Start development of community Biosecure aquaculture zones in 2 communes of Vietnam

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Abstract

The main goal of safe aquaculture is responsible and sustainable production which is safe for the consumer and maintains environmental integrity. The purpose of a safe aquaculture zone is to create a cluster of farms within a defined boundary where biosecurity and safe aquaculture practices are undertaken.

A review and analysis of all the Better Management Practices available on the NACA web site was undertaken and those applicable to safe aquaculture practice were consolidated into one document.

An assessment of the main biosecurity risks was undertaken and recommendations made for addressing these risks at different stages of the culture process

- the planning stage,
- pre-stocking stage,
- pond operational stage

The implementation of safe aquaculture zones will take some time and is a step by step process. The implementation of safe aquaculture in two communities was undertaken in order to find out the operational issues and practical difficulties for the farmers to implement the concept.

The methodology for this activity was to select two case study areas of around 100 ha with 50 households in each commune that was selected under SUDA Activity 1.4.9. In these two areas, the model for safe aquaculture zone was developed. All households in the area were interviewed in detail to establish present practice and productivity levels. All ponds in the area were mapped using GPS and the data entered into GIS using Google Earth. This allowed the water flow system, that is, the water supply to the ponds and effluent from the ponds, to be understood in order to minimise risk of self pollution and risk from introduction of disease through the water system.

Better Management Practices (BMPs) were analysed for enhancing safe aquaculture practice and detailed interviews made with the selected households to establish which BMPs could be practically implemented that the farmer can afford. All households in the selected safe zone were then given training in safe aquaculture practice. A safe aquaculture zone committee was established with representatives from the commune, cooperative, farmers, extension officers, and unions. This committee was encouraged to plan, manage and monitor the safe aquaculture zone development.

Within the chosen area nine ponds were selected for the safe aquaculture practice and to be monitored closely. These ponds were monitored daily over the entire production season in using the following areas

- Disease
- Water quality
- Feed and feeding
- Productivity
- Pond management

At the end of the culture period, the results were analysed and disease outbreaks compared between the selected ponds, the remaining ponds in the safe area, ponds outside the safe area and the previous pond production (from the farmer interviews undertaken at the start of the activity.

Some limited support was made available to the selected farmers to implement the safe aquaculture practice. This included

- Cost of disease testing for the post larvae (PLs) in the hatchery before purchase
- Nursing of the PLs in a common nursery pond
- Cost of disease testing for the PLs in the nursery before stocking in the grow-out ponds
- Disinfection of pond soil and water before stocking PLs
- Crab and shrimp prevention nets on the intake water supply
- Crab traps on the pond walls.

At the end of the production period, the production results and safe aquaculture practices implemented were analysed and the safe aquaculture practices reviewed and improved for implementation in new safe aquaculture areas.

A series of recommendations were then prepared based on the experience of starting to implement safe aquaculture in the two communities. A number of follow on activities were also identified

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- Ngo Van Tuan - Evaluating the quality of fingerling of P.monodon in Thua Thien Hue and Da Nang province.

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1. Introduction

The project aims were to start development of community safe aquaculture areas in two communes in the provinces of Ca Mau and Hue. The activity was undertaken by Patrick White and Pedro Bueno, Aquamarine Ltd and Dr. Nguyen Quang Linh and Mr. Nguyen Ngoc Phuoc Faculty of Fisheries, Hue University of Agriculture and Forestry. Translations from English to Vietnamese and visa versa were undertaken by Nguyen Q. Linh.

1.1 Safe aquaculture

Safe aquaculture has yet to be fully defined. It can mean different things to different stakeholders. The common denominator is a product that is safe to consume.

- Seafood consumers want to have an assurance that the product is safe to eat.
- Retailers have a responsibility to provide high quality seafood
- Processors should follow Hazard Analysis and Critical Control Point (HACCP) guidelines to ensure that their products are safe for human consumption.
- At the farm site, farmers need to know what practices decrease or increase the risk of a disease outbreak occurring.
- The environment is not polluted by aquaculture or other activities, particularly with chemicals and drugs (Safe environment)

According to the regulation on safe shrimp culturing zone and shrimp farm management (Issued in compliance with the Decision No 06/2006/QD-BTS on 10/04/2006 by the Minister of Fisheries) the definitions on safe farms, zones and management are as follows;

Safe shrimp farm is a farm/facility applying GAP or CoC and certified by an authorized body such as a GAP or CoC farm/facility with a corresponding certificate (so-called Safe Shrimp Farm Certificate)

Safe shrimp culturing zone is a zone consisting of 100% of the shrimp farms applying GAP or CoC, and at least 80% of those have the Safe Shrimp Farm Certificate and certified by an authorized body as a GAP or CoC with a corresponding certificate (so-called Safe Shrimp Culturing zone Certificate)

Safe shrimp culturing zone and shrimp farm management are activities of guidance, development and maintenance of as well as monitoring and certification of safe shrimp culturing zones and shrimp farms.

1.2 Goals

The main goal of safe aquaculture is responsible and sustainable production which is safe for the consumer and maintains environmental integrity. The purpose of the safe aquaculture zones is to create a cluster of farms within a defined boundary where safe aquaculture practices are undertaken.

These goals can be achieved by

- Minimising the outbreak and spread of shrimp diseases.
- Breaking the disease cycle, usually by fallowing
- Establishing physical or natural buffers between zones
- Reducing the hazards (chemicals, antibiotics and organic pollution) on the environment.
- Controlling of risks (water supply, feed, utilization of chemicals and antibiotics) to shrimp quality and food safety.

- Improving farm productivity by controlling the quality of seed, water quality and practices of integrated pond management.
- Introduction of co-management with the participation of local farmers through the participatory approach to and co-management of the safe shrimp culture.

This can be implemented in the different stages of farm development and production

Design
- Good site selection
- Good site layout to include water supply treatment and effluent treatment
- Good pond design

Operation
- Good biosecurity measures taken by the hatchery supplier and farms within the zone
- Good aquaculture practices for the hatchery supplier and farms within the zone
- Good practices for manufacture of home made feeds
- Good feeding practice
- Responsible use of drugs and chemicals that are not banned

Post harvest
- Good practices for harvesting, handling and transport, and marketing
- Good management practices and HACCP controls for processing plants

Safe aquaculture zones were initiated under the Decree No. 43/2003/ND management areas and facilities for shrimp safety (See annex 1). Safe area management is a combination of Better Management Practices (BMPs), Good Aquaculture Practice (GAPs) and Responsible practices (Following the FAO Guidelines for responsible aquaculture).

The development of safe aquaculture zones should ensure the following
- Safer from disease
- Safer for the environment
- Safer shrimp to eat
- Safer profits for the farmer

The development of safe aquaculture zones relies primarily on establishing good biosecurity within the selected zone to reduce the risk of disease introduction, outbreak, or spread.

For this, there needs to be control of
- Water supply and quality
- Disease carriers (wild shrimp and crabs)
- Disease free post larvae
- Shrimp feed (reduction or non-use of home made feed)

This will be enhanced by the application of a better management practice such as Good Aquaculture Practice (GAP) or Code of Conduct (CoC) for
- Pond preparation
- Seed quality and stocking
- Good feeding and feeding
- Good water management
- Good pond management
- No use of banned chemicals

2. Background

Brackishwater Shrimp

Black tiger shrimp (*Penaeus monodon*) is an important species in the aquaculture industry in Vietnam and is mainly cultured in the coastal provinces. There are a number of different culture systems ranging from earthen-pond shrimp farming, rice-shrimp farming, mangrove-shrimp farming, at various levels of stocking density i.e. intensive to semi-intensive, improved extensive and extensive farming. Brackish shrimp pond area has increased from 210,448 ha in 1999 to 604,479 ha in 2005 with a yearly average increase of over 30 percent. Shrimp farming is mainly practiced in the Mekong River Delta and accounts for 88.5 % of the total production area. In parallel with an increasing shrimp farming pond area, there has been an increase in shrimp production from 63,664 tonnes in 1999 to 324,680 tonnes in 2005 of which 89.3 % comes from black tiger shrimp.

The government has understood the increasing risks from increasing production intensity. As the area of intensive farming systems expands, the risks of water pollution, outbreak of diseases, and compromised product quality and safety also increase. To address this, the Government has introduced safe aquaculture zones. These are areas where there are control systems to manage quality of seeds, rearing procedure, and use of allowed chemicals and antibiotics supported by Better Management Practices (BMP) such as Code of Conduct (CoC)) and Good Aquaculture Practice (GAP).

The key terms for the regulation on inspection and recognition of sustainable-oriented aquaculture are explained as follows:

1. **Better Management Practices** (BMP) shall be practice norms applied to the aquaculture conducted in farming units in order to ensure the food safety and reduce the disease epidemic and environmental pollution.
2. **Good Aquaculture Practices** (GaqP) shall be the practices applied to the aquaculture to ensure the provision of safe food and reduce the disease epidemic and environmental pollution.
3. **Code of Conduct for Responsible Aquaculture** (CoC) shall be a body of practices in aquaculture to ensure the provision of safe food, reduce disease epidemic and environmental pollution not affecting the ecosystem and ensure socially responsible practice.

2.1 Previous initiatives in Vietnam

A number of initiatives have been introduced in Vietnam to support responsible and sustainable aquaculture development and to meet requirements of food quality and safety assurance of the international as well as domestic markets.

Organic shrimp farming in Vietnam

Organic aquaculture was introduced to Vietnam in 1999 as one of the ways for the development of sustainable and responsible aquaculture. The first organic farming system of tiger shrimp was undertaken in Ca Mau as part of the SIPPO & MOFI project (2003-2006). One of the requirements for the farming system is that 70 percent of the total farm area must be covered with mangrove. The first batch of organic shrimp was exported to Europe in 2002 with a premium price that was 20 percent higher than the market prices.

Environment-Friendly Aquaculture

Extensive and improved extensive shrimp farming occupies 90 percent of the total shrimp farming area. Extensive shrimp farming in very large ponds of up to hundreds of hectares with low-stocking density, little artificial feed and without chemical treatment, is considered as environment-friendly aquaculture that reduces the impact of farming on the environment and produces better quality shrimp.

Other culture practices considered environmentally friendly include

- Rice-fish culture, which has become a traditional activity of the farmers in the Mekong River Delta, especially in the unflooded or controlled flooding areas
- The culture of mud-crab in mangrove farming system

Improved feed quality
Good feed quality and correct feeding practices are important for the production of high quality product, good productivity and low impact on the environment. Feed costs can account for the major proportion of the operating cost. The government has set quality standards for aquatic animal feed for the different life stages of freshwater fish, giant freshwater prawn and marine shrimp.

Improved Management Practices
In parallel with environmentally friendly aquaculture technologies, the government is encouraging the use of Good Aquaculture Practices (GAP) and Code of Conduct (CoC) or Better Management Practices (BMP) to help in producing safe and high-quality aquaculture foods. These have been introduced to farmers in several coastal provinces, especially to those involved in shrimp farming and river-catfish (*Pangasius* sp) culture.

2.2 Principles for safe aquaculture zone

A series of guidelines have been prepared by the government which cover the following aspects of culture (Phillips SUDA 3.5.5.).

Better management practices (BMP)
Better management practices (BMP) for black tiger (*Penaeus monodon*) and white leg (*Penaeus vannamei*) shrimp farming:

- Farm location/siting
- Design and construction of farms and farming zones
- Equipment, tools and staff
- Pond preparation
- Seed selection and stocking
- Veterinary medicine, products used for pond improvement and treatment
- Feeding and feed management
- Pond water management
- Animal health management
- Harvest and shrimp preservation
- Waste management
- Management profile

Good Aquaculture Practice (GAP)
Good Aquaculture Practice (GAP) for black tiger (*Penaeus monodon*) and white leg (*Penaeus vannamei*) shrimp farming includes the requirements as specified in BMP plus some additional requirements as follows.

Farm and farming zone location:

- Design and construction of shrimp farm and farming zone:
- Sludge collection and influent and effluent treatment areas, house, toilets and discharge should be separated from water sources, water supply, settlement pond and growing ponds.
- Settlement pond for inlet water before supply to growing ponds; the area ratio of settlement pond to influent treatment pond must be suitable to the grow-out pond area.

- Sludge settlement and treatment areas must have sufficient capacity for the whole grow-out pond area. Channel and grow-out ponds must be designed and embanked regularly to prevent infiltration, erosion and exclusion of predators.

Shrimp health requirements:

- Measures to prevent predators entering grow-out ponds and regular cleaning of dykes and water supply canals.
- Controlling the entrance of people into grow-out pond areas to prevent contamination with shrimp pathogens. Transportation equipment cleaned and disinfected before moving between ponds.
- Workers cleaned and disinfected before moving from one pond to another.
- Designated staff member responsible for monitoring shrimp disease and measures in place to prevent disease infection.
- Each grow-out pond with its own tools and equipment, disinfected before and after use
- Shrimp farm effluent must meet the government quality standards/criteria before being discharged to the outside environment.
- Sludge must be transported to specially designated areas without leakage, spillage or causing pollution to shrimp growing ponds and surrounding areas.

In 2003, a case study project for the application of GAP in black tiger shrimp culture was carried out in Ben Tre province. In 2004 another project started "Application of GAP for sustainable development of shrimp culture in Vietnam" (2004-2006). Their findings were also implemented by NAFIQAVED with the objectives of supplying cultured shrimp compatible with food safety requirements of international as well as domestic markets and of reducing the risks of shrimp disease outbreaks and environmental pollution.

Code of Conduct (COC)

Code of Conduct (COC) for Black Tiger and White leg shrimps farming include all the GAP requirements plus some additional requirements for environmental and social responsibility as follows:

- Shrimp farms and farming zone location must not impact mangrove forests, sensitive ecosystems or other wetlands.
- Requirements for design, construction for shrimp farms and farming zones:
- Design and construction must include repair of any damage done to natural ecosystems; maintaining buffer zones and ecological areas between shrimp farms, farming zones and surrounding areas;
- No destruction of aquatic resources, mangrove forest etc.;
- No siltation of surrounding areas during construction and operation of shrimp farms;
- No influencing water current;
- No causing water pollution.
- Social responsibility requirements:
    - Preferential use of local labour;
    - Ensure benefits accrue to local communities and other sectors;
    - Contribute to welfare of communities to improve environment, health care, security and education;
    - Raising community awareness, sharing information and farming experiences.

The implementation of the Code of Conduct of shrimp aquaculture is part of the requirements for the establishment and management of safe aquaculture zones

Shrimp farmer clubs
Co-management by farmers is an appropriate approach for improvement of management practices of the aquaculture area; it would help reduce risks in terms of diseases and environmental impacts. In 2004, a shrimp farmer club was set up in Soc Trang province to encourage co-management of water quality, health management, to improve the awareness of fisheries regulations related to environment protection, food safety, and set up the action plan for their activities and monthly monitoring. Fish and shrimp farmer clubs have been successful in a number of other countries in the region.

3. BMPs implemented in other Asian countries

This is a short overview of the nature and results of studies and pilot projects on the development and implementation of best management practices in shrimp aquaculture. Examples for this review come from a global study on shrimp aquaculture and the environment and from pilot projects in India, Indonesia, Thailand and Vietnam. In all of these NACA was a collaborating organization.

An analysis of case studies in countries of Africa, Asia-Pacific and Latin America, under the Shrimp Farming and the Environment Consortium of FAO, NACA, World Bank, WWF and UNEP, found that 8-10 activities cause the most impacts on farms and there were usually 3-5 impacts per farm; BMPs reduce impacts to acceptable levels; most BMPs pay for themselves within 2-3 years; social-oriented BMPs are important to reduce impacts and increase profit; one important barrier to adopting BMPs is lack of information, another is no profitability without the BMP; better managed operations have better returns and fewer impacts; and regulations usually encourage mere compliance rather than stimulate innovation among farmers.

The experiences in India, Vietnam, Thailand and Indonesia collectively show that well-designed and implemented BMPs can support farmers to increase efficiency and productivity by reducing the risk of shrimp health problems, reduce the impacts of farming on the environment, improve food safety and quality of shrimp farm product, and improve the social benefits from shrimp farming.

What follows are highlights of the results of the country pilot projects.

3.1 Nature and outcomes of projects

3.1.1 India

A 5- year pilot project that began with health management as its focus and expanded into a community development type project that had BMP development and farmer's organization as its major activities found that adoption by farmer groups of BMPs:

- Reduced disease and increased the likelihood of planned (normal) harvests rather than emergency or early harvests. The incidence of disease in demonstration ponds decreased by 67% from 82% in 2003 to 15% in 2005.
- Obviously, a successful crop tended to improve profits. Fewer disease incidences and less damage from disease improved profits from a successful crop.
- BMP farms used no antibiotics and used chemicals sparingly, because the BMP encouraged farmers to prevent rather than treat diseases
- BMP and cluster farming enabled better traceability of shrimp.
- BMP adoption by organized farmers increased co-operation among them and between their clubs and other players in the market chain. The desirable social aspects from Aquaclub formation and their adoption of BMPs included: more opportunities for mutual help, helping disadvantaged farmers; a regular information and knowledge sharing on BPMs by members of the group; cooperation in buying at competitive prices high quality farm inputs (seed, feed, lime etc) It also enabled

a stronger bargaining power in the purchase of farm inputs and sale of harvest. There was better co-operation in sharing common facilities and in area improvements such as deepening of inlets and unclogging the drains, and a collective approach to dealing with common problems such as maintenance and protection of common water sources.

- Better co-operation between farmers and hatchery operators. Under the contract hatchery system, Aquaclub farmers were able to place bulk orders to a hatchery, 45-60 days in advance of the stocking date, for production of required quantity and quality of seeds.
- Increased interaction between farmers and processors. Some of the processing plants in India are well equipped to maintain very high quality standards of processing in accordance with international market requirements. Processors and farmers working together to improve harvest and post harvest practices increased the quality of shrimp supplied to the processing plants.
- The BMPs, which were developed by experts working with the farmers, contained nine specific practices:
  - Pond preparation
  - Seed quality
  - Water quality
  - Feed management
  - Pond bottom management
  - Health management
  - Harvesting
  - Emergency harvesting
  - Mangrove maintenance and replanting

It is important to note that the BMP farmers were supported by a range of purposely designed technical services from government, academic, industry and NGO sectors as well as from international assistance agencies.

3.1.2 Indonesia (Aceh)

Post tsunami rehabilitation programs in Aceh aimed not simply to restore capacities and resources for earning livelihoods but to ensure that development would be sustainable. Among the projects with this objective was the promotion of BMPs for environmentally sustainable business practices under the program “Reduction of Key Impacts of Shrimp Aquaculture”. The specific project was Better Management Practice Development and Market Access for Compliant Producers. Its contents included:

Key aspects for successful tambak (earthen pond) farming

- Farmer group formation
- Crop planning
- Crop calendar
- Better management practices

The project promoted better management practices in

- Location of ponds
- Design and construction of ponds
- Pond preparation practices
- Shrimp seed selection and stocking practices
- Feed management practices
- Water management practices
- Health management practices
- Harvest and post-harvest handling practices
- Keeping daily record book of each pond
- Improved marketing practices

The outcomes, based on the farmers' perspectives and responses were:

- A clear improvement in crop outcomes compared to previous years; they have not seen a similar harvest since 1995
- Achieved 70-75% "success"
- Expressed high interest to continue and to acquire better skills
- The BMPs were followed
- Positive views on reduced chemical use; they thought the ponds were more "fertile"
- Keen to share experiences, knowledge and lessons learned with other farmers

3.1.3 Thailand

Thailand initiated the "Farm to Plate" program in 2003 to promote an international image of safe and responsibly produced aquatic food products that consisted of:

- good aquaculture practices (GAP),
- code of conduct (COC shrimp) program in shrimp,
- traceability schemes,
- detection of banned chemicals and drugs,
- HACCP and other standards and quality certification schemes in food handling and processing.

