GUIDELINES — FARMS

The following guidelines provide perspective and clarification for the BAP farm certification standards referenced in the Certification Application Form. The application form and guidelines were designed to assist program applicants in performing environmental and social impact assessments of their shrimp production facilities and developing management systems for compliance with the certification standards. The word "shall" is used throughout to indicate mandatory provisions. For further information, please refer to the additional resources listed.

Standard 1 — Community
Property Rights and Regulatory Compliance

Farms shall comply with local and national laws and environmental regulations, and provide current documentation that demonstrates legal rights for land use, water use, construction and operation.

Reasons for Standard

Certified farms shall comply with applicable business-related laws and regulations for mangrove protection, effluents, operation of landfills, predator control, etc. These regulations are needed to assure that shrimp farms provide pertinent information to governments and pay fees to support such programs. BAP requires compliance because it recognizes that not all governmental agencies have sufficient resources to effectively enforce laws.

Some shrimp farms have been sited on coastal land to which farm owners do not have legal right. Such farms are usually found in undeveloped areas under government ownership where land use is poorly controlled. This land may be occupied by landless people or used by coastal communities for hunting, fishing and gathering. Unauthorized installation of shrimp farms can displace landless people and interfere with the use of resources by local communities.

Implementation

Regulations regarding the operation and resource use of shrimp farms vary significantly from place to place. Among other requirements, such laws can call for:

- business licenses
- aquaculture licenses
- land deeds, leases or concession agreements
- land use taxes
- construction permits
- water use permits
- mangrove protection
- effluent permits
- predator control permits
- well operation permits
- landfill operation permits.

ACC inspectors cannot know all laws that apply to shrimp aquaculture in all nations. Participating farms have the responsibility to obtain all necessary documentation for siting, constructing and operating their facilities.

Assistance in determining these necessary permits and licenses can be sought from governmental agencies responsible for agriculture, environmental protection, fisheries and aquaculture, water management, and transportation, as well as local aquaculture associations. ACC inspectors must also become familiar with the legal requirements within the areas they service.

During the ACC inspection, the farm representative shall present all necessary documents to the inspector. All documents shall be current, and farms shall be in compliance with the requirements stipulated by the documents. For example, if a farm has an effluent discharge permit with water quality standards, those standards shall be enforced. In cases where governmental agencies have waived one or more permits, proof of these waivers shall be available.

For Additional Information

Codes of Practice for Responsible Shrimp Farming
C. E. Boyd — 1999
Global Aquaculture Alliance
St. Louis, Missouri, USA

Natural Resources Forum
Volume 15, 1991, pp. 66-72
"Aquacultural Development in Tropical Asia"
C. Bailey and M. Skladany

FAO Fisheries Report No. 572
Report of the Bangkok FAO Technical Consultation
on Policies for Sustainable
Shrimp Culture
Bangkok, Thailand, December 1997
FAO — 1998
Rome, Italy

FAO Fisheries Report No. 659
Report of the Expert Consultation on Food Management
Practices and Good Legal and Institutional Arrangements
for Sustainable Shrimp Culture
Brisbane, Australia, December 2000
FAO/Government of Australia — 2001
Rome, Italy

Standard 2 — Community
Community Relations

Farms shall not deny local communities access to public mangrove areas, fishing grounds or other public resources.

Reasons for Standard
Shrimp farms are typically located in rural areas, where individual families or communities rely on access to coastal resources to support traditional livelihoods. Some local residents benefit from employment or infrastructure improvements by shrimp farms, but others may feel deprived of access to areas formerly used for fishing, hunting or gathering.

Implementation
Shrimp farm management should attempt to accommodate traditional uses of coastal resources through a cooperative attitude toward established local interests and environmental stewardship. Farms should not block traditional access corridors to public mangrove areas and fishing grounds. In some cases, it may be necessary to provide a designated access route across the farm.

To avoid conflicts with local communities, farms are encouraged to communicate with local leaders through telephone calls, written correspondence, meetings or other means.

During facility inspection, the ACC inspector may verify compliance with this standard through examination of maps that define public and private zones, on-site inspection of fences, canals and other barriers, and interviews with local people and farm workers. The inspector should select the individuals for interview, rather than being provided a group of interviewees by farm management.

