Thailand. In particular, manuals covering the following sectors of the industry will be developed:

Volume 1 - Shrimp Farms
Volume 2 - Hatcheries and Broodstock Capture
Volume 3 - Processing Facilities
Volume 4 - Feeds and Chemical Suppliers

The objective of the operating guidelines and procedures manuals is to establish a consistent approach to industry operations through establishment of good management practices or GMPs. It is anticipated that implementation of these GMPs, will enable the industry to operate in a sustainable manner.

3. Good Management Practices

Good management practices are defined here as practices that are thought to be effective, yet practical, in eliminating or reducing environmental and social impacts. GMPs may include structural (e.g., a settling basin to remove suspended solids), biological (e.g., wetland plants to remove nutrients in effluent) or management practices (e.g., minimize use of chemicals) to solve a particular problem.

A single GMP seldom solves a problem; rather a system of GMPs is normally required to prevent a particular type of farming or other activity from causing negative impacts. Therefore, for an activity such as shrimp farming, a system based on GMPs requires identification of potential impacts (environmental and social) and the installation of GMPs to prevent or mitigate the possible impacts.

Shrimp farming in Thailand is conducted over a wide range of coastal environments within which physical, chemical, and biological conditions and resource use patterns differ. A flexible system of GMPs has therefore been formulated, and selected combinations of GMPs can then be used to optimize the operating systems for site-specific conditions in a given area and on individual farms.

4. Potential Impacts of Shrimp Farms

As noted above, the first step in developing GMPs is to identify the key impacts that need to be addressed. Shrimp farming is a comparatively new activity, but possible impacts associated with operating shrimp farms are well known and include :

- Conversion of mangrove and other coastal wetlands to ponds
- Nutrient enrichment and eutrophication of coastal waters by pond effluents
- Discharge of potentially toxic and bioaccumlative chemicals into natural ecosystems
- Sedimentation in coastal waters because of erosion from ponds and other earthen infrastructure
- Salinization of freshwater sources by pond effluents or seepage
- Reduction in biodiversity of coastal ecosystems caused by water pollution, sedimentation, and toxicity of effluents
- Introduction of non-native species or new shrimp diseases into coastal waters
- Competition with other activities for natural resources
- Land use disputes

5. Operating Guidelines and Procedures for Shrimp Farms

This manual was developed with the input from international and national experts on shrimp farming operations and was reviewed by shrimp farmers at a series of regional workshops held in Thailand in February 1999.

GMPs are provided to eliminate or minimize the negative environmental impacts listed above. The following sections of the manual discuss general guidelines for shrimp farm operations, specific procedures for implementing these guidelines, and a series of checklists and record keeping forms for farm management.

6. Operating Guidelines

1) Site Selection for New Shrimp Farms

Proper location of a shrimp farm is important to minimizing adverse environmental and social impacts and in maximizing production rates.

GMPs for site selection includes :

1.1. The shrimp farm owner should have clear title or right to their property or other, legal land concession agreements.

1.2 All stakeholders should be involved in area zoning for shrimp farming.

1.3 The carrying capacity of an area would be determined in order to prevent too many shrimp farms in one place.

1.4 The water and soil quality should be suitable for shrimp farming and farms should be located far away from pollution sources.

1.5 Farmers should register with the appropriate government agencies.

2) General Pond Management

Good pond management helps prevent water pollution, loss of biodiversity, and other negative environmental impacts, and it will improve the efficiency of shrimp production.

GMPs for pond management include:

2.1 Good water quality should be maintained by using stocking and feeding rates that do not exceed the assimilative capacity of the culture system and by using high quality feeds and good feeding practices.

2.2 Water exchange should be reduced as much as possible.

2.3 Fertilizers, liming materials, and all other chemicals should be used in a responsible manner and only as needed.

2.4 Good shrimp health management should be used.

2.5 Aerators should be positioned and operated to minimize erosion and creation of sediment mounds in pond bottoms.

2.6 Water inlets and outlet to ponds should be screened to prevent entrance of competitors and release of culture species.

2.7 Predator control methods that do not require destruction of ecologically important species in receiving water should be used.