GAP focuses on food safety and was directed at better market access while the Code of Conduct aims to reduce impacts on the environment by reducing disease risks and pollution. GAP had more than 21,000 shrimp farms and 700 hatcheries as registered adopters, however the COC had much less adoption.

Shrimp farms had less environmental impacts because of non-use of antibiotics and treatment of effluent water in treatment ponds before discharge, less damage from the viral diseases as a result of a healthier environment for the shrimp, and better access of markets (no returned or burned shipments because of the presence of banned drugs in shrimp flesh).

3.1.4 Vietnam

The pilot work in Vietnam was carried out under the FSPS project of the government. Simple and practical BMPs were developed for broodstock traders, hatcheries, seed traders and farmers. Inspired and adapting some of the experiences and materials from the Indian project, Vietnam developed ten sets of extension material containing Better Management Practices designed for these players in the aquaculture chain.

The results were that:

- Seed production in the six participating BMP hatcheries increased 1.5 times while the price of seed was 30-40% higher than non-BMP hatchery produced seed. BMPs for hatcheries also assured that farmers got quality and disease-free seed.
- BMP implementation in pilot farming communities led to a much lower risk of mortality, a higher production and a higher probability of making a profit. Farming communes that introduced seed testing increased their chances of making a profit 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.
- Farmers complying even with only two recommended practices, namely, (i) testing of seed for White Spot Syndrome Virus (ii) and removing sludge before stocking -- reduced the risk of crop failure from 61.0% to 47.8%.

3.2 Issues associated with BMP development and adoption

There are numerous practical constraints to adopting BMPs. From a regional standpoint, the important ones include the following:

- Many small-scale farms are unregistered or illegal
- Insufficient government investment in infrastructure i.e. water supply and discharge canals and protection dikes.
- The programs of extension services do not include BMPs, related to which is the lack of information on BMPs.
- Perception by farmers of a higher risk and less profitability from adopting COC (Code of Conduct)
- Lack of operational capital to enable farmers to implement the additional requirements of GAPs and COCs.

An assessment of the BMP development program in Vietnam identified the following implementation issues:

- Shrimp farmers will need to work in groups to offset the cost of transition to GAP or BMP
- The view from government that GAPs/COCs/BMPs are more suited for intensive operations and needing more investments in structures and running costs, would exclude the small scale operators in the program
- Non-alignment of the Vietnamese definition of GAP or BMP with internationally recognized definitions resulting in confusion and restricted market access for Vietnamese shrimp
- Inconsistencies in the application of BMPs
- Lack of legislation which is reflected in inadequate planning
- On the other hand, there can be too much legislation which is expressed in too many and complex requirements!

3.3 Organizational Issues

This section highlights the lessons from the project in **India** related to organizing farmers for a more effective adoption and implementation of BMPs.

- **Organizational levels.** There are three types of farmers' organizational units that were formed for BMP work:
  - **Cluster** - a group of farmers whose shrimp ponds are situated in a specific geographical area and their ponds depend on the same water source.
  - **Aquaclub** - an informal group of farmers cooperating with each other on various aspects of management in the cluster. The farmers of more than one cluster can form an Aquaclub.
  - **Society** - a formal and registered group of (20 to 75) farmers in a locality. The Societies are organized according to a model established by the government; registered with the Ministry of Revenue, and subject to annual audits by government officials to verify accounts and ensure a democratic and transparent management.

The small scale farmers in the Indian project were organized into self-help groups - the Aquaclubs. Project staff, government extension and research personnel and regional advisers fielded by NACA developed the BMPs with participation of the farmers. These were then promoted for adoption. The promotional work included seminars, field visits, demonstration, and the production of manuals and posters that were translated into local languages.

Two organizational issues are especially critical for success:

- leadership and capacity building of the club or association,

- the ability of the farmers organizations to establish and maintain contractual relations with hatcheries, feed suppliers, processors/exporters and buyers.

3.4 Provision of technical services

The process of promoting, adopting and sustaining the practice of BMPs needs the provision of appropriate technical services. These include technology development, training and extension, credit, information, access to good inputs like healthy seed and quality feed, and market. In this connection, the project staff helped the farmers by working with government, the private industry sector and with institutional buyers to facilitate the organization of technical services for the farmers.

It is emphasized that being organized strengthened the farmers' capacity to demand and absorb the services. By being organized, it became easier for the societies to comply with local and national laws; they were able to produce shrimps that meet food safety standards by among others not using antibiotics, their products were traceable, production produced minimal impact on the environment. They presented an image of social responsibility and finally, being organized, they achieved economy of scale. In other words, the small individual farms working cooperatively could do things more efficiently and economically than if they were working separately. These are enabled by:

Acquiring a legal character: Farms and the societies are registered with the Coastal Aquaculture Authority of India. A society has its own guidelines and Standard Operating Procedure. Societies are audited every year by Marine Products Export Development Authority for the implementation of guidelines and SOPs.

Producing safe products: Only antibiotic and disease free healthy shrimp seeds obtained through the contract hatchery system are stocked in society ponds. Societies are also closely monitored by the National Centre for Sustainable Aquaculture (NaCSA) through society coordinators to make sure there is no use of antibiotics in society farms. Shrimps are raised in low-density ponds, antibiotics like Chloramphenicol or Nitrofurans are therefore unnecessary to counter the problems of overcrowding

Enabling traceability: Internal records are maintained in hatcheries, nurseries and farms on general management and key information. Purchasing and distribution records are maintained in nurseries and farms. Traceability is extended one step backward from brood stock to several steps forward until the product reaches consumers through exporters.

Eco-friendly shrimp production with no pollution: Stocking density is less than 6 pcs per square meter which is far below the level in other countries. Reduced use of chemicals, antibiotics, efficient use of feed and limited discharge of sediments and water exchange enable a more environmentally friendly operation

Social responsibility is enhanced by regular information sharing among farmers during weekly meetings; cooperation in selecting/testing and buying seeds/feed etc. Each society has its own fund for its long term sustainability with each member paying INR 1000 as initial membership fee and 0.05% of the income at the end of each crop. Cooperation engenders better communication and harmony between society farmers and local community.

Efficiently managed small farmer societies: Societies procure all their seed requirement from one hatchery, use feed from one company and linked to exporters so that all the shrimp from the society is sold to one exporter. Middlemen may not be necessary. Finally, harvests can be coordinated and better harvest and post harvest practices can be practiced.

3.5 Lessons learned

The national experiences cited above yielded a number of important lessons:

- Yields and profitability, product quality, and environmental performance are improved
- Farmers had high interest to continue and to acquire better skills
- Farmers were keen to share experiences, knowledge and lessons learned with other farmers
- Shrimp farms that introduced seed testing greatly increased their chances of making a profit,
- Farms that adopted BMP had much higher average yields than farms did not,
    - had less environmental impacts because of non-use of antibiotics, less use of chemicals and due to treatment of effluent water in treatment ponds before discharge,
    - had less outbreak from viral diseases as a result of a healthier environment for the shrimp and had a higher probability of making a profit, and
    - had better access to markets; no shipments were returned or burned because of the presence of banned drugs in shrimp flesh.
- Organized farmers can successfully manage risks of crop loss, especially diseases, through the adoption of BMPs,
- It is important to organize the provision of better technical services (from government, academic, industry and NGO sectors as well as from international assistance agencies) to organized farmers for them to improve their capacity to adopt sustainable farming practices

Two organizational issues are especially critical for success:

- leadership and capacity building of the club or association,
- the ability of the farmers organizations to establish and maintain contractual relations with hatcheries, feed suppliers, processors/exporters and buyers.

4 Biosecurity zones

The World Organisation for Animal Health (OiE) describes biosecurity and biosecurity zones in the Aquatic Animal Health Code (OiE 2003) as:

Basic biosecurity conditions means a set of conditions and management systems put in place for a particular location to ensure adequate disease biosecurity, such as:

- Reporting outbreak of the disease, (including suspicion of the disease) to the Competent Authority; and
- Having an early detection system put in place within the zone; and
- Having import restrictions to prevent the introduction of disease into the zone.

Biosecurity Zone means an area comprising:

- an entire water catchment basin from the source of a waterway to the estuary or lake, or
- a series of water catchment basins, or
- part of a water catchment basin from the source of a waterway to a barrier that prevents the introduction of diseases, or
- part of a coastal area with a precise geographical delimitation, or
- an estuary with a precise geographical delimitation,

that consists of a continuous hydrological system with a distinct health status with respect to a specific disease or diseases. The zones should be clearly documented (e.g. by a map or other precise locators such as GPS co-ordinates) by the Competent Authority/ies.

4.1 Biosecurity zoning initiatives

The main biosecurity zoning initiatives aim at a coordinated management of the zone to prevent disease outbreak and to break the disease cycle and reduce aquaculture impact on the environment. This is achieved by a number of management strategies

- **All-in all-out**. Fish or shrimp are introduced into the area or zone at one agreed time by all the farms (all-in). The fish or shrimp are grown to market size and then harvested (all-out). The area is then allowed to remain free of culture fish or shrimp for a certain time to break the disease cycle and to fallow (allow the environment to recover from the additional nutrient input to the area).
- **Crop calendars**. Requiring the stocking of fry or PLs by all farmers in one zone at the same time with different stocking time for neighbouring zones.
- **Crop rotation**. Stocking of shrimp for one crop and then stocking fish for the next crop.
- **Stocking only with disease free seed**. Requiring all farmers to stock only with tested or certified disease free seed.
- **Synchonised disease treatment**. Requiring all farmers to simultaneously treat their farms after an outbreak on one farm in the zone

Sri Lanka

Sri Lanka has developed and applied a management system of shrimp 'Crop Calendar'. The implementation of crop calendars came in to being in 2004. The principle underlining the crop calendar was to divide the shrimp farm areas into sub-zones and devise a calendar with the participation of the stakeholders (shrimp farmers, processors, hatchery operators and shrimp feed importers), to enable shrimp farmers in particular sub-zones to farm and crop within a particular time frame.

Shrimp crops can be carried out by the farmer per year according to the crop calendar that requires stocking of PLs at different times for different zones. There should be at least 60 days rest period in between two culture cycles. Pond drying, removing organic load in the pond bottom, repairing dikes and canals, liming (if required) and fertilization (if required) etc could be carried out during this period.

Norway

Norway has implemented a management framework for promoting sustainable aquaculture development, including an elaborate licensing system. Careful management and systematic planning is twinned with long-term investments in research and development to improve the knowledge base, both for the development of the industry and the regional economy and for preventing adverse environmental impacts and user conflicts

Environmental effect and access to areas are crucial factors in the Norwegian aquaculture industry's development and growth. Work has started on developing a total system for the regulation of environmental effects and adaptation of areas for aquaculture. The system is called MOLO and it covers both the planning and operation phases for aquaculture and combines the use of geographical information systems with calculations of the carrying capacity and the monitoring of environmental effects.

Scotland

The Scottish fin fish aquaculture industry recognised the advantages to be gained from farmers working together under area management agreements. These agreements maximise the benefits of following code of best practice, such as synchronous fallowing of neighbouring farms in an area or zone to promote fish health. The criteria on separation distances between farms in Scotland have led to a complex pattern of development with many farms in one area operated by different owners. These management agreements between the different farm owners allow coordinated management to minimise impact and reduce disease outbreaks.

Ireland
The "Coordinated Local Area Management Systems" (CLAMS) was launched in 2002 for Clew Bay. A customised code of practice was published in 2003 to further the responsible development and management of the Clew Bay Aquaculture Sector. This code of practice encompasses a wide range of issues from stock health management and waste management to visual impact issues.

5 Methodology for the starting of community safe aquaculture areas in two communes

The implementation of safe aquaculture zones takes time and is a step by step process.

5.1 Identification of communities to introduce safe aquaculture zone

Hue Province
The identification of communities for implementing safe aquaculture zones suitable for poor farmers was based on the SUDA Activity 1.4.9. This activity undertook a study and provincial workshop to identify suitable communities for activity 1.4.3. The consultants undertook the ranking of different criteria and methodology on how to select the locations to develop a safe zone for sustainable aquaculture development in the lagoon communities of Thua Thien Hue and specifically the Tam Giang – Cau Hai lagoon system.

The study determined that
(i) the aquaculture area in Vinh Hung was in the provincial planning for aquaculture development;
(ii) it was in an isolated area which doesn't effect the sensitive natural habitat;
(iii) it already has a community organization (Dai Thang cooperative);
(iv) they only culture shrimp,
(v) the farmers together with the local officers were willing to establish the SAZ.
(vi) Vinh Hung commune can fulfill the national standard for establishing the SAZ better than the other short listed commune; Vinh Xuan commune.

It was decided that the activity of establishing the SAZ should be carried out in Vinh Hung commune, Phu Loc District. In the workshop with FSPS II Thua Thien Hue, Fishery extension center, Representative of Phu Vang, Phu Loc districts and Vinh Xuan, Vinh Hung commune there was more discussion for re-planning of aquaculture zone. However it was concluded that it would be difficult to invest further and create a new pond system. The farmers wanted to continue their shrimp production and start to apply BMPs and use EM and *Bokashi-betel* probiotics measures for water treatment and improve water quality. In the discussions, the cooperative wanted to have their own hatchery so that they can buy seed more easily and avoid having to buy seed from Da Nang. They could also have nursery ponds for the 3-week nursery stage and the cooperative can take care and deliver PLs to farmer groups.

At the workshop, all of the participants agreed that Vinh Hung was suitable for building up a safe aquaculture zone. The project could select one of two cooperatives for implementation. More importantly, Vinh Hung cooperative was interested in the BMP model and they had more motivation and enthusiasm for building the SAZ than Vinh Xuan. There was no one from Vinh Xuan to join the workshop and the local CPC and village head did not attend the workshop to be able to understand the model.

Ca Mau Province

During the local workshop in Ca Mau FSPS office, the Director of FSPS, Mr. Nguyen Thong Nhan and Centre for Fishery Extension suggested that the commune of Tan Duyet should be selected. Because SUDA projects can not support big areas for projects, a limited area with one village was selected to implement a demonstration model for the region. The Fishery Extension Center had already selected 15 households in Tan Duyet for learning and implementing BMPs, so there were more advantages for carrying out SAZ in Tan Duyet. Representatives from Dam Doi, Hung My and Cai Nuoc also suggested to implement SAZ in their areas but finally, Hung My extension officer said they can learn from Tan Duyet and that if the model was successful it could be adopted by Hung My commune. Dam Doi district staff asked for more support for Tan Duyet which had more problems with shrimp culture and environment pollution; Tan Duyet is a very isolated area surrounded by rivers. In addition farmers from Ca Mau bought post-larvae from Central Vietnam (Ninh Thuan, Binh Thuan and other district as Nam Can), so it would be good if they could cooperate to buy post-larvae jointly that could be checked and tested carefully for disease.

The farmers in Ca Mau did not yet have models for learning or following BMPs. Mr. Nguyen Thong Nhận of the Department of Agriculture and Rural Development said that it was necessary for them to understand the benefits of implementing GAP, COC, and BMP particularly as the fisheries products are for export.

Analysis of safe aquaculture zone and non safe aquaculture zone is indicated in tables 1 & 2.

Table 1. Criteria for selecting place for construction of safe aquaculture zone in Thua Thien Hue

Criteria	Vinh Xuan, Phu Vang	Vinh Hung, Phu Loc
The aquaculture areas located in planning of district and province	10	10
The activity didn't influence on environment and degrading as mangrove forest and conservation of wetland	10	10
Aquaculture systems	5	8
Area, size, irrigation system	7	7
Aquaculture planning, connection	4	6
Water source	8	8
Water quality inputs and outputs	8	8
Community development	4	7
The responsibility of the farmer and the local government	3	7
Total points for selection	59	71

(1 to 10 range of scales of areas and criteria)

Table 2. Criteria for selecting a place for establishing a safe aquaculture zone in Ca Mau

Criteria	Tan Duyet	Hung My
In side of aquaculture planning of district and province	8	7
Not impact on environmental aspects (mangrove forest...)	10	10
Major feeding systems and practices	6	8
Culture area (S)	10	10
Aquaculture production systems	8	5
Water source	10	10
Water inputs and output quality, irrigation systems	7	8
Community development	8	5
The responsibility of farmers and stakeholders	9	7
Total of points for selection	**76**	**70**

Within the selected communes, the areas chosen for starting the Safe Aquaculture Zone were based on the folling criteria.

Table 3. The criteria system to analysis of safe aquaculture zone and non safe aquacuture zone in Thua Thien Hue

Criteria	Safe aquaculture zone	Non safe aquaculture zone
Aquaculture planning, connection	Good and can recreated	No good
Water supplies/source	Good	No good
Water management and control	Separated canal input and output	The same canal inputs and output
Area, size	15-20 ha	Non restricted
Irrigation systems	Good control	Non control
Pond preparations and techniques approaches (Uses of bio-products for treatment)	Bio-product uses	Chemical uses
Seed quality	Good and free diseases	Not enough/infection
Stocking density and seasonal delivery	5-7 heads/m^2 Suitable	More 10 heads/m^2, nonsuitable
Health status test by regulation	Every day	Sometimes or don't know how to test
Growth rate control	Good control	Non-control

Feeding regime and schedules	Semi-intensive/improved extensive	No control and fresh-feedstuffs used
EM (Effective microorganisms) and Bokashi products used	Yes	No
Aquaculture systems	Monoculture of *P.monodon*	Interpolyculture (shrimp, crab, fish)
	High/middle-tide	Low-tide
Community management	Good	Not good

Table 4. The criteria system to analysis of safe aquaculture zone and non safe aquacuture zone in Ca Mau

Criteria	**Safe aquaculture zone**	**Non safe aquaculture zone**
Aquaculture planning, connection	Good and can recreated	No good
Water supplies/source	Good	No good
Water management and control (inputs/ouputs)	Balance	Unbalance
Area, size	15-20 ha	Non restricted
Pond preparations and techniques approaches (Uses of bio-products for treatment)	Bio-product uses	Chemical uses
Seed quality	Good and free diseases	Not enough/infection
Stocking density and seasonal delivery	3-5 heads/m^2 All in/out	More 7 heads/m^2 Monthly seed delivery
Health status test by regulation	Every day	Sometimes or don't know how to test
Growth rate control	Good control	Non-control
Feeding regime and schedules	Semi-intensive/improved extensive	No control and fresh-feedstuffs used or intensive on household
Bokashi products used	Yes	No
Aquaculture systems	Polyculture (shrimp, fish)	Monoculture
Community management	Good	Not good

5.2 Start implementation of safe aquaculture zone

The methodology for this activity was to select one case study area of around 100 ha with 50 households in each commune that was selected under SUDA Activity 1.4.9. In these 2 areas, develop the model for safe aquaculture zone. All households in the area were

interviewed in detail to establish present practice and productivity. All ponds in the area were mapped using GPS and the data entered into GIS using Google Earth. This allowed the water flow system (water supply to the ponds and effluent from the ponds) to be understood in order to minimise risk of self pollution and risk from introduction of disease through the water system.

All households in the selected safe zone were then given training in safe aquaculture practice. A safe aquaculture zone coordinating committee was established with representatives from the commune, cooperative, extension officers, farmers and women's unions. This committee was encouraged to plan, manage and monitor the safe aquaculture zone development.

Within the selected area 9 ponds were selected to implement the safe aquaculture practice and be monitored closely. They ponds were monitored daily for the whole production season using the following parameters

- Disease
- Water quality
- Feed and feeding
- Productivity
- Pond management

At the end of the culture period, the results were be analysed and disease outbreaks compared between the selected ponds, the remaining ponds in the safe area, ponds outside the safe area and the previous pond production (from the farmer interviews undertaken at the start of the activity.