For Additional Information

Ocean and Shoreline Management
Volume 11, 1988, pp. 31-44
"The Social Consequences of Tropical Shrimp Mariculture Development"
C. Bailey

Scientific American
Volume 278, Issue 6, 1998, pp. 42-49
"Aquaculture and the Environment"
C. E. Boyd and J. W. Clay

Standard 3 — Community
Worker Safety and Employee Relations

Farms shall comply with local and national labor laws to assure adequate worker safety, compensation and living conditions at the facility.

Reasons for Standard
Farm work is potentially dangerous because of the types of machinery needed and the use of potentially hazardous materials. Workers are usually not highly educated, and safety instruction may not be adequate. Most shrimp farming is conducted in tropical nations where pay scales are low and wage or other labor laws may not be consistently enforced.

Since large corporate farms employ up to several hundred workers, they commonly provide on-site living quarters. An effort shall be made to develop and maintain decent living conditions there.

Implementation
At a minimum, certified shrimp farms shall provide legal wages, a safe working environment and adequate living conditions. However, every effort should be made to exceed these minimum requirements.

Workers should be given adequate initial training, as well regular refresher training, on safety in all areas of farm operation. Workers should also be trained in the first aid of electrical shock, profuse bleeding, drowning and other possible medical emergencies.

Living quarters should be well ventilated and have adequate shower and toilet facilities. Food services should provide wholesome meals for workers, with food storage and preparation done in a responsible manner. Trash and garbage should not accumulate in living, food preparation or dining areas (see Standard 9).

During facility inspection, the ACC inspector will evaluate whether conditions comply with labor laws. The inspector will also interview a random sample of workers to obtain their opinions about wages, safety and living conditions.

For Additional Information

Safety for Fish Farm Workers
D. C. Minchew — 1999
USDA/Cooperative State Research and Extension Service
Washington, D.C., USA

Standard 4 — Environment
Mangrove Conservation And Biodiversity Protection

Shrimp farms shall not be located in mangrove areas, seagrass beds or other coastal wetlands. Farm operations shall not damage wetlands or reduce the biodiversity of coastal ecosystems. Mangroves removed for allowable purposes shall be replaced by replanting an area three times as large.

Reasons for Standard

Mangroves and other wetlands are important components of many coastal ecosystems in shrimp-producing nations. Mangroves protect coastal areas from storm damage. Mangrove areas and other coastal wetlands are important breeding and nursery grounds for many aquatic species. They also provide habitat for birds and other creatures.

Local people often rely on mangrove areas for hunting, fishing and gathering. In addition, mangroves serve as water-purification systems by assimilating wastes that humans discharge into coastal waters.

Although shrimp farming has been responsible for some mangrove destruction, many other human activities have contributed to mangrove loss, and the role of shrimp farming has often been overstated. Nevertheless, shrimp farming should not cause further loss of valuable ecological resources.

Shrimp farm operations also may alter coastal ecosystems and cause a decline in biodiversity through lethal predator control, discharge of suspended solids and escapes of shrimp.

Implementation

Shrimp farms should be located on salt flats or other lands above the normal tidal zone that are usually inundated only a few times per month by the highest tides. Farm construction shall take place outside wetlands and not infringe on areas occupied by mangroves, seagrasses, or other sensitive wetland vegetation. The most reliable way of delineating wetland areas is by the type of vegetation present.

Particular care should be taken to assure that hydrological conditions are not altered in a way that deprives mangroves or other coastal wetland species of contact with brackish water. Certified farms shall not discharge effluents into public mangrove areas to effect water treatment unless monitoring at the point of entry shows that total suspended solids do not exceed 100 mg/L or 50 mg/L after five years.

Shrimp farm operation requires access to coastal waters, and limited removal of mangroves shall be allowed for the installation of inlet and outlet canals, pump stations and docks. Mangroves removed for allowable purposes shall be mitigated by replanting an area of mangroves three times the size of the area removed.

Shrimp farms shall obey laws related to the destruction of birds and other predators. However, the BAP program encourages farms to employ nonlethal measures for predator control even where lethal methods are permitted.

To prevent impingement of aquatic animals, screens shall be installed on water intake pumps. Screens also shall be installed to prevent the escape of shrimp from farms.