3) Stocking Density

Stocking density is an important consideration in shrimp farming because the amount of feed needed to culture shrimp to market size increases in direct proportion to the stocking density. As feeding rates increase, water and soil quality in ponds tends to deteriorate. Ponds with high stocking rates tend to have poorer water quality than ponds stocked at moderate density. Impaired water quality stresses shrimp and reduces the efficiency with which they convert feed to shrimp flesh. This results in increased feed cost. Stress also can lead to a greater incidence of disease. Effluents from ponds with excessive stocking and feeding rates

are of lower quality and have a greater potential to cause water pollution than effluents from ponds stocked at more reasonable rates.

GMPs for optimizing stocking density include :

3.1 Stocking densities should be based on anticipated survival, desired size at harvest, and carrying capacity of ponds.

3.2 The size and age of shrimp fry should be considered.

4) Feed management

Feed is the basis for high levels of shrimp production in intensive shrimp culture ponds. However, shrimp do not eat all of the feed provided to them, and only a portion of the feed consumed is converted to shrimp flesh. Uneaten feed, feces, and metabolic wastes enter ponds and serve as nutrients for phytoplankton. Ammonia excreted into pond water by shrimp can reach toxic concentrations. As feeding rates increase, water quality and soil quality in ponds usually deteriorates.

Good feed quality and careful feed management are essential ingredients for efficient shrimp culture. By using high quality feeds in reasonable quantities, water and soil quality in ponds is protected. This reduces stress on shrimp, there is less likelihood of disease, and they convert feed more efficiently to improve the feed conversion ratio and minimize feed costs. Better water quality in ponds allows a higher quality effluent and reduces the possibility for negative environmental impacts in receiving water bodies.

GMPs for feed management include.

4.1 Feed should be purchased fresh and not stored for more than a few months.

4.2 Feed should be stored in cool and dry areas.

4.3 Feed management practices should be implemented to assure the shrimp consume the feed as completely as possible

4.4 Medicated feed should be used only if necessary for the control of a specific diagnosis of disease.

4.5 Cut fish should not be used as shrimp feed, but if it is, care should be taken to prevent overfeeding.

4.6 Pond managers should keep careful records of daily feed application rates so that feed conversion ratio (FCR) can be assessed.

5) Shrimp Health Management

Authorities on shrimp health management recognize that stress reduction through better handling, reasonable stocking densities, good nutrition, and optimal environmental conditions in ponds can prevent most infectious and non-infectious diseases. Treatment should be undertaken only when a specific disease has been diagnosed and it is known that this disease is treatable. Also, effective measures must be taken to minimize the spread of disease between farm stocks and natural stocks.

GMPs for shrimp health management include.

5.1 Water quality evaluation and management should be implemented to avoid stressing shrimp, but when stressful conditions are observed, shrimp should be checked for disease.

5.2 For non-infectious diseases related to pond conditions, carry out the best option for disease treatment or for correcting pond conditions.

5.3 For infectious diseases that may spread widely, isolate the pond, net harvest remaining shrimp, and disinfect the pond before discharging water.

6) Therapeutic Agents and Other Chemicals

There is considerable use of therapeutic agents and other chemicals in shrimp culture in Thailand. Some of the chemicals can be toxic to shrimp or accumulate in the flesh of shrimp and represent a potential hazard to the consumer. Also, some chemicals may exist in effluents as residues and be harmful to natural aquatic ecosystems. Reducing the use of these agents and chemicals will improve environment performance but also reduce cost of operating shrimp farms. Shrimp health management should focus on disease prevention through good nutrition, sound pond management, and overall stress reduction rather than disease treatment

GMPs for safe use of therapeutic agents and other chemicals include:

6.1 Shrimp farmers should follow reliable information regarding dosage, withdrawal period, proper use, storage, disposal, and other constraints on the use of a chemical including environmental and human safety precautions.

6.2 When potentially toxic or bioacumulative chemicals are used in ponds, waters should not be discharged until compounds have naturally decomposed to non-toxic form.

6.3 Careful records should be maintained regarding use of chemicals in ponds.

6.4 Store therapeutants in a cool place and in a secure manner where they will be inaccessible to unauthorized personnel, children, and animals. Dispose of unused compounds by methods that prevent environmental contamination.