Some limited support was made available to the farmers whose ponds were selected for the safe aquaculture practice. This included

- Cost of disease testing for the PLs in the hatchery before purchase
- Nursing of the PLs in a common nursery pond
- Cost of disease testing for the PLs in the nursery before stocking in the grow-out ponds
- Disinfection of the soil and water before stocking PLs
- Crab and shrimp prevention nets on the intake water supply
- Crab traps on the pond walls.

At the end of the production period, the production results and safe aquaculture practices implemented were analysed and the safe aquaculture practices reviewed and improved for implementation in new safe aquaculture areas.

5.3 Implementation in two selected communes

The start of the implementation of safe aquaculture zone in the two communities was undertaken in a Step-by-Step process.

In each commune there were general discussions with cooperative leaders and farmers about the project and concept of safe aquaculture zones and safe aquaculture practice.

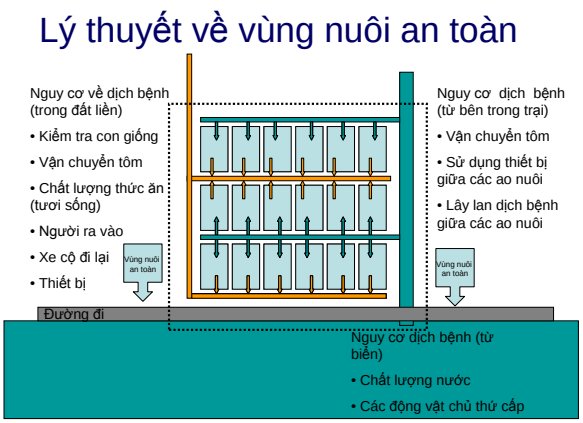
Initial discussions with farmers in Ca Mau

The pond area was then visited and a suitable area selected which contained about 50 families farming 100 ha of pond surface area.

Selected safe area in Vinh Hung commune

Selected safe area in Tan Long commune

An introductory workshop was then organised for all the farmers within the zone to explain Better Management Practices, Safe Aquaculture Practice and Safe Aquaculture Zones which was followed by discussions on the ways to implement the concept.



1 day workshop on safe aquaculture in Vinh Hung

A safe aquaculture zone management committee was established in each commune with representatives from the commune, fish farmers cooperative, extension service and women's union. At the first meeting, the functions of the committee and expectations for the management of the safe aquaculture zone were discussed.

Nine ponds were selected in each area for close monitoring. Nine improved extensive ponds in Hue and nine ponds in Ca Mau comprising 3 intensive, 3 improved extensive and 3 extensive ponds.

Questionnaires were completed by all the farmers within the zone to determine the socioeconomics, number of ponds, culture system, culture methodology and productivity. This was to establish baseline information in order to compare whether the implementation of safe aquaculture practice made significant improvement to productivity or not.

All the ponds in the selected area were mapped using GPS and the data entered into Google Earth.

GPS Reading of water intakes to the safe aquaculture zone in Tan Long

In each commune there was a one day farmer field training on practical pond management methodology for safe aquaculture


Farmer field training in Vinh Hung

A second training workshop was undertaken in each commune for the farmers in the safe aquaculture zone.

- Detailed BMPs - Mr Phuoc
- Safe aquaculture practice and zone – Mr White
- Implementation of BMPs in other regions of Asia – Mr Bueno
- The concept of a safe aquaculture zone – Mr White


Second training workshop at Ca Mau

Students from Hue University lived in the communes for 4 months during the first culture period to collect data from the selected ponds. In each area monitoring was undertaken by students for

- Disease (every 2 weeks)
- Water quality (every 2 weeks)
- Water management (daily)
- Feed and feeding (daily)

A summary of the results are given in the Annexes to this report.

5.4 Implementation - Preparation

Prior to stocking, the farmers in Vinh Hung were asked to install pH control on water supply systems. This comprised sacks of lime through which the water passed that would keep the water supply within the acceptable pH levels. These were placed at the following locations

- Pump station
- Pond entrance
- 2nd water supply

The farmers were asked to place fine mesh net screens to prevent wild shrimp and crabs from entering the ponds. Wild shrimp and crabs can be carriers of disease and transfer disease to the shrimp being cultured in the safe aquaculture zone. The nets were installed

- at the suction end of the pump house
- on the secondary inlet canal where some of the peripheral ponds in the safe aquaculture zone pump water from

There were some low tide ponds located close to the common inlet canal that were a biosecurity risk. These ponds take water directly from the lagoon and discharge freshwater back into the lagoon using the same gate so that if one pond had disease, there would be a risk that the effluent from these ponds would be carried by currents into the common inlet canal and pumped into the ponds within the safe aquaculture zone. Therefore an agreement was made with the 6 closest ponds to the inlet canal to pump discharge water into the common effluent canal rather than discharge directly back to the lagoon. Some financial support was made available to these pond farmers for the additional costs for pipe and diesel.

The farmers of the 9 test ponds were asked to spread chlorine on the bottom of the pond just before filling the ponds to disinfect the pond bottom and the incoming water. They were also asked to pass the water through a fine mesh net to filter out any wild fish, shrimps and crabs.

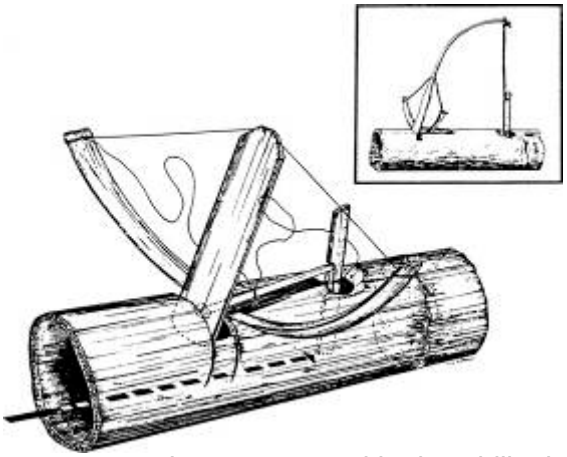
The management committee was asked to erect signs at the edges of the safe aquaculture zone and at the main entry points that warn people this area was now a Safe Aquaculture Zone

At Tan Duyet Commune the farmers were asked to follow the safe aquaculture practices that were explained to them during the series of workshops. The farmers of the 9 test ponds were asked to buy seed that had been tested for disease, follow the pond preparation guidelines, spread chlorine on the bottom of the pond just before filling the ponds to disinfect the pond bottom and the incoming water. They were also asked to pass the water through a fine mesh net to filter out any wild fish, shrimps and crabs. They were asked to follow the pond management guidelines.

5.5 Implementation - operation

Hatcheries were located in each area and good quality seed was selected and a sample sent for testing for disease. In the Vinh Hung commune, the disease free seed was nursed for one month in a pond outside the safe area and the seed tested again and only then transferred to the selected ponds in the safe area.

One of the main risks for disease transmission between ponds outside the safe aquaculture zone and the ponds within the Safe Aquaculture Zone is the movement of wild crabs which could be carriers of shrimp disease. The farmers were asked to construct cheap crab traps from bamboo and string. The design given to them was that used successfully in the Philippines to catch wild crab.



Low-cost crab traps as used in the Philippines

The ponds were continually monitored by the resident students who collected the data and worked with the selected farmers to keep a daily log book of pond operation. The scientific data that was collected

- Disease status (hatchery, nursery, production)
- Water quality (every 10 days)
- Feeding (daily)
- Pond management (daily)

The students analysed and reported the results of the studies in their project reports.

6 Analysis and results of the implementation

6.1 Vinh Hung commune, Thua Thien Hue province

Overview of household characteristics in Vinh Hung villages

- **Age**: most of the farmers were adults, 63.6% were in the age period of 40 – 60 years
- **Education**: According to the household survey, the number of farmers with education level 2 accounted for 40% and education level 3 accounting for 23.7%. In addition, the number of illiterate and primary educated was low, at 3.6% and 32.7% compared with the total household survey.
- **Training**: Nearly 92.7% of the investigated households participated in the training techniques.
- **Cooperatives**: Most shrimp farming households belonged to two cooperative (Dai Thang and Bach Thang cooperative)

Fingerling and quality of fingerling

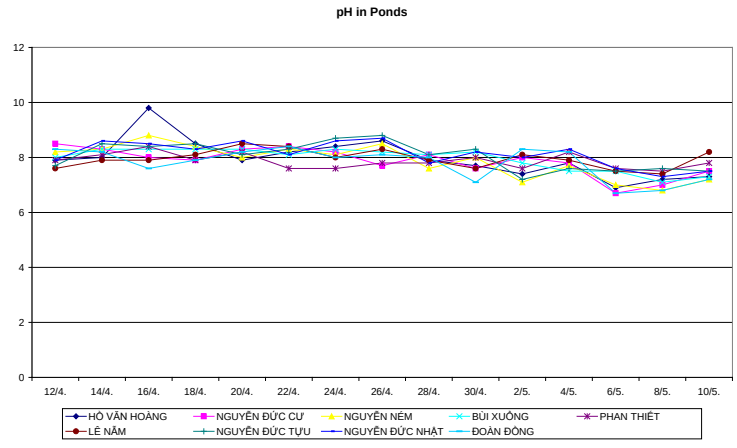
- *Penaeus monodon* is the main culture species in Vinh Hung commune.
- Fingerlings were obtained from local hatcheries and the quality of fingerlings was tested for diseases using recommended tests
- A third of the surveyed households (33%) stocked with low density (7-9 shrimp/m^2).

Pond system and pond preparation:

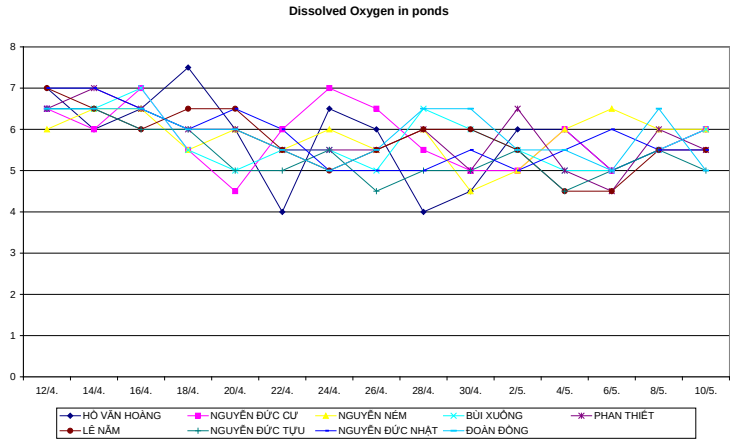
The culture area was located in a high tide zone. There was a pumping station in the culture area. Good pond preparation was carried out and the farmers followed all steps in the technical guideline: drainage, liming, killing predators and water colouring. Semi-intensive was the common model in this commune.

Water quality

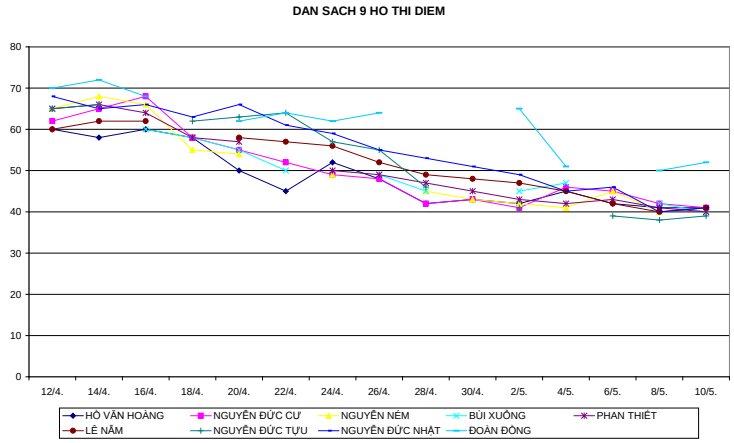
pH. pH ranged from 7.4 to 8.2 was in the optimal range of shrimp growth. pH was similar in all ponds. pH reduced slightly during the production season



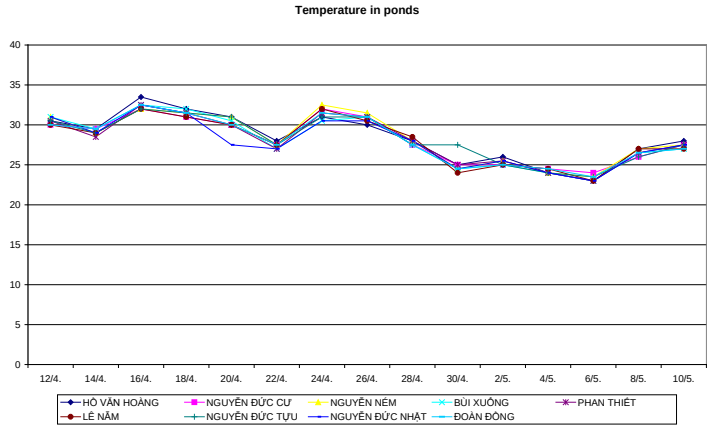
Dissolved Oxygen. DO (>4mg/l) was in the optimal range of shrimp growth. DO differed significanty between ponds. This was due to different levels of algae in the ponds. DO tended to decrease during the production season as biomass increased.



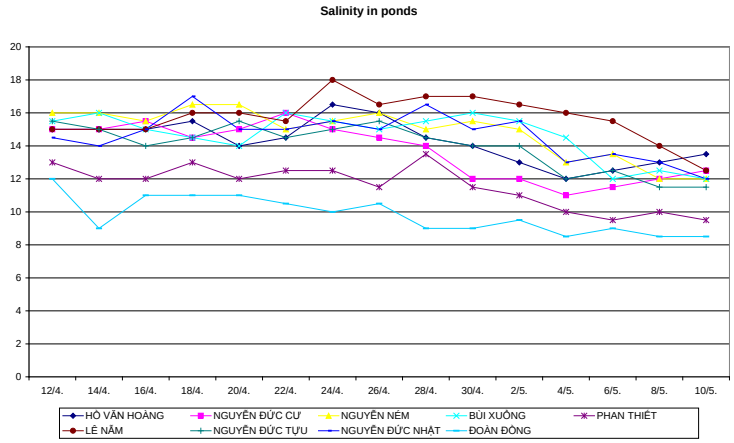
Alkalinity. Alkalinity (52-74mg/l) was quite low and it was lower than the optimal range of shrimp culture. Alkalinity tended to decrease during the production season.



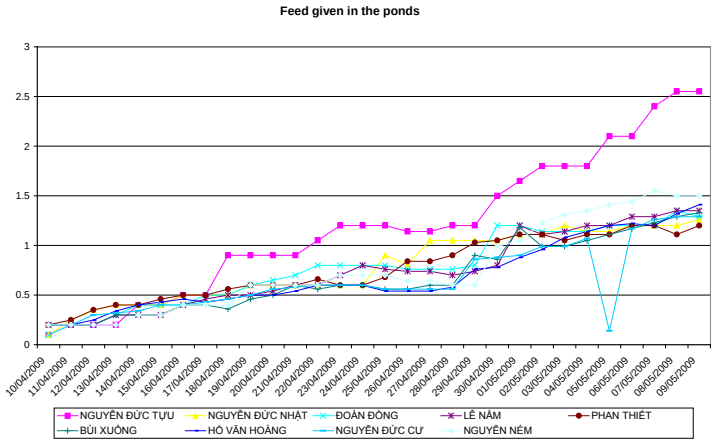
Temperature. High fluctuation of temperature (24-31ºC) was observed during the culture period but this was due to the prevailing climatic conditions.



Salinity. Salinity varied between ponds. This was dependent on the salinity in the lagoon when the ponds were initially filled.Salinity tended to decrease during the culture period due to rainfall.



Feed and feed regime: Commercial feed from the UN, CP, and Groberg companies were used. Amount fed per day in kg increased as the biomass of shrimp increased.



Disease Outbreaks

During the survey, we found that, diseases were very serious problem in Vinh Hung commune. The status of shrimp diseases of 108 ponds of 55 households is presented in the following table

The status of outbreak of shrimp disease

Common diseases	hhs	Per. (%)
WSSV	48	87,3
MBV	8	14,5
Yellow gill disease	38	69,1
Black gill disease	11	20
Fouling disease	29	52,7
Red body disease	16	29,1
Negative Impact of diseseas on production		
Loss production totally	9	16,4
Loss 2/3 of production	18	32,7
Loss half of production	5	27,3
Loss 1/3 of production	11	20,0
Loss not much	7	12,7
No loss	5	9,0

The investigated result of 55 households showed that, diseases at experimental areas spread in both quantity and ability of transmission. There were 50 out of 55 households which had faced disease problems during the previous culture season. The common diseases and pathologicals signal were: WSSV (48 households exceed to 87.3%), MBV (8

households), yellow gill disease (38 households), fouling disease (29 households), black gill disease (16 households) and red body disease. 36 out of 132 households have pathogens but unknown reason. Only 5 out of 55 households were interviewed answering that no diseases occurred because of good water treatment and good management during culture time. These disease cause the loss of shrimp production. There were 32 out of 55 households (58,2%) have faced heavy loss of production in which 9 households lost total production and 18 household lost more than 75% of total production.

On another hand, predators such as trash fish, small crabs and shrimps were also problems for local farmers. The most important reasons for shrimp diseases are: (i) lack of culture techniques: using un-treated water, no quarantine the fingerling, don't follow the crop calendar.

Following the implementation of the safe aquaculture zone and safe aquaculture practice there was no outbreak of disease within the zone during the culture period.
No WSSV infection was observed in shrimp that was cultured in Dai Thang cooperative area.

6.2 Tan Duyet commune, Ca Mau

Overview of household characteristics in Tan Duyet commune
In general, the shrimp farmers have around 8 years (from 2000) of experience in farming shrimp. Their technical abilities required further capacity building for biosecurity, techniques of the stock selection and water management. Approximately 31.82% of the ponds were improved extensive system and the remaining 68.18% were traditional extensive pond culture. Farmers can stock some ponds and harvest from the other ponds in the same month.

The average age of farmers was 40. They are younger than the farmers in the other area. Their education status was as follows: 20.8% primary; 62.4% middle school and 8.4% secondary school

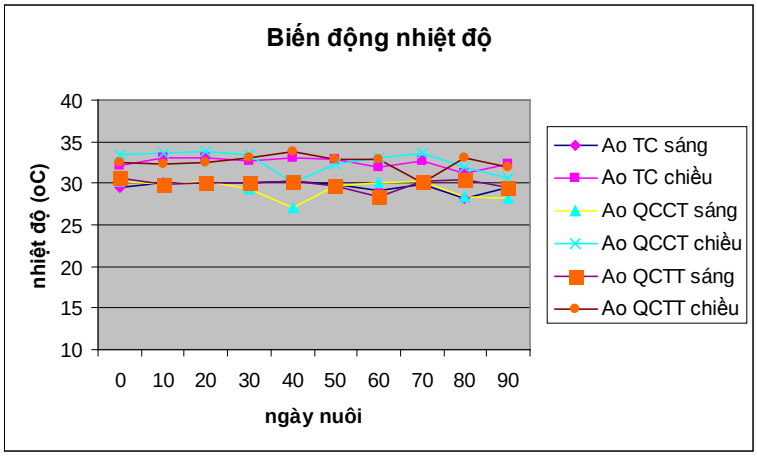
Pond system and pond preparation: Most of the ponds located in the middle tide area, can be filled and drained by gravity through the inlet gate. The process of pond preparation was simple: the ponds are dried between culture periods for one month between 15 August and 15 September annually.

Fingerling and quality of fingerling: Shrimp seed was obtained from other provinces and there was a wide variability in price (16 – 52 VN dong/ PL 12). Generally the seed was not selected on a quality or disease free basis.