During initial facility inspection, the ACC inspector will note farm areas occupied by mangroves or other coastal wetlands. When farms are inspected for recertification, the inspector will determine if subsequent mangrove removal was allowable and required mitigation was performed. Mangrove removal for unapproved purposes or failure to mitigate allowable removal will result in loss of certification.

Where dying mangroves or other coastal wetland vegetation are observed on farms, the inspector will determine if the mortality is the result of farm operations. If it is, a warning will be issued, and the deficiency shall be corrected for continuation of certification.

Planting to mitigate the removal of mangroves shall be done in suitable brackish water areas. Mangroves can be established along the edges of ponds and canals to protect against erosion. They can also be planted on tidal land in the vicinity of farms. If suitable replanting areas are not available on or near a farm, proof of financial contribution to a recognized mangrove reforestation project shall be provided.

All farms in mangrove areas are encouraged to demonstrate mangrove stewardship by replanting mangroves or contributing to reforestation. When ponds constructed in former wetland areas are closed, farms should restore mangroves or other wetland vegetation in the abandoned areas.

For Additional Information

Codes of Practice for Responsible Shrimp Farming
C. E. Boyd — 1999
Global Aquaculture Alliance
St. Louis, Missouri, USA

Responsible Marine Aquaculture
"Mangroves and Coastal Aquaculture"
pp. 145-157
C. E. Boyd — 2002
R. R. Stickney and J. P. McVey, Editors
CABI Publishing
Wallington, Oxon, United Kingdom

Restoration of Mangrove Ecosystems
C. Field, Editor — 1996
International Society for Mangrove Ecosystems
University of Ryukyus
Okinawa, Japan

Mangrove Management and Shrimp Aquaculture
L. Massaut — 1999
International Center for Aquaculture and Aquatic Environments
Auburn University
Alabama, USA

Standard 5 — Environment

Effluent Management

Farms shall monitor effluents at the frequency specified to confirm that water quality complies with BAP criteria*. Water quality measurements taken during certification inspection shall meet both BAP criteria and those of applicable government permits. Farms shall comply with BAP's final criteria within five years.

BAP Water Quality Criteria

Variable (units)	Initial Value	Final Value (after 5 years)	Collection Frequency
pH (standard units)	6.0-9.5	6.0-9.0	Monthly
Total suspended solids (mg/L)	100 or less	50 or less	Quarterly
Soluble phosphorus (mg/L)	0.5 or less	0.3 or less	Monthly
Total ammonia nitrogen (mg/L)	5 or less	3 or less	Monthly
5-day biochemical oxygen demand (mg/L)	50 or less	30 or less	Quarterly
Dissolved oxygen (mg/L)	4 or more	5 or more	Monthly
Chloride Water with less than 1 ppt salinity, specific conductance below 1,500 μmhos/cm or chloride less than 550 mg/L is considered fresh.	No discharge above 800 mg/L chloride into freshwater	No discharge above 550 mg/L chloride into freshwater	

* **Limited Option:** The source water for aquaculture farms can have higher concentrations of water quality variables than allowed by the initial criteria. In these cases, demonstration that the concentrations of the variables do not increase (or decrease for dissolved oxygen) between the source water and farm effluent is an acceptable alternative to compliance with the criteria. This option does not apply to chloride.

Additional Data

Although specific criteria are not currently established for the data, ACC will record farms' feed conversion ratios and protein conversion rates. After the first year of effluent monitoring, ACC will also use data provided by facilities' application forms to calculate:

- an annual water use index, determined as described below.
- annual load indices for total suspended solids, soluble phosphorus, total ammonia nitrogen and five-day biochemical oxygen demand, determined as described below.

Reasons for Standard

Shrimp farms discharge effluents when ponds exchange water and are drained for harvest. These effluents can contain nitrogen, phosphorus and other nutrients, suspended solids and organic matter at greater than ambient concentrations. These substances can contribute to eutrophication, sedimentation and high oxygen demand in receiving water. At times, pond effluents have lower dissolved oxygen concentration and greater pH and salinity than receiving water. Such conditions can negatively affect aquatic organisms and limit further use of the water.

Since shrimp nibble on feed pellets, up to 40% of their feed may not be consumed directly. In addition, only 20-25% of the nitrogen and 10-15% of the phosphorus in feed is taken up by shrimp. Excess shrimp feed can therefore degrade water and pond bottom quality, and contribute significantly to excessive nutrient levels in effluents.