6.5 Drug, antibiotic, and other chemical treatments should be done in accordance with recommended practices and comply with all national and international regulations.

7) Effluent and Solid Waste Management

Pond effluents often contain elevated concentrations of nutrients, biochemical oxygen demand, suspended solids, and possibly other potential pollutants. Pond management GMPs outlined previously can help improve effluent quality and reduce effluent volume. Effluent quality can be further improved by alterations of the discharge infrastructure and by the timing and manner of final discharge. Shrimp farms also generate solid wastes that should be disposed of in a manner that does not damage aquatic or terrestrial ecosystems.

GMPs for effluent and solid waste management include:

7.1 Canals and embankments should be maintained in a manner to reduce erosion of above water portions.

7.2 Minimize water exchange to the extent feasible.

7.3 Use efficient fertilization and feeding practices to promote natural primary

productivity while minimizing nutrient inputs.

7.4 Store and use fuels, feeds, and other products in a responsible manner to avoid accidental spills that could contaminate water. An emergency plan should be made for containing accidental spills

7.5 The effluent should be treated before discharging if it does not comply with existing standards.

7.6 Ponds should be drained in a manner to minimize resuspension of sediment and prevent excessive water velocities in canals and at effluent outfalls.

7.7 Design outfalls so that no significant impacts of effluents on natural waters occur beyond the mixing zone.

7.8 Shrimp pond effluents should not be discharged into freshwater areas or onto agricultural land.

7.9 Sediment from ponds, canals, or settling basins should be put back into areas from which it was eroded, used as earthfill, or disposed in some other environmentally-responsible way.

7.10 Sanitary facilities for disposal of human wastes and other health facilities should be provided.

7.11 Garbage and other farm wastes should be managed by acceptable methods.

7.12 Shrimp farms should comply with existing governmental regulations related to effluents and other wastes.

7.13 Managers should routinely evaluate waste management procedures and continually attempt to improve them.

8) Social Responsibility

Sometimes, conflicts arise between shrimp farmer and others who either live in the coastal zone or depend upon coastal zone resources for their livelihood. Shrimp farmers also employ people, and conflicts may arise over various employee-employer relationships. Public relations and employee welfare are complex issues, but general guidelines presented in the GMPs will be useful in enhancing the prospects of harmonious interactions among large shrimp farming companies, worker, and the local community. In Thailand there are many small shrimp farmers in addition to large company-operated farms, and many of the issues related to community relations will be addressed through other sectors of the industry, such as government regulations and shrimp farming associations.

GMPs for improving community relations include:

8.1 Shrimp farmers or associations should communicate with community leaders. This is particularly important in the planning stages for new farms or expansions.

8.2 Shrimp farmers or associations should attempt to accommodate traditional uses of coastal resources and encourage mangrove replantation activities through a cooperative attitude towards established local interests and environmental stewardship.

8.3 Shrimp farmers or associations should contribute to community efforts to improve local environmental conditions, public health and safety, and education.

8.4 Local workers should be employed as possible, and they should be fairly

compensated with respect to local wage scales.

8.5 Healthy and safe living and working conditions should be provided.

8.6 Shrimp farm management should have clearly-defined and posted security

policies.

8.7 Employees should have a clear understanding of their duties and of company expectations regarding their performance.

9) Farmer Associations and Education

Shrimp farmers should form cooperatives or associations by region in order to exchange technology and to achieve cooperation in water use and waste management. Shrimp culture techniques are also constantly improving, and it is important that shrimp operators continue to increase their knowledge of sustainable farming techniques.

GMPs for farmer association and education include :

9.1 Farmer associations should be encouraged. Meetings among members should be routinely held for exchanging information on shrimp culture.

9.2 The farmers would participate in training in the aspects of shrimp farm management, in the manner of friendly environment practices, and for law and regulation for shrimp culture industry.

9.3 The associations should promote “environmentally-friendly” practices.

10) Data collection

Data collection on the above topics and farm accounts should be done. Shrimp farming associations should cooperate with the Department of Fisheries to collect, organize, and evaluate data to demonstrate the adoption of GMPs and document the benefits of their use.