Water quality:

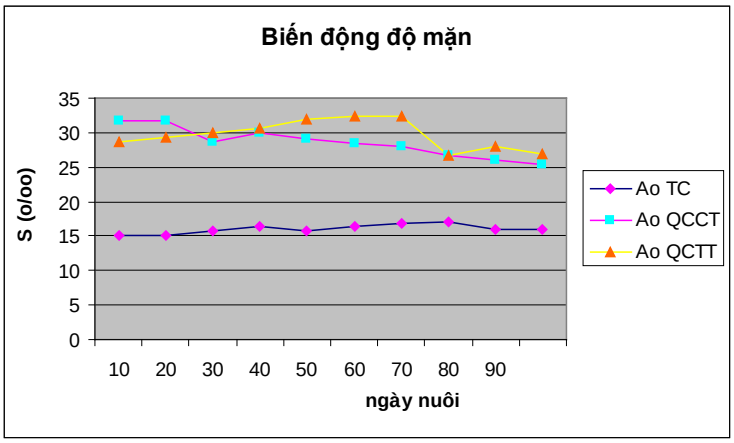
Phòng thí nghiệm phân viện Minh Hải - Viện Nuôi Trồng Thuỷ sản II

Temperature: average temperature in the selected ponds ranged between 27 to 33^{0}C which is within the limit tolerated by shrimp, the temperatures in the morning and afternoon in the pond were not significantly different.



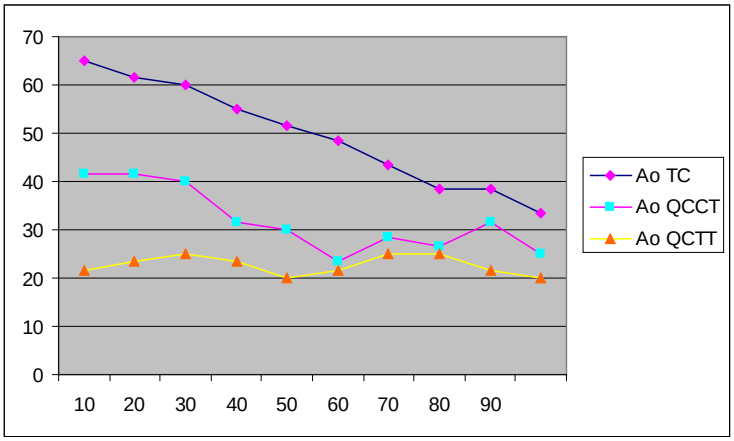
Đồ thị 1. Biến động nhiệt độ ở các ao nuôi

Salinity: Salinity in all selected ponds was in the acceptable range for shrimp growth (15 – 33‰),. The salinity in the intensive pond was low at 15 mg/l but this was a factor of the salinity during initial filling of the ponds. The salinity decreased slightly in improved extensive and extensive ponds due to rainfall and replenishment with lower salinity water.



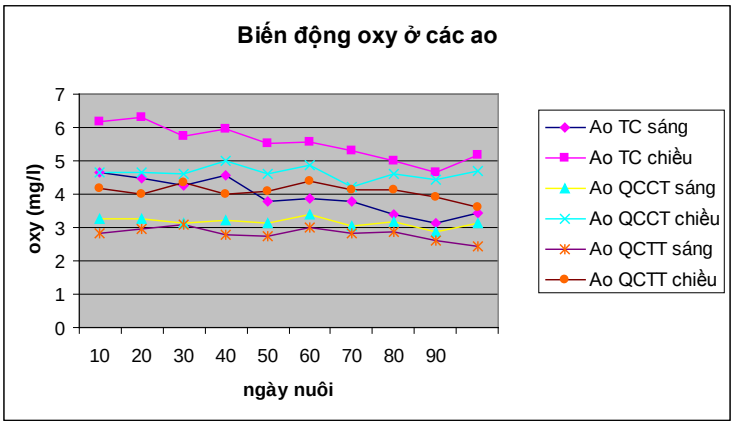
Đồ thị 2. Biến động độ mặn ở các ao nuôi

Transparency: The water was not treated water and there ae no settling ponds so that the transparency of extensive ponds was low and the amount of particulates was high. In contrast, the intensive ponds had high transparency at the start but this decreased during the culture season.



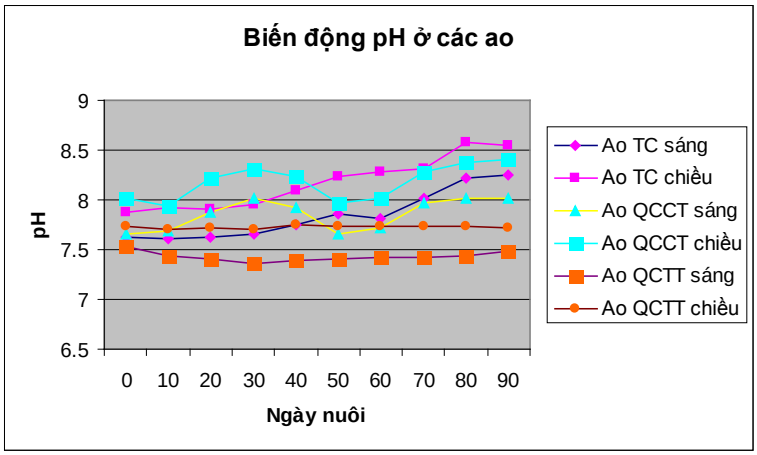
Đồ thị 3. Biến động độ trong ở các ao nuôi

Dissolved Oxygen: DO was high in intensive ponds (DO > 3 mg/l), but low value of DO was observed in traditional and improved extensive ponds because poor pond preparation and turbid water. Oxygen levels generally decreased slightly during the culture period.



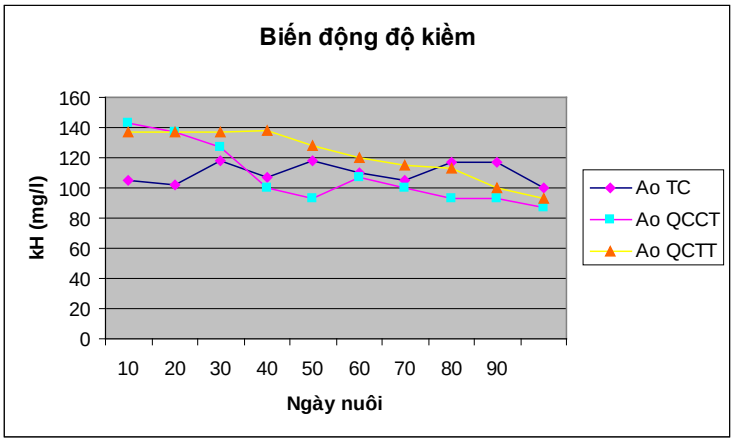
Đồ thị 4. Biến động oxy ở các ao nuôi

pH. pH in all selected ponds were in the acceptable range between 7.5 and 8.5. pH increased during the culture period in the intensive ponds but remained relatively constant in the improved extensive and extensive ponds



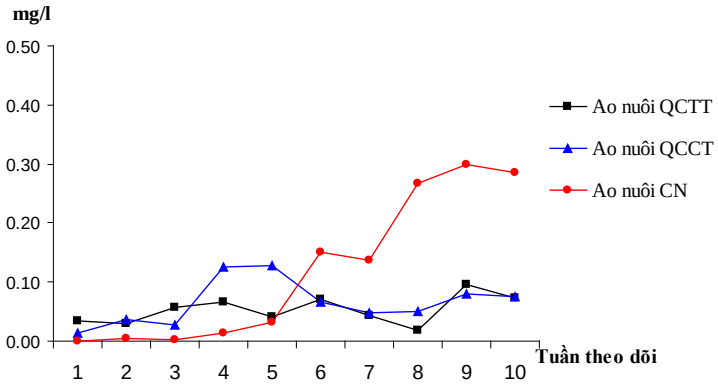
Đồ thị 5. Biến động pH ở các ao nuôi

Alkalinity. Alkalinity in all selected ponds were in the acceptable range for shrimp development at 80-150mg/l. Alkalinity tended to decrease slightly in all types of ponds during the culture period.



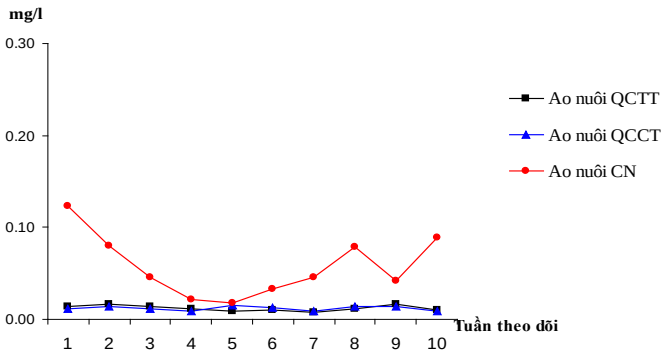
Đồ thị 6. Biến động độ kiềm ở các ao nuôi

Ammonia: NH_3 increased in intensive l ponds following the culture time and exceeded the upper limit (0,33mg/l) in the ninth week culture. NH_3 in the extensive ponds was in the acceptable range (0 – 0,15ng/l)



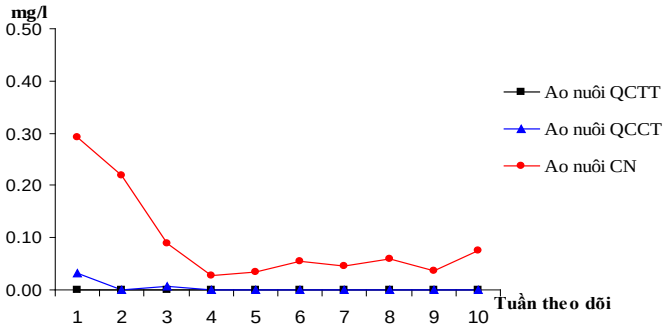
Đồ thị 4.11. Biến động hàm lượng NH3 theo thời gian nuôi

Nitrite: NO_2^- level was relatively low in all systems. It is interesting to note that the Nitrite level started much higher in the intensive ponds due to fertilisation of the ponds and that this was assimilated over 4 weeks to low levels before rising again due to shrimp feed inputs and shrimp excretion with increasing biomass.



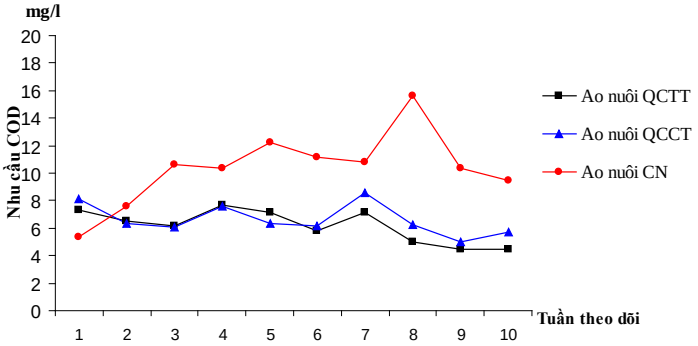
Đồ thị 4.12. Biến động hàm lượng NO2- hàng tuần trong các mô hình nuôi

Phosphate PO_4^{3-} Remained low in the improved extensive and extensive ponds but its initial level was much higher in the intensive ponds due to fertilisation of the ponds. This was assimilated over a span of 4 weeks to low levels before rising slightly due to shrimp feed inputs and shrimp excretion with increasing biomass



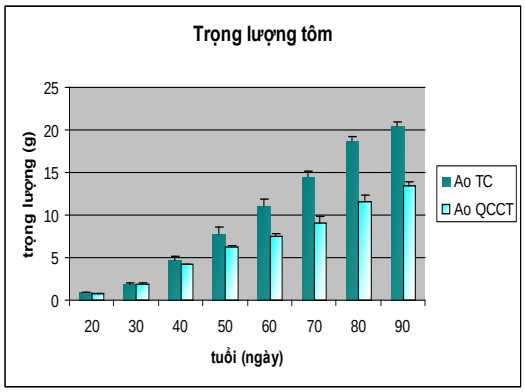
Đồ thị 4.13. Biến động hàm lượng PO43- hàng tuần trong các mô hình nuôi

Chemical Oxygen Demand. COD increased during culture time for the intensive ponds but remained relatively stable for the improved extensive and extensive. However all remained within the optimal level.

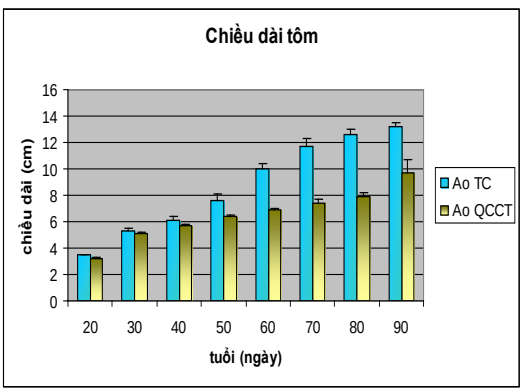


Đồ thị 4.9. Biến động COD theo thời gian nuôi

Growth rate: The **g**rowth rate of shrimp was faster in intensive pond due to the additional feeding. They achieved an average size of 29 grams in 90 days. By contrast, the size of the shrimp in the improved extensive ponds were 14 grams during the same culture period.



Đồ thị 7. Tăng trưởng về trọng lượng



Đồ thị 8. Tăng trưởng về chiều dài tôm

Feed and feeding regime: The traditional extensive systems were mainly based on the natural food production in the ponds. In the improved extensive ponds there was some feeding. In the intensive ponds, the shrimp were given formulated feed. No home made feed was used.

Disease outbreak: Because the quality of fingerling was not tested before stocking and due to the limited management skills of farmers, disease outbreaks occurred and quickly spread over a large area. Farmers are encouraged to adopt the improved extensive model because of technical and economic consideration and less water resources degradation.

Use of probiotics

In Tan Duyet, Ca Mau there were some disease problems with one intensive farm but the disease was treated quickly with Betel Bokashi a combination of Betel juice and micro-organisms mixed with the feed at 20 ml/kg for daily feeding. Betel Bokashi is used like a probiotics to control the water quality and improve shrimp health. This was also applied in Vinh Hung, Thua Thien Hue during the period of 21 days to 60 days, also with amount of 20ml per kg of feed on feeding.

Results of water environment parameters after 60 culture days: During the experiment, water parameters did not change: S, T, pH, kH compared between control and trials. On the whole, these parameters still fall within the scope of compatible threshold for shrimp culture. However, the salinity of the stages is quite low, an average of 8.65 – 8.7 ‰, which might affect shrimp health. The distinction of using EM (Effective Micro-organisms) in order to improve those water parameters is shown apparently by: water colour, clarity, NH3 content and DO. The pond applied with used EM had a better water colour and clarity than control pond. NH3 content was not detected in experimental pond in first feeding stage 40 d-period. DO was kept at 4.87±0.18mg/l, higher than control pond, 4.30 ± 0.17 mg/l ($P < 0.05$).

BOD_5 in second feeding stage 40 -60 d-period: Bokashi product applied into the trial ponds increased from 5.2 to 5.7 mg/l, while control ponds did not change. The result indicates that EM and betel leaves product have a positive effect on environment, and water quality, which enhanced shrimp performance in the ponds

Total of E.coli and Coliform: The product was useful for water quality and seemed to improve resistance to harmful bacteria as E.coli. It is shown in Fig.2a; 2b, after 40 d-period, 1– 4 CFU/ml in water and 2 – 12 CFU/ml in bottom mud, lower than control pond,1–10 CFU/ml and 2 – 18 CFU/ml, respectively ($P < 0.05$). Coliform at the control pond, 10^4 CFU/ml was higher than in the trial ponds 8,5 x 10^3 CFU/ml, after 40 d-period, ($p < 0,05$). *Saccharomyces cerevisiae* and actinomycetes group *Strepptomyces spp* in EM products can reduce the density of harmful bacteria in the environment.

Total vibrio*:* The results showed that Vibrio density in control pond was 0.32 x 10^3 CFU/ml in water and 35.8 – 36.2 x 10^3 CFU/ml in mud, while Vibrio in trial pond was 0.19 x 10^3 CFU/ml and 11 x 10^3 CFU/ml, respectively, $P < 0.05$. A test of *Saccharomyces , Aspergillus sp., Penicillium*, conducted by Gilda Lio Po et al. (2005), showed there are seven fungus strains that have the ability as intracellular inhibitors of Vibrio. Thse are the *Rhodotorula sp., Saccharomyces sp., Candida sp., Penicillium sp., Mycelia sterilia* and two other chains.

Vibrio infection of shrimp: Vibrio in shrimp body of trial and control ponds were different, there differed; in Fig. 5 the control pond was more vibrio infection detected in the control pond than the trial ponds, 1480 CFU/ml compared with 770 at 40 d-period and 3570 CFU/ml and 1460 CFU/ml at 70 d-period, respectively ($P < 0.05$).

MBV infection in shrimp: MBV was detected in onlyinfection wsa only 3% in the trial ponds and was 9 times lower than contro. The correlation between the extent of infection and the treatment with EM, betel Bokashi treatment and infection by Vibrio, MBV, (r1 0.907) and MBV (r2 = 0.940), $P < 0.05$.

However, in two areas for safe aquaculture there were still some disease risks. There was parasitic infestation (*Gregarine*) in one pond, which occurred 4 weeks after stocking; treatment with Sodium Tripolyphosphate / STPP stopped the infestation after 3 days of treatment. In Ca Mau, one intensive pond was infected by WSSV before the project started and the farmer disinfected the pond using chlorine at a concentration of 30 ppm. After 3 weeks, the pond was prepared again for another stocking of PLs and remained disease free until the end of the activity.

6.3 Analysis of safe aquaculture zone and non safe aquaculture zone

Non Safe aquaculture zone: the area with many small-scale farms that are unregisted or illegal, lack of government investment in infrastructure i.e. water supply and discharge canals and protection dikes and lack of crop planning.

Farmer group formation in the safe aquaculture zones in the two communes: all farms were members of Cooperative. They follow same crop planning and same crop calendar. This gives more opportunities for mutual help, and helping disadvantaged farmers. The techniques were applied following the Better management practices. Regular information and knowledge sharing on Better Management Practices was encouraged by farmers that are members of the group.

Cooperation in buying high quality farm inputs (seed, feed, lime etc) at competitive price.

- Increase efficiency and productivity by reducing the risk of shrimp health problems: Farmers complying even with only two recommended practices i.e. (i) testing of seed for White Spot Syndrome Virus (ii) and removing sludge before stocking - no infection of WSSV, HPV, GAV, BMN in the despmntration ponds in Vinh Hung compared with 10% viral infection in the non safe aquaculture zone and reduced the risk of MBV infection from 10% in non-safe aquaculture zone to 7% in safe aquaculture zone (more detail in annex 4).
- Reduce the impacts of farming on the environment: No antibiotics are used in Cooperative shrimp farms. Use of other chemicals are also minimized by implementation of BMPs. Farmers are encouraged to prevent rather than treat diseases
- Improve food safety and quality of shrimp farm product; and Improve the social benefits from shrimp farming

6.4 Problems and costs for implementation by the farmer.

Problems.

- The farmers are reluctant or unable to invest in the extra costs needed to implement better practices
- The farmer does not have access to funds for the extra costs.
- There are not many hatcheries producing certified disease fry seed

6.5 Change farmer behaviour

All farmers interviewed agreed that there has been a decrease in the quantity of aquatic products available during the past five years. In particular a sharp decline has been observed in the last year 2004-2005. The market is unstable in the recent years. The price of products for exporting decreased because of low quality. Antibiotic and chemical

residues are the serious problems in the exporting. However, all farmers interviewed said that they did not know about BMP.

The series of training courses and workshops on BMP (what is BMP, the benefit of BMP applying,...) was organised to the farmers. After that they would apply BMP if it is simple and easy for applied. Especially, they will apply BMP guideline if their output products would be sold with high price and they have a stable market. Participatory BMP guideline was developed in the series of workshop with local community. The guidelines consensus of all members, therefore, all members willing follow the guidelines. Participatory BMP planning was conducted to decide the steps and the time for applying each BMP step in Vinh Hung and Tan Duyet commune.