To reduce the amount of waste that enters ponds, farmers are encouraged to improve feed conversion. Moreover, lowering feed conversion levels lessens the amount of fishmeal and marine oil used in feed – an important issue in aquaculture. The BAP program supports continued research on nonmarine protein alternatives to fishmeal and fish oils in aquaculture feed, as well as the sourcing of fish-based feed ingredients from sustainable fisheries identified in the United Nations Food and Agriculture Organization Status of Reduction Fisheries report.

Implementation

This standard is designed to demonstrate that compliance with other BAP standards and use of good management practices are effective in reducing the volume and improving the quality of farm effluents. The BAP water quality criteria also assure that concentrations of critical variables do not exceed those normally allowed in discharge permits for effluents from other point sources.

Proper collection and analysis of effluent samples are essential, as well as suitable record-keeping systems for effluent data (see sample forms on pages 18-19). To confirm compliance with BAP water quality criteria, the inspector will take an effluent sample during inspection.

Sampling

- Samples shall be collected near the point where effluents exit the farm property. A control structure at the sampling site or suitable sampling method should be used to prevent mixing of effluent and water from the receiving body.
- For farms with multiple effluent outfalls, all or several outfalls shall be sampled to prepare a composite sample for analysis. Where there are more than four outfalls, three outfalls shall be selected as sampling locations.

- If the limited option is used, source water samples shall be collected directly in front of the pump station or from the pump discharge outlet but before pumped water mixes with the supply canal.
- Water shall be dipped from the water surface and contained in a clean, plastic bottle placed on ice in a closed, insulated chest to prevent exposure to light.
- Samples or direct measurements for dissolved oxygen and pH shall be obtained between 0500 and 0700 hours, and 1300 and 1500 hours on the same day. The average of the two measurements for each variable will be used for verification of compliance.
- Samples for other variables shall be collected between 0500 and 0700 hours.
- The number of ponds being drained for harvest at the time of sampling shall be recorded.

Analyses

- Analyses may be done on farms or by a private laboratory.
- Hach and Merck water analysis equipment is approved for total ammonia nitrogen, soluble phosphorus, and chloride analyses. However, inspectors can reject analytical results if sampling, *in situ* measurements or lab protocols are deficient.
- Measurements for dissolved oxygen and pH taken *in situ* with portable meters are preferred, but analyses of these variables may be made in the laboratory.
- Salinity should be determined by a conductivity meter with a salinity scale, rather than hand-held, refractometer-type salinity meters. Alternatively, specific conductance can be measured. Assume that water with specific conductance above 2,000 μmhos/cm exceeds 1.5 ppt salinity, and water with specific conductance over 1,500 μmhos/cm exceeds 1.0 ppt salinity. Note: 1 mS/m = 10 μmhos/cm and 1 μmho/cm = 1 mS/cm.

Rules for Compliance

At least three months of effluent data are required for initial farm certification. For each variable measured monthly, at least 10 values obtained during a 12-month period shall initially comply with the criteria. After five years, the target is one annual case of noncompliance for each variable. For variables measured quarterly, one noncompliance is initially permitted for each variable during a 12-month period. The target after five years is one case of noncompliance for each variable during a 24-month period. When noncompliances occur, farms should make every effort to correct the problems within 90 days.

Annual Effluent Volume

After the first year of effluent monitoring, an estimation of annual effluent volume at a shrimp farm shall be determined by one of the following equations:

Equation 1
Farm discharge in m^3/yr = Pump discharge in m^3/min x Average time of pump operation in hr/day x 60 min/hr x 365 days/yr

Equation 2
Farm discharge in m^3/yr = [Volume of ponds in m^3 x Number of crops/yr] + [Volume of ponds in m^3 x Average daily water exchange rate as fraction of pond volume x Crop in days x Number of crops/yr].

Annual Effluent Loads

Variable load values are more indicative of the pollution potential of farm effluents than separate measurements of variable concentration and effluent volume. After the first year of effluent monitoring, annual effluent loads for total suspended solids, soluble phosphorus, total ammonia nitrogen and five-day biochemical oxygen demand shall be calculated as follows:

Equation 3
Load of variable (kg/yr) = Farm discharge in m^3/yr x Average annual concentration of variable (mg/L, same as g/m^3) x 10^{-3} kg/g

Water Use and Load Indices

It is possible to comply with numerical water quality criteria by increasing the amount of water passing through a farm to dilute the concentrations of tested variables. Compliance with the water use index assures that farms meet water quality criteria through good management rather than diluting effluents before they are released into natural waters. After the first year of effluent monitoring, water use and load indices shall be estimated using the following equations:

Equation 4
Water use index (m^3/kg shrimp) = Annual effluent volume (m^3) ÷ Annual shrimp production (kg)

Equation 5
Load index (kg variable/ton shrimp) = Annual load of variable (kg/yr) ÷ Annual shrimp production (ton/yr).

It is important to understand that these load indices are inflated, because the effluent load of each variable does not result entirely from shrimp culture operations. Supply water contains some concentration of each variable that is not subtracted from the effluent concentration. Nevertheless, the indices show changes in water use efficiency or pollution loads.

Feed Conversion

The feed conversion ratio (FCR) is a measure of the amount of feed needed to produce a unit weight of shrimp. Participants shall calculate and record FCR yearly using the following equation:

Equation 6
Feed conversion ratio = Annual feed use (mt) ÷
Shrimp harvested (mt).

Although a BAP standard for feed conversion has not been established, producers should strive to reduce FCR as low as practical. A farm with good feed management practices might reduce FCR as low as 1.5. Also, certified farms are expected to maintain or lower feed conversion in subsequent years after their initial certification.

Protein Conversion

Since protein is the most ecologically sensitive component of aquaculture feeds, conversion of feed protein into shrimp protein shall be recorded yearly. Crude protein conversion ratio (PCR) can be calculated by multiplying the FCR by the ratio of crude protein in the farm's most commonly used growout feed (indicated on feed bags) to the crude protein content of whole shrimp:

Equation 7
Protein conversion ratio = FCR x
Feed protein content (%) ÷ Shrimp protein content (19.3%).

Production Practices

Compliance with the effluent standard will require some farms to adopt better production practices, such as those outlined in the Global Aquaculture Alliance manual Codes of Practice for Responsible Shrimp Farming. This manual contains practices related to erosion control, feed management, water and bottom soil quality, pond amendments and water exchange that can reduce and improve pond effluents.

If adoption of these practices is not sufficient to meet BAP water quality criteria, a settling basin shall be installed to provide water treatment before final discharge. If a settling basin is used, the criteria apply to its final outfall. In cases where source water has a high concentration of suspended solids, installation of a presettling basin to improve water quality before the water reaches production ponds may be beneficial in enhancing effluent quality.

For Additional Information

Codes of Practice for Responsible Shrimp Farming
C. E. Boyd — 1999
Global Aquaculture Alliance
St. Louis, Missouri, USA

Global Aquaculture Advocate
Volume 3, Issue 5, 2000, pp. 61-66
"Effluent Composition and Water Quality Standards"
C. E. Boyd and D. Gautier

Global Aquaculture Advocate
Volume 3, Issue 4, 2000, pp. 26-27
"Farm Effluent During Draining for Harvest"
C. E. Boyd

Sample Effluent Monitoring Form: Dissolved Oxygen and pH

Date (day/month/year)	Dissolved Oxygen (mg/L)			pH (standard units)			Number of Ponds Being Harvested
	Morning	Evening	Average	Morning	Evening	Average	
_____/01/_____							
_____/02/_____							
_____/03/_____							
_____/04/_____							
_____/05/_____							
_____/06/_____							
_____/07/_____							
_____/08/_____							
_____/09/_____							
_____/10/_____							
_____/11/_____							
_____/12/_____							
Annual Average							

Sample Effluent Monitoring Form: Soluble Phosphorus, Total Ammonia Nitrogen, Chloride

Date (day/month/year)	Soluble Phosphorus (mg/L)	Total Ammonia Nitrogen (mg/L)	Chloride (mg/L)	Number of Ponds Being Harvested
_____/01/_____				
_____/02/_____				
_____/03/_____				
_____/04/_____				
_____/05/_____				
_____/06/_____				
_____/07/_____				
_____/08/_____				
_____/09/_____				
_____/10/_____				
_____/11/_____				
_____/12/_____				
Annual Average				