Technical support (such as farm field school) was done monthly by technicians from HUAF supporterd by the resident students to help the farmer to follow the BMP guidelines as well as help the farmers in problem solving during the culture period. Farmers did work together and ensure the mutual agreements between tiger shrimp farmers in the stocking time, seed sources, culture techniques in the whole of area. This showed that by doing same thing following the culture calendar farmers changed their farming activity and this leads to reduce the risk of shrimp diseases.

Change farmer behaviour

- The result of SAZ should clearly show to farmers that their extra investment will be more than covered by higher income;
- The farmers should be convinced by the results that working cooperatively, as required by an SAZ, increases the success of their crops;
- The farmers should be convinced that being associated improves their profitability by among others reducing their transaction costs (better deals with feed and seed suppliers and lower marketing costs) and increasing the price of their products (from higher quality shrimp and more reliable harvest and therefore reliable supply to processors

6.6 Cost Benefit to farmer

The additional costs for the farmer to implement Safe aquaculture in their ponds (2000 m2) are the costs to cover

- Lime to control pH of pond bottom
- Lime box to control pH of incoming water
- Chlorine to disinfect soil and water filling the pond
- Fine mesh nets to filter wild shrimp, crabs and fish from entering the pond
- Disease tests in hatchery and nursery
- Additional cost to purchase better quality fry (stocked at 6/m2)
- Crab traps around pond to catch wild crabs

Zone costs to implement

- Signs at the entrance to the safe zone
- pH control in inlet channel
- Fine mesh nets on inlet canal and in front of pump suction pipe
- Setting up a management committee

Actual costs for implementation of safe aquaculture

	Farmer expense (VND/pond)	Joint expense (VND/area)
PCR test in hatchery (1)		180,000
PCR test in nursery pond (2)		360,000
Additional cost for better quality	180,000	

seed		
Purchase better quality fry (difference between poor and good)		
pH Control in inlet supply		200,000
pH Control in pond	60,000	
Double layer filter for wild crustacean in inlet supply		800,000
Double layer filter for wild crustacea	200,000	
Crab traps	100,000	
Chlorination of pond bottom	400,000	
Pipe and pumping costs for low water ponds		1,500,000
Signage around safe area		1,000,000
Setting up management committee		1,000,000
Total	940,000	5,040,000
Cost per pond	940,000	560,000

The total additional costs for implementing the safe aquaculture was 1,500,000 VND per pond.

The production cost is shown in the table below.

Production costs for improved extensive shrimp culture systems

Variables	Improved extensive	
	Số tiền (đồng)	% tổng chi phí
Seed and PLs	1.200.000	17,14
Feed and feeding	3.000.000	42,86
Medicines and disinfections	300.000	4,28
Bio-products and EM	400.000	5,71
Materials	1.000.000	14,28
Labours	1.000.000	14,28
Others	100.000	1,45
Total costs	7.000.000	

Harvest size (shrimp/kg)	% production
>35	10
35 - 50	50
50 - 80	20
80	20

If the farm did not have any major disease problem they would expect to harvest 150 to 170 kg per pond.

From the farm survey of actual production results there was an average of between 35 and 40 % mortality from a variety of diseases (WSS, YH, RBD and BKC) and 80 to 90% of all farmers have some problem with disease.

With a typical loss of 35 to 40% of shrimp due to disease, the loss of income would be 60 kg of srimp per crop. At an average price of VND 100,000 per kilo, the value of the loss would be 6 million VND.

Therefore the 'investment cost' of 1.5 million VMD required to follow the Safe aquaculture practice gives a potential return of 6 million VND.

6.7 Discussion

The ability to implement safe aquaculture zones and practice depends on a number of factors

- Pond area design
- Pond design
- Technical support
- Distance to hatcheries and number of hatcheries supplying the area
- Culture system

The implementation of the safe aquaculture zone was **easier in Hue** because

- The pond design was more appropriate for a safe zone
    - the ponds were high tide ponds provided with water from a single inlet channel and a pump station
    - The ponds drained into a common effluent channel that took effluent and returned it to the lagoon approximately 2 km from the inlet canal
    - The ponds had separate inlet and outlet gates
    - The zone was physically separated from ponds outside the zone by the main inlet channel.
- Zone management
    - The shrimp farmers cooperative covered the whole safe aquaculture zone and other ponds outside the zone
    - Technical support was easier to provide as it was closer to Hue University
- Hatcheries
    - The shrimp farms are supplied from a small number of hatcheries in the region and it was easier to organise disease testing of seed and organise for the safe aquaculture farmers to purchase the disease free seed.

The implementation of the safe aquaculture zone was **more difficult in Ca Mau** because

- The pond design was not appropriate for a safe zone
    - the ponds were middle tide ponds supplied with water from individual gates along the river
    - The ponds have only one gate which means that effluent water is mixed with intake water from the river. There would be need for a major engineering work (and cost) to create a separate effluent canal to collect effluent from all the ponds in the zone.
    - Although the zone was on an island that was physically separated from ponds outside the zone, the river system that surrounds the zone is used for both water supply and drainage so that there is always the risk that effluent water from a pond outside the zone that carried pathogens could be used as intake water by ponds inside the zone.
- Zone management
    - Technical support is difficult as it was much further from Hue University
    - There was no disease testing faciliy close by
    - The production systems in the zone are a mix of intensive, improved extensive and extensive so that three different safe aquaculture protocols need to be developed.
- Hatcheries
    - The shrimp farms are supplied from a large number of hatcheries outside the region and seed is provided by middlemen whose batches of seed are probably mixed. There is no chance for the farmer to visit the hatchery and

select quality fry. It is very difficult to test for disease because of the distance to the nearest laboratory.

Ao nuôi QCCT

Cải tạo ao nuôi QCCT

Ao nuôi CN

Cải tạo ao nuôi CN

Tôm thu hoạch ao nuôi QCCT

Tôm thu hoạch ao nuôi QCTT

Culture systems.

Intensive shrimp pond culture

- It is **easier to implement** safe aquaculture in intensive ponds because
  - The design of the pond systems is already closer to that required for safe aquaculture zone, separate inlet and outlet channels, separate pond inlet and outlet gates, etc
  - The technical and management skills of the manager are usually better

- It is more cost efficient to erect crab nets around the farm or ponds, to have footbaths at the entrances, to erect warning signs at the entrances etc.
- There is usually access to funds to make the necessary changes
- The farmer can be convinced not to use home made feeds

Improved extensive

- **It is possible** to implement safe aquaculture in improved extensive ponds if
  - The design of the pond area already has separate inlet and outlet channels, separate pond inlet and outlet gates, etc
  - If there are no extensive shrimp ponds bordering or close by
  - The farmer is willing to implement new production methods, but use disease free seed and keep records of operational data
  - If the farmer is willing to invest in water filtration nets, crab traps, etc
  - The farmer can be convinced not to use home made feeds

Extensive

- It is **almost impossible** to implement safe aquaculture in extensive ponds (in terms of biosecurity)
  - The design of the pond area typically has only one gate for water intake and effluent discharge
  - The farmers usually have less technical and management skills to implement new production methods
  - The farmers do not normally have sufficient funds to make or buy water filtration nets, crab traps, etc
  - The ponds are stocked and harvested continually
  - The ponds cannot be drained fully for drying between culture cycles.
- However the extensive system does not use chemicals or feeds so it is safe in that it has minimum impact on the environment and the shrimp is safe for human consumption.

Regulation on inspection and recognition of sustainable-oriented aquaculture
Scope and subject of application

This Regulation applies to the process, procedures, responsibility of agencies, organizations and individuals in the registration, inspection and recognition of sustainable-oriented aquaculture establishments.

This Regulation applies to agencies, organizations and individuals subject to registration, inspection and recognition of sustainable-oriented aquaculture establishments in Vietnam.

6.8 Management committees for safe aquaculture zones

Management and planning the safe shrimp zone

1. The development of a safe shrimp zone can be only done if the aquaculture area has been planned for shrimp and with the approval of the correct level of authorities.
2. Detailed planning of a safe shrimp zone should be undertaken to ensure suitable system, drainage to meet technical requirements to avoid infectious diseases between the ponds in the area or between ponds in the zone and neighbouring ponds, ensure the good natural conditions, economic profitability and food safety

Environmental management of a safe shrimp zone

The environmental management of safe shrimp zone for intensive forms of aquaculture are implemented as stipulated in Regulation Environmental Management regional focus shrimp (promulgated with Decision No. 04/2002/QD-BTS 24 January, 2002 of Ministry of

Fisheries); management environment for shrimp breeding area in the form of a highly visible and measurable improvement, and by complying with Environmental Protection Act of 2005.

6.9 Conclusions to the start of safe aquaculture

Safe aquaculture was implemented 67 households in Ca Mau and 55 households in Vinh Hung, Hue with 9 ponds in each safe artea followed closely. There was reduced disease in the ponds that practiced safe aquaculture compared to those not practicing; the latter suffered 40-50% infection of white spot disease (Hue).

This activity showed that safe aquaculture practice can be implemented in certain areas and in certain types of culture system and that disease outbreaks are reduced compared to non-safe zones. However there are a number of factors that influence successful implementation.

- Community attitude is an important factor in the successful implementation of safe aquaculture
- Site location is important (away from pollution, good water replenishment, etc)
- A good design of the pond area infrastructure (inlet and outlet canals, water treatment ponds) and pond design (separate inlet and outlet gates) are important for establishing a safe aquaculture zone. Areas and ponds with poor design may need further investment to improve the design.
- Seed must be tested for disease pathogens before stocking
- Some farmers lack the money for any additional expenses (disease free seed, commercial feeds, water filter nets, etc) Incentives may need to be given initially to demonstrate to the farmer that the additional expenses for following safe aquaculture practice result in less disease and higher productivity
- It is easier to implement safe aquaculture in intensive and improved extensive culture systems. It is almost impossible to implement safe aquaculture practice in extensive pond systems.
- It is almost impossible to implement safe aquaculture practice in areas where there is a mix of culture systems (intensive, improved extensive and extensive).
- Significant technical assistance to the farmers is initially required to implement safe aquaculture
- The process for implementation must be a step by step process starting from the implementation of safe aquaculture practice progressing towards full certification of the safe aquaculture zone.
- There should be farmer field training to key farmers, farmer to farmer training and training of trainers to provide technical information and explain the reasons behind the safe aquaculture practice.
- A promotion Centre should be established where farmers can come and learn from each other and exchange experiences.
- After agreement of the regulations of safe aquaculture zone, all of the farmers that are in the safe aquaculture zone should have to sign a contract with the community at the promotion center to commit themselves to implement the safe aquaculture zone, and agree that if they make any infringements to the regulations, they must rectify this or face fines from the community. The farmers fear being ostracised by the village or community.
- At the start, there should be technical assistance provided to the community (such as by university staff or the extension agency) to explain the safe aquaculture regulations and guidelines and to supervise the implementation and help with any technical problems.
- Implementation of safe aquaculture needs to be initially demonstrated to a few key farmers and then extended to a larger number of neighbouring farms.

- For each safe aquaculture zone key farmers (RDFs) should be identified and encouraged to demonstrate what they have done in their aquaculture systems and impart their techniques and experiences to the group and community.

7 Recommendations for planning, implementation management and control of safe aquaculture

7.1 Identifying safe aquaculture areas and zones

The key to establishing a safe aquaculture zone is to have a number of neighbouring ponds within an identifiable zone with physical borders or buffers.

Neighbouring ponds
The selected ponds should be contiguous to one another, with all ponds in the zone following the safe aquaculture management protocols.

Pond and zone Inlets and outlets
The ponds should have individual inlet gates from a source of water which could be directly from the estuary or river or a shared water supply channel for the zone. The pond should have separate effluent gates (from the inlet gates) and these should drain back into the estuary or river at a significant distance from the inlet. For a zone, it is preferable to have a shared effluent channel that drains into effluent treatment ponds before being released into the receiving water.

Clearly defined borders to the safe area
These borders can be water supply channels, water effluent channels, rice fields, etc. The borders could also be buffers for example a series of shrimp ponds that are surrounded by fish ponds and so separated from the other shrimp ponds by fish ponds.

Mapping pond corners, inlet and outlet channels
The ponds should be accurately mapped (preferably using GPS) and a plan of the main inlet channels and outlet effluent channels made.

Cataloguing culture system, culture species and productivity
There should be collection of data on the culture species and culture system and present productivity.

7.2 Scales of safe aquaculture zones (sharing common water source)

There are a number of different scales that could be designated as safe zones from individual farms to a whole river basin. The safe aquaculture zone could be implemented step by step starting with individual farms, then clusters of farms eventually including all farms on a shared water source or river basin.

Individual pond or farm
The safe zone could be at the scale of an individual farm that practices safe aquaculture. For example an intensive shrimp farm that practices strict biosecurity and safe aquaculture, has separate inlet and outlet channels and is separated from other farms by fences could be a safe zone. However according to the regulation, a safe shrimp zone should have at least two farms.

Clusters of contiguous farms
Clusters of farms all practicing safe aquaculture in a specified zone with an identifiable buffer or border between other farm areas could be a safe zone.

All farms within a river basin or coastal zone
On a larger scale, all the farms in a river basin where all farms follow safe aquaculture practice could be a safe zone.

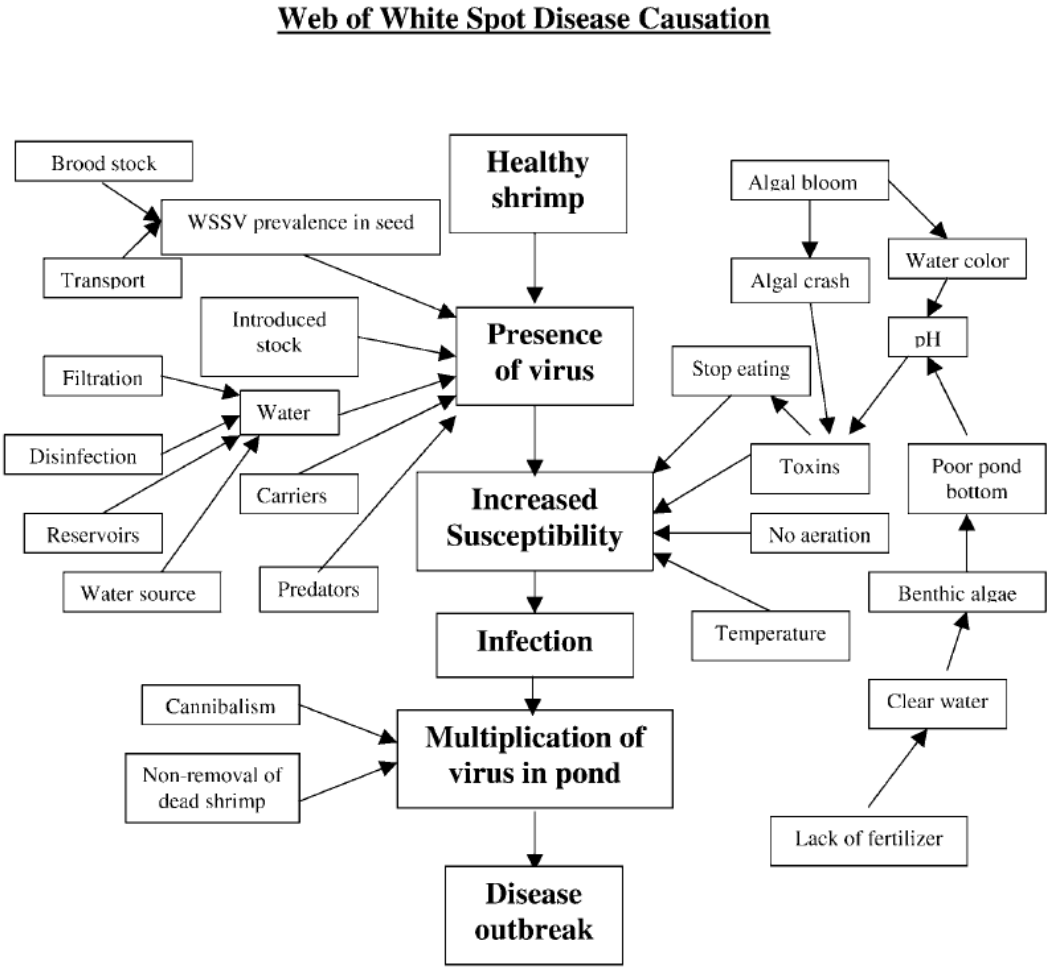
7.3 Disease Control

Disease outbreaks at farms are not caused by any one factor but rather a number of risk factors that influence the occurrence of disease in the farm. These risk factors occur throughout the shrimp cropping cycle and in general terms fall into the following categories during the different stages of the crop cycle:

- Season of stocking
- Pond preparation
- Pond filling and water preparation
- Seed quality and screening
- Water management
- Pond bottom management
- Feed management
- Disease treatments

At each stage of the cropping cycle, a number of factors influence the development of the disease in individual animals and also in the population of shrimp in each pond. Disease can enter the shrimp and pond through different routes, including shrimp seed, water, carrier animals and transfer of infected animals and farm equipment from one farm to another. Adverse environmental factors combined with a high incidence of infected shrimp among the pond population are necessary for a mass disease outbreak to occur. Management methods/practices can be used to control environmental factors and reduce risks of disease outbreak occurring in the pond.

To be successful in controlling shrimp disease, the farmer has to manage all potential risks at different stages of the cropping cycle. The different causes of disease outbreak are illustrated below



Source: NACA shrimp health manual

7.4 Identification of risks

Risk analysis is a powerful tool that allows risks to be identified, quantified and prioritised. The “risk” is the potential for realisation of unwanted, adverse consequences to human life, health, property or the environment. Its estimation involves both the likelihood (probability) of a negative event occurring as the result of a proposed action and the consequences that will result if it does happen.

As an example, taken from pathogen risk analysis, the Aquatic Animal Health Code (OIE, 2007) defines risk as:

“Risk – means the likelihood of the occurrence and the likely magnitude of the consequences of an adverse event to public, aquatic animal or terrestrial animal health in the importing country during a specified time period.”

Risks from aquaculture

- Risks from disease
- Risks to the environment
- Risk to food safety
- Risk to self-pollution

Risks to aquaculture

- Pollution, water quality
- Climate change

Upstream hazards

- Hatchery supplies
- Feed supplies
- Medication and chemical suppliers

In the overview of main disease risks affecting household scale shrimp producers in the Mekong Delta undertaken by Hambrey (SUDA Activity 3.2.1.), the environmental and disease risks are presented in Table 1

Table 1: Characteristics of main disease risks affecting household scale shrimp producers

Hazards	**likelihood**	**severity**	**uncertainty**
Seed quality	high	moderate	moderate
Widespread release of infected *L. vannamei*	high	High	high
Water quality	moderate	moderate	low
Increasing resistance to antibiotics	moderate	moderate	moderate
Disease in pond sediment	moderate	moderate	low
Disease in supply water	high	High	low
Disease from carriers	high	High	high

Source (Hambrey 2009).

Hambrey took into account the likelihood, severity and uncertainty of the risks to household scale producers of shrimp and ranked them in terms of priority for action and research as follows:

1. Disease spread related to illegal import/release of *L. vannamei*
2. Disease spread through carriers
3. Disease spread through water supply
4. Seed quality
5. Excessive use of antibiotics
6. Feed quality
7. Pathogen accumulation in sediments

8. Designing safe aquaculture ponds and farms

Ideally, to be able to establish safe aquaculture zones, the process should start at the design and construction stage and should include;

- Correct site selection for the zone
- Separate water inlet supply and effluent discharge systems to the zone
- Separate water inlet and outlet systems in the ponds
- Suitable soils
- Suitable water quality
- Sufficient pond water depth
- Inlet water treatment area
- Effluent water treatment area
- Physical or natural buffers between different safe aquaculture zones

8.1 Site selection

Site selection of safe aquaculture zones should take into consideration

- Identifying risks in planned area
- Buffers from sensitive habitats and species
- Distance from sources of pollution
- Suitable water quality

The safe aquaculture zone should be in a well selected site. For example if the water quality is poor with high siltation from rivers, rapid changes in salinity, or poor replenishment of water then shrimp will be stressed and more susceptible to disease, Even if biosecurity is enforced in the zone the zone will always be more vulnerable to disease outbreak.

Water replenishment
The replenishment of water or residence time in the water body is important for dilution of nutrients in the effluent from the ponds, the background bacterial levels and water quality for filling and water exchange in the ponds.

Water quality
Shrimp production depends on a supply of good quality water and maintaining good water quality in the ponds. If water quality is poor or variable, there is a risk to growth, health and survival. In many areas there is increasing risk of poor water quality due to urbanisation, industrialisation and from increasing aquaculture development.

Salinity
Shrimp do not respond well to sudden changes in salinity, and rainfall patterns have become more erratic, with increased rainfall for example in the dry season. Furthermore, erratic heavy rain may result in poor water quality because of runoff from upstream. This poses a significant risk for producers by causing stress to the shrimp making them more susceptible to disease. Farms that are located in areas prone to rapid changes in salinity will tend to suffer increased disease incidence.

Temperature and temperature fluctuation
Sites that are at the extremes of the temperature range for optimal growth (too hot or too cold) or suffer from wide temperature fluctuations (hot days/cold nights) will also be problematic for production. This tends to be more pronounced when the water is taken from a shallow waterbody.

Number and intensity of farms in the area
There is increasing risk of poor water quality and disease outbreak due to the increasing number and intensity of farms in the area.

8.2 Zone and pond design

The safe aquaculture area should be planned and designed before the pond development starts. It is often more expensive to modify pond or farm design after it has been built and is operational than planning correctly in advance. However planning pond layout, pond water supply and treatment needs to be flexible to allow for changes in culture species in response to shifting market conditions.

Separate inlet and effluent water supplies and water treatment
The concentration of shrimp farms in an area means that transfer of disease between farms through the water supply is likely. The level of risk is higher in areas where the density of farms is highest and where water intakes and effluent outputs are to the same water body.

There are three ways to address this problem

- Building separate water inlets and outlets
- Treatment of inlet water
- Treatment of effluent water

Inlet water treatment area
The use of supply water reservoirs and water pre-treatment is relatively common for intensive production, but remains rare for improved-extensive systems and is often non-existent for extensive producers. It should be a standard practice in all improved-extensive and intensive systems.

Effluent water treatment area
In shrimp culture, waste loading comes from two sources: shrimp feed and shrimp excretion. These organic wastes and nutrients consist of solid matter (mainly uneaten feed, faeces, and phytoplankton) and dissolved metabolites (mainly ammonia, urea and carbon dioxide). Uneaten feed and excretory products sinking directly onto the pond bottom can have a significant effect on the sediment quality and on the health of shrimp living there.

Aquaculture wastes that are discharged to receiving water have a measurable impact on the environment. Thus, aquaculture activity is focusing its attention on development of technologies for improvement of effluent quality and pollution loading. In most cases, a significant fraction of the biological oxygen demand (BOD) and organic nitrogen waste can be removed with simple settling technology.

An effluent sedimentation area is required particularly for higher intensive production. Most intensive shrimp farmers have settling ponds however few semi-intensive producers use sedimentation ponds. Extensive systems pose no significant threat to water quality in the wider environment. Farmers can use either a common sedimentation area or zone or have their own sedimentation area for effluent water. Depth of the sedimentation area should be one meter. To reduce the organic load of water, it is recommended to culture bivalves and seaweed in the sedimentation area to strip excess nutrients from the water (See SUDA Activity 334).

Effluent water may be discharged to the environment under gravity. Minimum sedimentation area is 10% of farm operating area.

9. Implementing safe aquaculture practice

Implementing safe aquaculture practice should be undertaken by implementing biosecurity measures and good aquaculture practices.

Biosecurity - Reducing risk of disease
Control of

- Water supply and quality
- Disease carriers (wild shrimp and crabs)
- Disease free post larvae
- Shrimp feed (home made feed)

Environment

- Reduced nutrient effluents to the environment
- Reduced water exchange
- Prevention of salination of groundwater
- Prevention of impact on sensitive habitats and species

Food safety

- No use of banned medication or chemicals
- No use of antibiotics
- Implement correct withdrawal time
- Hygienic harvest and post harvest
- Maintain cold chain

9.1 Participation

Every farmer in an aquaculture zone should participate in the implementation of biosecurity and safe aquaculture practice. If one of the farmers does not conform and stocks diseased seed, then all the other farmers are at risk and it is not a safe zone.

9.2 Operational planning

There are some management practices that can minimise disease outbreaks

Crop calendars and seasonal planning
In many cases the outbreak of disease is seasonal. Temperature is an important factor, as *Penaeus monodon* is more susceptible to WSSV at lower temperatures. Whilst the weather pattern may vary from year to year, it is therefore desirable for farmers to stock shrimp avoiding high-risk periods. Crop calendars which are linked to long range weather forecasts can be developed to help with the optimal time for stocking.

Disease prevention and control plan
General biosecurity precautions need to be established in each zone to help support the activities of both disease prevention and disease control. A short manual of standard operating procedures (SOP) should be prepared by the safe aquaculture zone management committee to provide a set of standard rules and guidelines for biosecurity measures and disease monitoring.

The manual should include such things as

- zone map with pond and owners,
- water flow system Inlet and outlet,
- rules for limited or restricted visitor access to zone,
- visitor log book,
- disinfection procedures for pond water,
- disinfection procedures for shared equipment,
- a sludge disposal plan,
- pest control guidelines (crabs),
- general safe husbandry and management procedures.

This manual should also incorporate procedures to be followed if a disease is detected or an outbreak occurs. Record keeping is important to the success of any biosecurity program because it can provide accurate historical information about the health status, weight gains, feed consumption, treatments, and management practices of the ponds and zone.

9.3 Operation measures – Hatcheries

Hatchery Operations
Few hatcheries supply many farmers and so it is easier to target the hatcheries and encourage them to supply disease free fry rather than target the many small scale farmers to buy disease free seed. Biosecurity measures that should be introduced to hatcheries include

- Tanks for water storage and inlet water filtration and disinfection.
- Effluent treatment tank.
- PCR testing for WSD and MBV before receiving breeders to the hatchery to ensure that breeders are free from WSD.

- Breeders should be kept in the quarantine tank until test results are known. If the breeders are infected with WSD, they have to be treated or destroyed
- Post larvae should be subjected to screening by PCR for every cycle so that a whole batch produced by the hatchery is represented to ensure that each batch is free from WSD and MBV (level of <5 %). If any disease is found, the hatchery should be chlorinated and kept closed for a minimum of at least two weeks
- After every two or three operational cycles, the hatchery should be kept closed at least for two weeks and the hatchery disinfected and dried out.

The hatcheries should be encouraged to maintain Specific Pathogen Free (SPF) broodstock that are held in biosecure facilities and are routinely checked and found to be free of specified pathogens.

Due to the disease problems in broodstock collected from the wild and the periodic low quality and shortage of wild *Penaeus monodon* broodstock, there is a need for the selective breeding and development of domesticated broodstock. The development of such alternative sources of broodstock would also help to improve maturation and spawning success and limit the high price of broodstock during the seasons of highest demand.

Advantages of using domesticated and SPF stocks include:
- ready, year-round availability of disease-free broodstock;
- the ability to be selected for desirable traits such as fast growth rate, disease resistance and hence high survival, good FCR and increased production and productivity;
- reduced use of chemicals and treatments
- better adaptability of domesticated shrimp to captive environments, leading to reduced stress and better mating and reproductive success; and
- increased traceability of the origin of stocks and their past performance and future potential.

Currently there are a number of programmes aimed at producing domesticated stocks of disease-free *P. monodon* broodstock in Thailand and in Hawaii, United States of America (FAO, 2005). In Thailand there are hatcheries operating solely with domesticated broodstock (now 5th generation) held in ponds with water conditioning and treatment systems.

Seed – Poor quality
Seed quality is a key issue in shrimp production and can be problematic especially for small scale producers.

Poor seed quality may result in:
- Poor growth
- Poor FCR
- Vulnerability to disease and poor survival
- Poor quality product

Small-scale farmers are particularly vulnerable to poor quality seed due to their lack of awareness of the potential problems with poor quality seed. They are more inclined to buy cheap seed or there may not be hatcheries producing high quality seed in their area.

It is essential to test post larvae quality before stocking. Observations should be made on activity, colour, size, etc. from the selected tanks in the hatchery.

Specific Pathogen-Free (SPF) seed
Bringing new shrimp into the farm usually presents the greatest risk of introducing infectious disease.

One of the main ways to avoid the introduction of disease into the farm is to purchase shrimp/post larvae from a producer selling specific pathogen-free (SPF) seed. Though this does not eliminate all potential diseases in the seed supply, it does help reduce the risk of introducing the major pathogens of shrimp.

The farmer should check the quality of post larvae and if they are found to be good, post larvae should be tested for WSD by PCR screening. If the WSD disease is not found, stocking of post larvae could be carried out. If required, either pre growing ponds or Hapas could be used as nursery grows out tanks. Post larvae could be grown 1 month in these nursery facilities before releasing to the grow-out pond.

In order to achieve this, the hatcheries should be encouraged to establish domesticated in-house brood stock and spawning facilities.

9.4 Operation measures – Pre-stocking

A number of measures have been identified that can significantly reduce the risk of disease outbreaks and improve shrimp production.

- Removal of bottom sludge, particularly in ponds stocking higher densities.
- Ploughing of soil when wet.
- Use of lime in pond preparation.

There are management practices that can be adopted to reduce risk factors associated with pond filling and preparation of water before stocking. These include:

- Water filtration (mesh of 60 holes/sq inch) reduces the risk of disease outbreak through reduced introduction of carriers to the pond.
- Disinfection of pond water can also reduce the risk of disease outbreaks in farms using higher stocking density (such as Nellore district).
- Fertilization reduces the risk of disease outbreak in lower stocking density farms.

Pond preparation
Pond preparation is essential to reduce risks of shrimp disease outbreaks. Shrimp ponds with a history of disease outbreaks have a greater likelihood of future disease outbreaks; therefore special attention is required during pond preparation in such farms. Farms with poor bottom soil quality, particularly the presence of a black soil layer, will suffer crop failures.

There are certain key pond preparation measures that are necessary to improve pond bottom conditions.

- Organic matter in the pond bottom should be removed even whether it is wet or dry. This sludge must be removed as if it left by the side of the pond (where it may drain back into the pond) it may constitute a risk to shrimp health.
- Lime is recommended to be used according to pH of the soil.
- Fertilizing of the pond is recommended according to the fertility of the pond soil

Pond disinfection
An important area of disease prevention and control that is often overlooked in the aquaculture industry is disinfection. Ponds (and water filling the ponds) can be disinfected by adding chlorine to the pond bottom just prior to filling the pond.

Quarantine during nursery

In addition to disease avoidance, a quarantine program should be implemented to isolate any new seed arrivals to the aquaculture zone into a separated nursery pond. The seed should be nursed separately for a minimum of 30 days. During this time, the shrimp should be monitored for signs of disease, sampled for disease testing after 30 days and if found to be free from disease then stocked into grow-out ponds.

9.5 Operation measures - ongrowing

Optimal management techniques, including stocking densities, nutrition, and genetics are essential for all aquaculture species to develop and maintain optimal health and resist disease.

Maintaining good water quality during on-growing
Poor water quality may lead to loss of condition, stress, disease, low survival, and poor food conversion.

There are a number of water management measures that can be taken to reduce risk of disease outbreak. These include:

- Water exchange practices – in ponds exchanging water to maintain water quality improves shrimp production.
- Water filtration - ponds using water filter nets of fine mesh have better production.
- High pH (>8.5) has an effect on the risk of disease outbreaks. In cases where pH exceeds 8.5, the toxicity of ammonia increases leading to higher stress conditions for shrimps.
- High salinity has an affect on the risk of disease outbreaks. In high saline waters it is difficult to maintain water quality, especially to maintain a stable microalgae bloom compared with that in low saline waters. Therefore, the stress on shrimp due to changes in bloom conditions may make them more susceptible to viral infection and subsequent disease outbreak

There is also a significant relationship between shrimp disease outbreaks and micro-algae and macro-algae in the ponds:

- Ponds with clear water at stocking and during the culture cycle are at risk from lower production and shrimp disease outbreaks.
- Green water (pond colour) ponds have better production and lower risk of disease outbreaks.
- Clear water with benthic and filamentous algae lead to lower production.
- Ponds with dead benthic algae observed during culture are at risk of disease and poor production.

However many household scale producers have limited options in terms of water supply and exchange, and may lack the means to treat incoming water, or effectively remove sediments between cycles.

Water used for filling the pond should be filtered through a fine mesh screen to filter crustacean, fish eggs and wild fish etc.

Feed quality and safety
Quality of feed (especially home made feed) is an issue, especially for smaller scale shrimp farmers. The consequences of using poor quality feed intentionally or unintentionally may be serious in terms of:

- Poor FCR
- Slower growth
- Poor condition/quality
- Susceptibility to disease

There are risks of disease transfer from home made feed to the shrimp if incorrect raw ingredients are used. If fresh feed ingredients such as snail or trash fish are used during the later stage of the cycle to improve growth, it should be only under close monitoring of water quality and a careful feeding strategy to avoid wastage. If possible it should be cooked to reduce risk of disease transfer. In no case should crustacean based ingredients be used in home made feed.

Farmers should monitor daily feeding in order to prevent excess feeding. A feeding record should be maintained at the farm to be used for monitoring purposes.

Accumulation of pond sediments
The occurrence of black and toxic bottom sediments has been shown to adversely affect shrimp health and lead to disease outbreak or poor production. The organic matter which accumulates in shrimp ponds is likely to harbour some diseases, and especially parasites. Complete emptying of ponds, drying, discarding or ploughing and disinfecting can eliminate most disease organisms.

Serious accumulation of sediments in ponds becomes a problem with more intensive forms of shrimp farming. Viral disease can probably survive in most ponds between crops unless there is significant fallow and pond bottom treatment. Household scale producers may find it more difficult to empty, dry and treat ponds, and there is therefore greater potential for pathogen accumulation.

There is a widespread and well documented tendency for growth and productivity in shrimp ponds to decline through time, and this may well be related to accumulation of toxins and disease organisms in pond sediments. Chronic disease in shrimp remains a major problem, and may be in part attributable to poor sediment treatment and management.

Possible management measures include
- Single crop with long fallow.
- Sediment drying and sterilization
- Sediment removal

Sludge removal
Cleaning the pond bottom is a very important pond preparation activity. The soil should be checked for the presence of black layer when it is in wet condition. If the soil is completely dried then the black layer will turn to a lighter colour due to oxidation, making it difficult to recognize that black layer in the soil. It is easy to remove the sludge when the soil is dry.

The sludge must be disposed of away from the pond site, so that it does not seep back into waterways, ponds, or cause other environmental problems. In farms with lower stocking densities, it may not be necessary to remove the sludge, unless there was disease outbreak during the last crop. In such a situation extra precaution should be taken. If the sludge is removed properly then management of the pond becomes easier during high pH periods, a common problem in areas with low salinity, and high plankton growth.

Sludge removal should pay attention to areas of the pond where there is a high accumulation of organic matter from previous crops, such as feeding areas, and the side ditches in extensive farms. Sludge has been found to be a good fertiliser especially for trees.

Ploughing
The main purpose of ploughing is to expose the black soil layer(s) underneath the bottom soil to sunlight and atmospheric oxygen. By this process, the organic waste (sludge) will be oxidised.

Presence of moisture in soil (*i.e.*, under wet soil conditions) during ploughing allows bacteria to work better in breaking down the black organic matter, thus making the ploughing process more effective. Ploughing on wet soil is particularly recommended when the sludge cannot be removed properly by manual or mechanical methods.

After ploughing, the pond bottom is dried for 5 to 7 days and the procedure repeated until no more black soil is seen.

The pond bottom soil should be checked on weekly basis, especially at the feeding area or trench. The occurrence of black soil, benthic algae and bad smell should be recorded. If the soil is black and smelly, water exchange should be carried out and feed reduced (using a feed tray to monitor requirements).

Disease carriers
Disease in carriers such as crab and wild shrimp is a significant and probably increasing risk for the transfer of disease. Diseases such as whitespot may well be widespread in wild crustaceans such as crabs.

This can be addressed by the following measures

- Filtering water intake water using a net of more than 60 holes/inch mesh (425 microns) that will prevent small shrimp or crab from entering
- Trapping wild crab
- Erecting crab nets between ponds

Equipment disinfection
There is risk of transferring disease between ponds through equipment that has not been disinfected between use. However, having separate equipment (nets, feed buckets, water sampling jars, etc.) for each production unit would be optimal in helping to eliminate the risk of contamination between production systems.

Equipment that has been in contact with shrimp from outside of the safe zone can spread diseases. To help minimize this risk, the farm equipment should be washed and disinfected before use.

- Nets should not be shared between farms unless thoroughly cleaned and disinfected.
- Equipment should be cleaned and disinfected between uses.

Vehicle disinfection
There is a risk of transferring disease between safe zones by vehicles especially vehicles transferring stock or equipment between farms or other facilities. Vehicle tyres and undercarriages should be cleaned with freshwater.

Visitors
When visitors to the farm are expected, consideration of relative risks allows you to develop and use practical biosecurity measures.

- **Low-risk visitors** - Visitors from villages or towns who have no contact with shrimp farms present very little risk of carrying diseases.
- **Moderate-risk visitors** - People who routinely visit fish farms but have little or no contact with the shrimp or culture water such as salesmen and delivery people present only a moderate risk of introducing disease.
- **High-risk visitors** - High-risk visitors include veterinarians, shrimp suppliers or shrimp buyers, neighbouring shrimp farmers, and anyone else who has close contact with shrimp or shrimp farms.
    - Visitors should wash their hands and feet.

- Equipment and instruments that have direct contact with shrimp should be cleaned and disinfected before and after use.

Probiotics
Some farmers use bacterial products (probiotics) to improve water quality. The addition of beneficial microorganisms may play an important role in safe aquaculture practice. Positive aspects of microbes include

- their potential to provide additional nutrients thereby reducing feed costs
- their role in maintaining good water conditions within the culture environment by reducing the presence of stressors like NH3, NO2, NO3 etc,
- their potential to stabilise microbial levels in the water and reduce bacterial infections caused by Vibrio and other bacterial pathogens

There is some research that indicates that selected microorganisms such as yeasts and yeast products offer several benefits: improving feed attractability, supporting growth by producing vitamins, minerals, nucleic acids and by stimulation of beneficial gut flora.

However, there is limited scientific evidence as to the efficiency of such products and there is a need for more research and field trials on the use of probiotics.

Immunostimulants
Shrimp do not develop a specific immune response. However the immune response can be boosted by the use of immunostimulants.

The immunostimulatory property of yeast cell walls (β-1-3 glucan, lipopolysaccharides, and peptidoglycans) to induce short-term non-specific immune response in shrimp can improve the ability of the shrimp to resist infection.

Regular disease monitoring
Disease monitoring should be an essential part of any biosecurity program. This consists of regularly checking the health of the shrimp and testing for disease.

Although disease testing cannot completely guarantee that there are no potential pathogens in a shrimp population, it does help reduce the risk of maintaining a pathogen in a population. Periodic monitoring can also help determine the number of individuals within a population that are infected, and the level or intensity of infection within that population.

Disease treatment
If there is a disease outbreak in a particular pond, prompt action must be taken to prevent the complete loss of the crop and the spread of disease to other ponds.