Sample Effluent Monitoring Form: Total Suspended Solids, 5-day Biochemical Oxygen Demand

Quarter	Date (day/month/year)	Total Suspended Solids (mg/L)	5-day Biochemical Oxygen Demand (mg/L)	Number of Ponds Being Harvested
1				
2				
3				
4				
Annual Average				

Example: Water Use, Load Indices For Farm Discharge Estimated By Pond Volume-Water Exchange Method

A shrimp farm has 100 ha of ponds that average 1 m deep, with average water exchange of 2.5% pond volume/day. There are 2.3 crops/year, and the average length of each crop is 120 days. The farm effluent contains an average of 35 mg/L total suspended solids (TSS), 0.16 mg/L soluble phosphorus (SP), 0.72 mg/L total ammonia nitrogen (TAN) and 8.1 mg/L biochemical oxygen demand (BOD). Shrimp production for the past year was 230,000 kg (230 tons).

Calculations:

Pond volume = 100 ha x 10,000 m^2/ha x 1 m = 1,000,000 m^3

Farm discharge = [1,000,000 m^3/crop x 2.3 crops/yr] + [1,000,000 m^3 x 0.025 pond volume/day x 120 days/crop x 2.3 crops/yr] = 9,200,000 m^3/yr

TSS load = (35 g/m^3)(9,200,000 m^3/yr)10^{-3} = 322,000 kg/yr

SP load = (0.16 g/m^3)(9,200,000 m^3/yr)10^{-3} = 1,472 kg/yr

TAN load = (0.72 g/m^3)(9,200,000 m^3/yr)10^{-3} = 6,624 kg/yr

BOD load = (8.12/m^3)(9,200,000 m^3/yr)10^{-3} = 74,520 kg/yr

Water use index = $\frac{9,200,000 \text{ m}^3\text{/yr}}{230,000 \text{ kg shrimp/yr}}$ = 40 m^3/kg shrimp

TSS index = $\frac{322,000 \text{ kg/yr}}{230 \text{ tons shrimp}}$ = 1,400 kg TSS/ton shrimp

SP index = $\frac{322,000 \text{ kg/yr}}{230 \text{ tons shrimp}}$ = 6.4 kg SP/ton shrimp

TAN index = $\frac{6,624 \text{ kg/yr}}{230 \text{ tons shrimp}}$ = 28.8 kg TAN/ton shrimp

BOD index = $\frac{74,520 \text{ kg/yr}}{230 \text{ tons shrimp}}$ = 324 kg BOD/ton shrimp

Example: Water Use, Load Indices For Farm Discharge Estimated By Pump Operation Method

A shrimp farm has two pumps that discharge a combined volume of 136 m^3/min. The pumps operate an average of 8 hr/day. Effluent contains 81 mg/L total suspended solids (TSS), 0.20 mg/L soluble phosphorus (SP), 1.05 mg/L total ammonia nitrogen (TAN) and 11.2 mg/L biochemical oxygen demand (BOD). Shrimp production during the past year was 378,000 kg (378 tons).

Calculations:

Farm discharge = 136 m^3/min x 60 min/hr x 8 hr/day x 365 days/yr = 23,827,200 m^3/yr

TSS load = (23,827,200 m^3/yr)(81 g/m^3)10^{-3} = 1,930,000 kg

SP load = (23,827,200 m^3/yr)(0.2 g/m^3)10^{-3} = 4,765 kg

TAN load = (23,827,200 m^3/yr)(1.05 g/m^3)10^{-3} = 25,018 kg

BOD load = (23,827,200 m^3/yr)(11.2 g/m^3)10^{-3} = 266,865 kg

Water use index = $\frac{23,827,200 \text{ m}^3\text{/yr}}{378,000 \text{ kg shrimp/yr}}$ = 63.0 m^3/kg shrimp

TSS index = $\frac{1,930,000 \text{ kg/yr}}{378 \text{ tons shrimp}}$ = 5,106 kg TSS/ton shrimp

SP index = $\frac{4,765 \text{ kg/yr}}{378 \text{ tons shrimp}}$ = 12.6 kg SP/ton shrimp

TAN index = $\frac{25,018 \text{ kg/yr}}{378 \text{ tons shrimp}}$ = 66.2 kg TAN/ton shrimp

BOD index = $\frac{266,865 \text{ kg/yr}}{378 \text{ tons shrimp}}$ = 706 kg BOD/ton shrimp

Standard 6 — Environment
Sediment Management

Farms shall contain sediment from ponds, canals and settling basins and not cause salinization or other ecological nuisance in surrounding land and water.