If a farm is observed to be infected with a disease, the Safe Management coordinating committee should be informed, as soon as possible. In order to inform nearby farms, a red flag should be erected at the disease-infected farm. Water from infected ponds should not be released to the environment. Farmers should strictly adhere to this.

If the size of shrimps in the infected pond is above 5 g in weight, a drag net could be used for harvesting. The remaining stock should be destroyed by using appropriate concentrations of suitable chemicals. Dead prawns, shells, parts of the bodies should be buried. Treated water should be discharged after seven days.

During periods of disease outbreak, surrounding farmers should try to avoid water exchange and should not use any equipment (nets, tanks, pumps, boat, *etc*) from affected farms. The aim of this practice is to avoid any risk of cross contamination of the virus or other disease causing agents.

Antibiotics and medication
There should be minimal usage of chemicals and no usage of banned chemicals. This leads to reduced cost of production and prevents problems for marketing of the harvested shrimp in domestic and export markets.

There is serious concern about the use of antibiotics and the use of certain medication. Their use in shrimp farming should be avoided. Warning signs can be erected to discourage use of banned chemicals such as those by FSPS Nghe An.

Harvesting
During harvesting, effluent water should be discharged to the sedimentation area to settle the organic load. Collecting prawns and transportation should be done hygienically in the best possible way.

Resting period
Ideally there should be at least 60 days rest period in between two culture cycles. Pond drying, removing organic load in the pond bottom, repairing dikes and canals, liming (if required) and fertilization (if required) can be carried out during this period.

Data recording
Keeping a pond daily record book helps to analyse the crop results, possible causes of disease, low yield etc. Also it helps to keep a check on crop related expenditures and income thus to improve the economic efficiency of the crop management by the farmer.

The following information on the farm operation should be recorded on a daily basis including;

- Pond preparation details
- Information on seed quality and quantity
- Hatchery name
- Date of stocking
- Treatments given to soil and water
- Water exchanges
- Feed quantity and type
- Numbers of observations made on any diseased or dead shrimps
- Water colour, pH, algae etc.

- Harvest date
- Harvested quantity
- Any other pond observations
- Expenditures on each activity and final income from sales.

9.6 Levels of safe aquaculture practice

It is almost impossible to introduce safe aquaculture practice immediately. First the farmers need to be convinced that safe aquaculture practice leads to reduced disease and increased profits (or reduced losses).

A range of steps can be implemented in terms of numbers of farms participating in the safe aquaculture zone or the level of application of the safe aquaculture practices.
These steps can be classified into three levels of application;

Easy/light

- Following local aquaculture regulations and legislation
- Below certification standards
- First step at implementing
- Low cost measures
- High impact measures
- Biosecurity

Intermediate

- Minimum certification standards
- Require some additional inputs (time, financial)
- Practices with some positive cost benefit

Difficult/strict

- Above minimum certification standards or GAP
- Require inputs without measurable cost benefit
- Responsible production/ Altruistic

9.7 Certification of a safe aquaculture zone

The Regulation on safe shrimp culturing Zone and shrimp farm management (decision No 06/2006/QD-BTS on 10/04/2006 by the Minister of Fisheries - See Annex 4) covers the certification of safe aquaculture farms and zones.

Safe shrimp farm certification
A farm applying GAP/CoC and satisfying all regulations of the Ministry of Fisheries on GAP/CoC will be checked by, then receive a Safe Shrimp Farm Certificate from an authorized body.

The shrimp in the ponds of safe shrimp farms or of those without Certificate on Safe shrimp farms but meet the sanitation and food safety requirements verified by necessary tests will receive a Certificate on food safety for cultured shrimp.

Safe Shrimp Culturing Zone Certification
Safe Shrimp Culturing Zone Certification can be given if 100% of the farms are applying GAP or CoC, and at least 80% of those have the safe shrimp farm certification in the zone. Initially this status will be checked by an authorized body and if found to conform, it receives a Safe Shrimp Culturing Zone Certificate.

The procedures of examination, issuance or withdrawal of a certificate on safe shrimp culturing zone, safe shrimp farm; certification of food safety for cultured shrimp will be regulated by relevant the Ministry of Fisheries's regulations.

The NAFIQAVED (including Fisheries Quality Assurance and Veterinary branches) is authorized for examination, issuance or withdrawal of Certificate on safe shrimp culturing zone and shrimp farm for intensive culture or semi-intensive shrimp culturing zones and farms.

The Provincial Fisheries Quality Assurance and Veterinary Body is authorized for examination, issuance or withdrawal of Certificate on safe shrimp culturing zone and shrimp farm for improved-extensive or extensive modes of culture; examination and certification of food safety for cultured shrimp for farms and shrimp culturing zones that have been checked and certificated on food safety by NAFIQAVED.

Based on the competence of Provincial Fisheries Quality Assurance and Veterinary Body, NAFIQAVED can authorize it to check and certificate the safe shrimp culturing zones and farms of intensive and semi-intensive culture.

Minimum acceptable standards
There should be minimum acceptable standards for the establishment and operation of a safe aquaculture zone based on

- Zone and pond design
- Safe aquaculture production practice
- Safe harvest and post harvest practice
- Safe zone management
- Effluent water quality

Measurable standards
These standards should be measurable in terms of their being "not met", "met" or "exceeded". They should be measured using standard methodology so that results are comparable. Measurement should be done by competent staff trained in measuring and evaluating the results. This initial evaluation and subsequent regular checks should be undertaken by an independent body or Government organisation.

Government recognition and registration of zones
The government should recognise the certification of safe aquaculture zones, register the names and details of the safe aquaculture zones and offer incentives (if possible) for further safe aquaculture zones to be established.

9.8 Stages of implementation

As mentioned earlier, the cooperation of the hatcheries supplying the seed to farms is required to regularly test their output for disease and quality.

Hatchery supplier

- **Quarantine area for newly caught broodstock.** The hatchery should have a quarantine area separated from the hatchery for the stocking of newly caught brooders.
- **Testing of broodstock for disease**. The breeders should be held in these facilities, tested for disease and if found to be disease free then they could be transferred to the hatchery for spawning. If they are found to be diseased they should be treated or destroyed.
- **Testing seed production for disease**. The hatchery should test each batch of seed for disease and only sell disease free seed to the farmers in safe aquaculture zones.

- **Testing for seed quality**. The hatchery should test the quality of seed in the presence of the farmer and only supply good quality seed to the farmers in safe aquaculture zones.

Following the experience from the implementation of the safe aquaculture practices in communes in Ca Mau and Hue, the suggested sequence of events of the setting up the safe aquaculture zone (existing ponds) is as follows

Producer

- **Information dissemination**. The farmers should be informed of the concepts and principles of safe aquaculture in a participatory manner by extension workers or other technically qualified staff.
- **Discussion with farmers**. There should be discussions with the farmers on how to implement the safe aquaculture practices and to find out which farmers are willing to follow the safe aquaculture practice
- **Identification of safe aquaculture zone**. The technical staff should identify the safe aquaculture zone where all the farmers in the zone agree to participate. The boundaries of the zone should be identified.
- **Data collection**. The technical staff should undertake a questionnaire survey of current aquaculture practice by the farmers in the zone as well as a sample of farmers outside the zone.
- **Workshop on safe aquaculture practice (1 day).** A 1-day workshop should be undertaken with the selected farmers and management committee to present the safe aquaculture practices to be followed. A written manual of the safe aquaculture practices should be distributed to all participants
- **Setting up management/coordinating committee**. A management committee should be set up comprising local leaders, representatives from the fishermen and fish farmer cooperatives, Women's union, etc.
- **Signage**. Signs should be erected at the edge of the safe aquaculture zone to identify the boundaries and request visitors not to enter without permission and disinfection. There should be foot baths at the main entrances to the zone.
- **Facilitated farmer field training (5 days**). There should be farmer field training undertaken to demonstrate pond preparation, pond water filling, and seed stocking techniques.
- **Safe aquaculture practice by farmers**. The farmers start to practice the safe aquaculture practices for seed selection, pond preparation, pond filling, feeding, pond management, disease treatment, harvesting, etc.
- **Monitoring and evaluating of implementation.** There should be a system of monitoring farmer compliance with the safe aquaculture practice. This could be undertaken by themselves, by monitoring each other's culture practices, or by regular visits to the ponds by a representative from the safe aquaculture zone management committee.
- **Minimum standards achieved by all farmers**. The safe aquaculture practices for the first culture season would initially be a form of Better Management Practices where better safe culture practice would be implemented. In this case the objective would be to improve the operational management. However during the second culture season, the safe aquaculture practice should be a form of Good Aquaculture Practice where compliance of culture practice is measurable against a minimum standard to be achieved. For example all seed should be tested for disease before stocking; All seed should be nursed in nursery ponds before stocking in grow-out ponds. Seed should be tested for disease before stocking in grow-out ponds, etc.
- **Application for certification**. Once all the cooperating farmers in the zone are complying with the safe aquaculture practices and everyone has achieved the minimum standards, they should apply for certification of the zone.

- **Checking certification compliance**. The Government should appoint an independent agency (it could be governmental for example the extension service or a private company) to check the pond, design and operational procedures and decide if they meet the minimum standards.
- **Awarding certified status**. If the minimum standards have been met then the zone should be awarded as a certified safe aquaculture zone. If there are certain criteria that have not been met, then they should be listed with recommendations on how to meet the criteria. The farmers should be given some time to make the necessary adjustments. These criteria should then be re-inspected and the zone certificated or not.
- **Formalising the management committee.** Once the zone is certificated the management committee should be formalised as a legal body.
- **Auditing certification compliance**. Once the zone is operational, there should be yearly inspections to ensure that the minimum standards are maintained.

10. Managing safe aquaculture

There are a number of steps towards setting up a management framework for the safe aquaculture zone.

Agreement between farmers to cooperate and follow safe aquaculture practice
It is very important for farmers to discuss the farming situation of the zone at regular intervals and to maintain a close watch for disease outbreaks in the surrounding areas. Organising cooperating farmers in the safe aquaculture zone in a formalised farmer club/association/society would lead to many additional benefits, such as common stocking dates and seed to minimize seed selection and transport cost. Similarly, they can collectively purchase feed, lime, fertilizers and other commonly used inputs. This minimizes the cost of inputs and assures farmers on the quality of the product.

The farmers' clubs can also procure basic instruments for soil and water quality parameter analysis (like pH meter, DO meter, kits for ammonia, alkalinity, etc.) and even some simple health management kits. During harvesting time, farmers' groups can negotiate with buyers, bargain reasonably good prices for shrimps and also get a premium price for high quality, chemical residue free shrimp which gives an added advantage to the farmer in marketing its product. Thus, the farmer groups can play a very important role in managing the source water quality and the local environment.

In addition, these may also be associated with “forum support” – effectively group insurance or shared risk to support a farmer who gets disease. This may be contributed to by a DARD disease prevention fund

Coordination committee overseeing implementation
Initially an informal safe aquaculture zone coordination committee should be established with representatives from the Commune, fishermen’s and fish farmer’s cooperative, women’s cooperative, RIAs, extension service. This committee should meet regularly to facilitate the farmers in establishing the zone and following safe aquaculture practices. They should also be involved with the monitoring of farm to ensure that farmers are following safe aquaculture practice and to coordinate the monitoring of pond effluent quality, disposal of pond sludge, and other operations.

Once the safe aquaculture zone applies for official status, a Management committee needs to be formally established.

Setting up SAZ management committees
The setting up of Safe aquaculture management committees is new and the structure and responsibilities will vary based on the local socio-political contexts and negotiations.

According to the Regulation on safe shrimp culturing Zone and shrimp farm management (decision No 06/2006/QD-BTS on 10/04/2006 by the Minister of Fisheries - See Annex 4) management board of the shrimp culturing zone (Management Board) must be established to assure the safe of shrimp culturing activities when there are least 2 farms desiring to register asafe shrimp culturing zone.

The organization and functions of the management board of a shrimp culturing zone are to act as the representative for member shrimp farm and is in charge of regulating the GAP or CoC application in the shrimp culturing zone in line with the regulations of GAP and CoC of the Ministry of Fisheries. The GAP and CoC of the Ministry of Fisheries will be issued and revised according to the technology development, market demands and production capacity and other relevant regulations.

The management board should;

- Facilitate the setting up of safe aquaculture zones
- Encourage the expansion of the zone to neighbouring areas
- Organise field farmer days for training members in safe aquaculture practice
- Encourage farmers to jointly buy and nurse disease free seed before stocking into ponds for production.
- Resolve conflicts between members of the safe aquaculture zone and between member and neighbours of the Safe Aquaculture Zone.
- Establish a People Fund for Shrimp Culturing Risk Supporting order to provide mutual support in disease control, natural disaster recovery and other risk prevention in shrimp culture. The establishment should be voluntary–based with open discussions among local organizations and individuals.

The purpose and benefits of the management board can be summarised as follows:

- it brings together safe aquaculture farmers with community and government decision-makers to communicate and take decisions on safe aquaculture zone initiation and management
- it builds the participation of the local community in the management of safe aquaculture zones
- it respects a consensus-based decision-making process
- it encourages self-management and self-monitoring and control

10.1 Encouraging safe aquaculture practice and zones.

The farmers will not form safe aquaculture zones unless they are persuaded in some way. This may be voluntarily or mandatory

10.1.1 Voluntary measures.

There are costs for the implementation of safe aquaculture practice or development of safe aquaculture zones. If the farmer can be convinced that by following the safe aquaculture practice and establishing a safe aquaculture zone, there will be less disease outbreak and better profitability, then they may take up the concept voluntarily.

Other ways to encourage uptake are as follows;

Better safe management practices (based on BMPs).
These are guidelines that encourage the farmer to improve operational practice taking into consideration biosecurity, protection of the environment and food safety. These BMPs should cover;

1. Pond preparation
2. Seed quality and stocking

3. Feed and feeding
4. Water management
5. Pond management
6. No banned chemicals
7. Harvesting and post-harvest

The implementation of BMPs has been successful in many other countries and lessons learned from these experiences are given in section 6.

Good safe aquaculture practices (based on GAPs)
These are measurable standards that the farmer must implement above a minimum acceptable level. These GAPs should cover standards for;

- Pond and zone location:
- Pond and zone design
- Disease testing
- Inlet water quality control
- Feed quality
- Chemical and medication use
- Biosecurity
- Effluent quality and disposal
- Sludge disposal

Safe Shrimp Culturing Certification
There are a number of safe certification schemes that could be developed.

8. Safe shrimp culturing zone (cấp hoặc thu hồi Giấy Chứng nhận vùng)
9. Safe intensive shrimp culturing farm (cơ sở nuôi tôm an toàn)
10. Food safety for cultured Shrimp (chứng nhận tôm nuôi đạt tiêu chuẩn an toàn thực phẩm)

10.1.2 Mandatory measures

The implementation of safe aquaculture zones could also be made mandatory. This is more appropriate to developing disease free hatcheries, better quality of feed or to farm areas that are at particular risk from disease.

Government regulations and legislation
The government could apply legislation of regulations to force the implementation of safe aquaculture practice or zones. However enforcement should be accompanied by some incentives available for the farmers to comply in order to help cover the additional costs or work involved.

Commune regulations
Safe aquaculture practice guidelines could be implemented at the community level particularly in communes where the shrimp farmers are suffering periodic or regular disease outbreaks. This would require capacity building at the community level from Provincial and Central government.

11. Control of safe aquaculture practice

If the implementation is through regulation or legislation, then there should be sufficient inspectors to monitor compliance.

If the implementation is voluntary, then it is more difficult to control compliance. However, there are a number of possible ways to try and control compliance.

Peer pressure. If the farmers are cooperating strongly and the coordination committee is monitoring progress, then peer pressure may be sufficient to ensure that all famers are following the safe aquaculture practice.

Fines (paid into a disaster fund). A system of small fines for not following correct safe practice could be introduced and implemented by the coordinating committee. These fines should be held in a disaster fund to assist farmers who suffer problems through no fault of their own (storm damage, floods, etc).

Expulsion from association/group. An extreme measure would be the expulsion of the non-complying farmer from the aquaculture zone. However, as all farmers in the zone must comply -- otherwise it is not a safe zone,-- this is not possible unless the ponds are on the edge of the zone and the zone can be reduced in size without compromising the safe operation of the remaining ponds.

Withdrawal of certification. If a farm or a zone has been certified, but the farmers do not continue to apply the safe aquaculture practice, then this should be noted at the regular inspection and the details given to the farmers on how to achieve the required standards. Upon re-inspection, if the standards have not been achieved then the certification for the safe aquaculture zone should be withdrawn.

12. Outcomes of Safe Aquaculture Zones and practice

The outcomes of applying safe aquaculture practice and having safe aquaculture zones are economic, social, environmental and food safety.

Social benefits

- There should be improved livelihoods due to the reduction in disease leading to improved survival, improved productivity and associated profits.
- The formation of safe aquaculture zones with cooperation between farmers and coordination committee members should lead to stronger community harmony

Economic benefits

- Improved productivity. As mentioned above reduction in disease will lead to improved profitability and better economic viability of the farm.
- Certification for safe aquaculture zones could lead to improved market prices for a product that is recognised as safe for the environment and safe to eat.

Environmental benefits

- There will be reduced impact on the environment due to
    - the use of effluent treatment ponds,
    - good pond management which will prevent the build up of anoxic sludge on the pond bottom and
    - reduced use of medication that might be released to the environment or accumulate in the pond sediment.

Food safety benefits

- Fewer disease outbreaks result in less chemicals and medication used and this will improve food safety of the product.
- Following best safe practice on harvest and post harvest practice will ensure that the cold chain is maintained from the farm to the consumer.

13. Follow-up activities

The project was only able to start the implementation of safe aquaculture zone for one culture period. It is hoped that the positive production results and reduction of disease in the ponds would persuade the farmers in these zones to continue to practice safe aquaculture and for the community to add new areas and zones.

Potential follow up projects to this activity are as follows;

Second culture season
Monitor the progress of the safe aquaculture zone for a second production season to reinforce the safe aquaculture practice and try to encourage more farmers to actively participate.

Safe hatchery practice
A key to reducing disease incidence is to ensure that all seed sold from hatcheries is disease free. A recommended follow-up activity would be to try to implement a safe hatchery with strict biosecurity and disease testing measures to try and produce only disease free seed.

Specific Disease Free domesticated broodstock
At present the majority of broodstock are collected from the wild and this is a potential risk to bringing disease into the hatchery. In addition, wild broodstock are expensive and not always available. The pond rearing of broodstock has now been demonstrated in a number of countries and allows the development of domesticated Specific Pathogen Free broodstock. It also allows selective breeding for faster growing strains. A follow-on activity could be to start the development of domesticated disease free broodstock in ponds.

Seaweed production in effluent treatment ponds to extract excess nutrients
Farmers tend to exchange water in shrimp ponds when there are algae blooms, the water quality is poor, or at the end of the production cycle. Therefore effluents from shrimp ponds contain a high level of nutrients and micro-algae which are released into the environment. Macroalgae can efficiently extract nutrients from water and offer a possible secondary crop to sell or use as ingredients or binders for home made feeds.

SUDA activity 334 investigated potential species of algae to grow in effluent ponds. A possible follow on activity would be to test the culture of macroalgae in effluent treatment ponds of effluent canals and estimate nutrient absoption and algae productivity. Macro-algae have also proved to be beneficial for inlet water treatment and are part of the protocol for the production of domesticated broodstock.

Funding and support from the Fisheries Extension Centers (FECs)
Support and funding for the expansion of the model into larger areas and more areas should be sought from provincial DOF offices and Fisheries Extension Centers (FECs) where they exist.

14. Recommendations

- Hatcheries should be priority target for the implementation of safe aquaculture so that they can supply disease free seed to all farmers.
- The implementation of safe aquaculture practice should be continued in the 2 communes and extended to all members of the cooperatives. Results should be compared to neighbouring cooperatives not practicing safe aquaculture practice.
- The process for implementation must be a step by step process starting from the implementation of safe aquaculture practice progressing towards full certification of the safe aquaculture zone.

- A promotion centre should be established where farmers can come and learn from each others and exchange experiences. The centre could later be developed into a one-stop aquaculture shop offering a wider range of technical advisory services to farmers.
- After agreement of the regulations of safe aquaculture zone, all the farmers who are in the safe aquaculture zone should sign a contract with the community at the promotion center to commit themselves to implement safe aquaculture zone, and agree that if they make any infringements to the regulations, they must rectify this or face fines from the community.
- At the start, there should be technical assistance provided to the community (such as by university staff) to explain the safe aquaculture regulations and guidelines and to supervise the implementation and help with any technical problems.
- Shrimp farming areas that are vulnerable to disease outbreaks should be identified and targeted for the implementation of safe aquaculture zones. A national activity could be an identification, mapping and characterization of these disease "hot spots".
- The lessons learned from Activity 143 should be widely disseminated to other communities in the identified vulnerable areas.
- There should be a review of the Vietnamese BMPs, GAPs and COC to clearly identify their role as a management measure and which farmers should be following which measure.
- There should be a further review of the Safe Aquaculture standards and a clear set of guidelines developed to assist the farmers to implement safe aquaculture practice and establish safe aquaculture zones.
- The safe aquaculture zone for shrimp should be expanded to safe aquaculture zones for fish production.
- There should be capacity building within the Fisheries Extension Service to promote safe aquaculture practice and zone model by training trainers how to establish and implement the model.
- Funding at central or provincial level should be identified to expand the implementation of the model in other vulnerable areas in Vietnam.

Annex 1 Sector standards

Sector Standard 28 TCN 110: 1998 – Technical procedure for intensive *P. monodon* culture – semi-intensive *Peaneid.*

Sector Standard 28 TCN 171: 2001 – Technical procedure for intensive *P. monodon* culture

Regulation on environment management in concentrated aquaculture zones (issued in compliance with Decision number 04/2002/QĐ-BTS on January 24, 2002 by the Minister of Fisheries).

Sector standard 28 TCN 190:2004 – Shrimp farms – Sanitation and Food safety conditions

Sector standard 28 TCN 191:2004 – Shrimp culturing zones – Sanitation and Food safety conditions.

Vietnam _ Working toward the Production of Safe and High-Quality Aquaculture Foods
Nguyen Van Trong Research Institute for Aquaculture No. 2

Annex 2. Safe Aquaculture Zone standard

MINISTRY OF FISHERIES **SOCIALIST REPUBLIC OF VIETNAM**
Independence-Freedom-Happiness

Ref. No. 06/2006/QD-BTS Hanoi, 10th April, 2006

DECISION

On the Issuance of the Regulation on

Safe Shrimp Culturing zone and Shrimp Farm Management

THE MINISTER

- Pursuant to the Decree number 43/2003/ND-CP on May 02, 2003 by the Government on the Functions, Responsibilities, Authorities and Organizational Structure of the Ministry of Fisheries;

- Pursuant to the Decision number 224/1999/QD-TTg on December 8, 1999 by the Prime Minister approving the Aquaculture Development Program for the Period 1999-2010;

- At the request of the General Director of Aquaculture Department,

HEREBY DECIDES

Article 1: Issuance in compliance of this decision is the Regulation on Safe Shrimp Culturing Zone and Shrimp Farm Management.

Article 2: This decision will take effect in 15 days counted from the day when it is announced on the Official Journal.

Article 3: The Leaders of the Departments, Directorates, Inspection, Ministerial Office, Directors of Provincial Departments of Fisheries, Provincial Departments of Agriculture and Rural Development of the provinces with fishery sector, Chairman of the Vietnamese Fisheries Association, other leaders of the institutions under the Ministry of Fisheries are responsible for implementation of this decision.

Receivers:
- As mentioned in Article 3;
- Government office;
- Leaders of the Ministry of Fisheries
- The Directorate of legal document examination, Ministry of Law (for checking);
- People Councils, People Committees of the provinces and cities under the Central;
- Official Journal;
- Archives in Clerical unit, Department of Aquaculture

ON BEHALF OF THE MINISTER
DEPUTY MINISTER
(Signed)

Nguyen Viet Thang

MINISTRY OF FISHERIES SOCIALIST REPUBLIC OF VIET NAM

Independence - Freedom - Happiness

REGULATION ON

SAFE SHRIMP CULTURING ZONE AND SHRIMP FARM MANAGEMENT

(Issued in compliance with the Decision No 06/2006/QD-BTS on 10/04/2006 by the Minister of Fisheries)

CHAPTER I

GENERAL PROVISIONS

Article 1. Objective of the Regulation

This regulation regulate safe shrimp culturing zone and shrimp farm management for sustainable shrimp farming development.

Article 2. Application of the regulation

Vietnamese organizations/individuals or foreign organizations/individuals conducting shrimp culturing activities in the territory of Viet Nam and relevant administration bodies nationwide.

Article 3. Explanation of Terms

As used in the Regulation, the terms and phrases shall be defined as follows:

1. ***Shrimp intensive culture*** is a shrimp farming method with appropriate infrastructure, equipment and farming techniques and procedures with an expected productivity of over 3 tons/ha/crop.

2. ***Shrimp semi-intensive culture*** is a shrimp farming method with appropriate infrastructure, equipment and farming techniques and procedures with an expected productivity from 1.5 to 3 tons/ha/crop.

3. ***Shrimp improved-extensive culture*** is a shrimp farming method with appropriate infrastructure, equipment and farming techniques and procedures with an expected productivity of under 1.5/tons/ha/crop.

4. ***Shrimp extensive culture*** is a shrimp farming method totally based on natural post-larvae and feed available in shrimp ponds.

5. ***Shrimp farm*** is a farm/facility where shrimp farming activities are conducted, in which the shrimp ponds adopt the same farming method, share the same water supply sources and effluent canals, and are owned by one organization/individual.

6. ***Shrimp culturing zone*** is a zone used for aquaculture consisting of at least 2 shrimp farms sharing the same water supply sources and effluent canals regardless administrative division and farming method.

7. ***Code of Conduct for Responsible Aquaculture (CoC)*** is practices applied to shrimp farming. These are developed in accordance with Article 9 - Aquaculture

Development - in Code of Conduct for Responsible Fisheries of FAO (Annex 1) for the target of disease control, environment protection, sanitation and food safety assurance for farmed fishery commodities, community equity and comprehensive efficiency of shrimp industry.

8. ***Good Aquaculture Practices (GAP)*** are practices applied to shrimp farming in accordance with Article 9 of CoC for the target of disease control, environment protection, sanitation and food safety assurance for cultured fishery commodities, community equity and comprehensive efficiency of shrimp industry.

9. ***Safe shrimp farm*** is a farm/facility applying GAP or CoC and certified by an authorized bodies as a GAP or CoC farm/facility with a correspond certificate (so-called Safe Shrimp Farm Certificate)

10. ***Safe shrimp culturing zone*** is a zone consisting of 100% of the shrimp farms applying GAP or CoC, and at least 80% of those have the Safe Shrimp Farm Certificate and certified by an authorized bodies as a GAP or CoC are with a correspond certificate (so-called Safe Shrimp Culturing zone Certificate)

11. ***Safe shrimp culturing zone and shrimp farm management*** are activities of guidance, development and maintenance of as well as monitoring and certificating safe shrimp culturing zones and shrimp farms.

12. ***Shrimp pond*** is a water surface area used for growing out shrimp with banks to separate it from the surrounding areas.

13. ***Aquaculture land*** includes land with inland water surface including ponds, lakes, lagoons, rivers, channels; coastal and riverine alluvial land, coastal sandy beaches; land used for farming economy purposes, non-agricultural land with water surface allocated and leased for aquaculture purposes.

CHAPTER II

SAFE SHRIMP CULTURING ZONE AND FARM MANAGEMENT

Article 4. Safe Shrimp Culturing Zone Planning Management

1. Safe shrimp culturing zone development could only be carried out in planned aquaculture zones reserving for shrimp culture with the approval of authorized bodies.

2. Detailed safe shrimp culturing plan should consist of qualified water supply and drainage canals, to ensure the elimination of cross-infection among the ponds within the zone and among the zone and the other zones as well as other natural, socio-economic conditions for safe shrimp farming.

Article 5. Environmental Management in Safe Shrimp Culturing Zones

In safe shrimp culturing zones, environmental management for intensive culture and semi-intensive modes of culture is regulated by the Regulation on "Environmental management in concentrated shrimp culturing zones" (issued in compliance with the Decision No 04/2002/QD-BTS on 24/01/2002 by the Minister of Fisheries); environmental management for improved-extensive and extensive shrimp culturing zones follows the regulations under Environment Protection Law in 2005 and the guiding documents.

Article 6. Organization and Functions of the Management Board of a Shrimp Culturing Zone

1. In order to assure the safe of shrimp culturing activities, the local where there are at least 02 farms desiring to register safe shrimp culturing zone is obligated to establish Management Board of the Shrimp culturing zone (Management Board in short).

2. A Management Board acts as the representative for member shrimpfarm and is in charge of regulating the GAP or CoC application in the shrimp culturing zone in line with the regulations of GAP and CoC of the Ministry of Fisheries (which will be issued and revised according to the technology development, market demands and production capacity) and other relevant regulations (Annex 2).

3. A Management Board's organization and functions will be defined in the Regulation on Organization and Functions of Management Board in the shrimp culturing zone.

Article 7. Safe Shrimp Farm Management

1. Farm owner should fulfill the business registration for shrimp farming following Article 12 Decree No 59/2005/ NĐ-CP on 04/05/2005 by the Government on production and trade conditions of some fisheries businesses.

2. Farm owner should ensure that his/her farm meets the veterinary conditions regulated under Item 2, Article 7 of the Decree No 33/2005/ND-CP on 15/03/2005 providing detailed guidance for the implementation of several articles of Veterinary Ordinance.

3. Farm owner registering safe shrimp farm should apply GAP or CoC following the regulations of the Ministry of Fisheries and other regulations involved (Annex 2). If there is any confliction between a regulation of GAP/CoC and of previous sector standards or sector technical requirements, the regulation of GAP/CoC will be applied.

4. Farm owner who participates into the establishment of a Management Board should be regulated by the Management Board about content and methodology of GAP/CoC in the shrimp culturing zone.

Article 8. Rights of the Shrimp Culturing Zone Management Board, Farm Owner and of the Safe Shrimp Culturing Zone Management Board and the Safe Shrimp Farm Owner

1. Rights of the shrimp culturing zone Management Board, the farm owner:

a) Cease shrimp culturing activities up to continuous 250 days without informing the Business Registration Body where the Management Board or farm owner registered his/her aquaculture business.

b) Register with the authorized state body to apply GAP or CoC and be trained and guided in GAP/CoC implementation.

c) Enjoy other rights regulated by laws.

2. Rights of the safe shrimp culturing zone Management Board and the safe shrimp farm owner:

a) As in points a) c) item 1 of this Article.

b) Request the National Fisheries Quality Assurance and Veterinary Directorate (NAFIQAVED) or Fisheries Quality Assurance and Veterinary bodies at provincial level (called Fisheries Quality Assurance and Veterinary Body) to add their zone or farm into the List of safe shrimp culturing zones and facilities

c) Advertise their safe shrimp culturing zone and/or farm on the mass media.

Article 9. Establishment of a People Fund for Shrimp Culturing Risk Support

It is encouraged that the locals where there are shrimp culturing zones establish a "People Fund for Shrimp Culturing Risk Support" in order to provide mutual support in disease control, natural disaster recovery and other risk prevention in shrimp culture. The establishment should be voluntary–based with open discussions among local organizations and individuals.

CHAPTER III

SAFE SHRIMP CULTURING ZONE AND SHRIMP FARM CERTIFICATION

Article 10. Food Safety Certification for Cultured Shrimp

The shrimp in the ponds of safe shrimp farms or of those without Certificate on Safe shrimp farms but meet the sanitation and food safety requirements verified by necessary tests will receive a Certificate on food safety for cultured shrimp.

Article 11. Examination, Issuance or Withdrawal of a Certificate on Safe Shrimp Culturing Zone, Safe Shrimp Farm; Certificate on Food Safety for Cultured Shrimp

Contents and procedures of examination, issuance or withdrawal of a certificate on safe shrimp culturing zone, safe shrimp farm; certification of food safety for cultured shrimp will be regulated by relevant the Ministry of Fisheries's regulations.

Article 12. Authorities for Examination, Issuance or Withdrawal of Certificate on Safe Shrimp Culturing Zone, Safe Shrimp Farm; Certificate on Food Safety for Cultured Shrimp

1. The NAFIQAVED (including Fisheries Quality Assurance and Veterinary branches) is authorized for examination, issuance or withdrawal of Certificate on safe shrimp culturing zone and shrimp farm for intensive culture or semi-intensive shrimp culturing zones and farms.

2. The Provincial Fisheries Quality Assurance and Veterinary Body is authorized for examination, issuance or withdrawal of Certificate on safe shrimp culturing zone and shrimp farm for improved-extensive or extensive modes of culture; examination and certification of food safety for cultured shrimp for farms and shrimp culturing zones that have been checked and certificated on food safety by NAFIQAVED.

3. Based on the competence of Provincial Fisheries Quality Assurance and Veterinary Body, NAFIQAVED can authorize it to check and certificate the safe shrimp culturing zones and farms of intensive and semi-intensive culture.

Article 13. Safe Shrimp Culturing Zone Certification

If 100% of the farms applying GAP or CoC, and at least 80% of those have the safe shrimp farm certification in the zone, it will be checked by, then receive a Safe Shrimp Culturing Zone Certificate from an authorized body.

Article 14. Safe Shrimp Farm Certification

A farm applying GAP/CoC and satisfying all regulations of the Ministry of Fisheries on GAP/CoC will be checked by, then receive a Safe Shrimp Farm Certificate from an authorized body.

Article 15. Fees and Charges for Examination and Certification of Safe Shrimp Culturing Zone and Shrimp Farm and Fees and Charges for Examination and Certification of Food Safety for Cultured Shrimp

1. The Fisheries Quality Assurance and Veterinary bodies have the right to collect fees and charges for examination and certification of safe shrimp culturing zones and shrimp farms and fees and charges for examination and certification of food safety for cultured shrimp.

2. The procedure of payment, collection, management and use of the fees and charges regulated in item 1 of this Article follows the legal regulations on fees and charges.

CHAPTER IV

RESPONSIBILITIES OF ADMINISTRATION BODIES

Article 16. Responsibilities of the NAFIQAVED:

1. Three (03) months before the first day of GAP/CoC implementation following Article 22 in this Regulation, develop and submit to the Minister of Fisheries:

   a) Technical standards of Good Aquaculture Practices (GAP) and Code of Conducts for Responsible Aquaculture (CoC) applying in shrimp culture.

   b) Regulations on procedure, examination and certification of safe shrimp culturing zones, shrimp farms.

   c) Sample regulation on organization and functions of Management Board of safe shrimp culturing zones.

2. Development and dissemination of guidlines and implementation methods at different levels in issuance and withdrawal of the Certificate on safe shrimp culturing zone, shrimp farm and in checking, monitoring activities nationwide.

3. Development and announcement of an annual list of shrimp intensive and semi-intensive culturing zones and shrimp farms (high risks of disease outbreaks, food safety and environment), and of shrimp improved extensive and extensive culturing zones and shrimp farms (low risks on disease outbreaks, food safety and environment); and monthly list of GAP/CoC implementation zones and shrimp farms and of GAP or CoC certificated safe shrimp culturing zones and shrimp farms.

Article 17. Responsibilities of DOFI, Department of Agriculture and Rural Development Related to Fisheries Management

1. Develop and implement the plan for local safe shrimp culturing zones and shrimp farms; manage the safe shrimp culturing zones and shrimp farms in accordance with functions of Department.

2. Collaborate with Provincial Department of Planning and Investment to guide shrimp farmers in production, trade and business registration.

3. Develop Regulation of organization and functions of Management Board of safe shrimp culturing zone based on the sample regulations of the Ministry of Fisheries, and submit to Provincial People's Committee for issuance.

4. Direct functional units to collaborate with local authorities in dissemination of regulations and supervision of the implementation.

5. Co-operate with local authorities of the newly converted shrimp culturing zones, of the rotational shrimp culturing zones, shrimp-rice culturing zones, shrimp –mangrove zones to establish a community organization (cooperative, collective, vocational association, club, v.v..) for mutual support in shrimp culturing activities.

6. Collaborate with local authorities at different levels to facilitate the zones, facilities to develop safe shrimp culturing zone and shrimp farms.

7. Facilitate the Fisheries Quality Assurance and Veterinary Bodies in examination, issuance or withdrawal Certificate; certification of safe shrimp culturing zone and shrimp farms and food safety for cultured shrimp in the province or city.

Article 18. Responsibilities of Provincial Fisheries Quality Assurance and Veterinary Bodies

1. Disseminate the legal documents on sustainable aquaculture development.

2. Provide training on techniques, methodologies of examination and assessment for the provincial staff following the guidance of NAFIQAVED in techniques and methodologies of examination and assessment of safe shrimp culturing zones and shrimp farms.

3. Examine, assess, issue, extent and withdraw certificates on safe shrimp culturing zone and shrimp farms; check the food safety certification for cultured shrimp under the regulation in Article 12 of the regulation; report to DOFI and Department of Agriculture and Rural Development in charge of fisheries management and NAFIQAVED.

4. Following the guidance of NAFIQAVED, co-operate with Fisheries Quality Assurance and Veterinary branches to make and announce a list of intensive and semi-intensive shrimp aquaculture based zones/farms, and a list of shrimp improved extensive and extensive culturing based zones/farms.

CHAPTER V

REWARD, SANCTION AND ACCUSATION

Article 19. Reward

Organizations and individuals who make a significant contribution to the enforcement of the Regulation shall be rewarded in accordance with legislation.

Article 20. Sanction

Any organization/individual against the regulation made under this Law shall be liable upon conviction to either a punishment following the government’s law.

Article 21. Complaints and denunciation

1. Organizations and individuals shall have a right to make complaints; individuals shall have the right to prosecute the violations committed to fisheries legislation to the competent agencies, organizations and individuals as regulated by legislation.

2. The competent organizations and individuals upon the reception of complaints and denunciation shall be responsible for taking timely actions as regulated by legislation.

CHAPTER VI

EXECUTIVE PROVISIONS

Article 22 Entry into force of Registration and Issuance of Certificate on Safe Shrimp Culturing Zone, Shrimp Farm

1. GAP Application Time

a) From 01/07/2007: shrimp farms taking part into stated-funded or foreign funded shrimp farming projects; great shrimp farming projects which need an investment license (following Decision No 16/2005/ND-CP issued on 07/02/2005 on construction investment project management); intensive shrimp culturing farms constructed after these regulation take effect.

b) From 01/01/2008: intensive shrimp culturing farms which are not in point a) of this Article.

c) From 01/07/2008: Shrimp farms not in point a) and b) of this Article.

2. CoC Application Time

a) From 01/01/2008: shrimp farms regulated in point a) item 1 of this Article.

b) From 01/07/2009: shrimp farm not regulated in point a) item 1 of this Article.

3. It is encouraged that the shrimp culturing zones/shrimp farms apply GAP/CoC before the time mentioned at items 1, 2 of this Article.

Article 23. Amendment of the Regulation

If there is anything inappropriate and needing to be amended during the implementation, organizations and individuals could feedback timely to the Ministry of Fisheries for consideration and making any responding decision.

SIGN ON BEHALF OF THE MINISTER

DEPUTY MINISTER

(Signed)

NGUYEN VIET THANG