Reasons for Standard
The sediment that accumulates in canals, ponds and settling basins on shrimp farms is mostly mineral soil enriched with organic material. It also contains a burden of water-soluble salt from contact with saline water.

Sediment accumulation in canals reduces volume and efficiency of water conveyance. In ponds, sediment reduces water depth and has adverse effects on bottom soil condition and water quality.

If sediment is disposed of outside water-holding structures, care shall be exercised to prevent the formation of spoil piles that can disrupt local ecological processes through erosion and transport to surrounding areas. Runoff from spoil piles onto nonsaline soil or into freshwater can cause salinization. Downward seepage can result in salinization of freshwater aquifers.

Implementation
The first principles of sediment management on shrimp farms are to prevent excessive sedimentation through good management practices and confine sedimentation to specific parts of the farm. Where farm supply water has a large sediment load, reservoirs for presedimentation can remove much of the suspended material so it will not settle in supply canals and production ponds. Sediment accumulation in ponds and canals can be reduced by:

- implementing proper earthen infrastructure design to lessen erosion by rainfall and water currents
- placing aerators to avoid impingement of water currents on embankments
- reinforcing erosion-prone areas with stone or other lining materials
- covering bare areas with gravel or grass.

On large farms, sediments removed by dredging should discharge into containment areas rather than directly into streams or other estuarine areas. These can be installed along the margins of canals or on areas of salt flats above high tide.

Pond sediment from bank erosion can usually be placed back on eroded areas. Compaction of the loose material will stabilize it and lessen the rate of further erosion.

When sediment must be disposed of outside the immediate farm area, it should be confined to prevent runoff in an earthen containment area where soils are saline. Overflow or seepage from the confinement will not cause harm in an area with saline soil and water.

In inland shrimp farming, saline sediment shall be confined to prevent overflow after rainfall events. The confinement structures should be large enough to hold the largest amount of rainfall expected within any 24-hour period over 25 years. If the soil is highly pervious, the confinement area shall be lined to prevent seepage. Once sediment is leached of salt by rainfall, it can be used for landfill or other purposes.

For Additional Information

Codes of Practice for Responsible Shrimp Farming
C. E. Boyd — 1999
Global Aquaculture Alliance
St. Louis, Missouri, USA

World Aquaculture
Volume 25, 1994, pp. 53-55
“Compositions of Sediment From Inland Shrimp Farms in Thailand”
C. E. Boyd, P. Munsiri and B. F. Hajek

U.S. Army Corps of Engineers
Engineering Manual No. 1110-2-5027
“Confined Disposal of Dredged Material”
Department of the Army — 1987
U.S. Army Corps of Engineers
Washington, D.C., USA
Online at http://www.usace.army.mil/inet/usace-docs/eng-manuals/em1110-2-5027/toc.htm

Standard 7 — Environment
Soil/Water Conservation

Farm construction and operations shall not cause soil and water salinization or depletion of ground water in surrounding areas.

Reasons for Standard
Shrimp farming can cause salinization if water from ponds infiltrates freshwater aquifers or is discharged into freshwater lakes or streams. Disposal of salt-laden sediments from shrimp ponds can also cause salinization of soil and water.

In some countries, freshwater from aquifers is pumped into ponds to dilute salinity. Water depletion, land subsidence and groundwater salinization can become problematic if too much water is removed from under ground.

Implementation
The basic principles for preventing salinization are to avoid:

- discharging saline water into freshwater
- disposing of pond sediment on nonsaline land
- pumping excessive groundwater for dilution of pond salinity.

(See Standards 5 and 6 for BAP salinity and sediment disposal criteria).

Pond bottoms should be sealed to minimize infiltration. Cover pond bottoms that contain a high percentage of sand and little clay with a layer of less-permeable soil or plastic liners. Both of these methods can be expensive, however. If freshwater wells or surface waters occur near coastal farms, chloride content of this water shall be monitored quarterly.

Although inland shrimp farms usually have salinities of only 2 to 5 ppt in pond water, these farms are often located in areas with nonsaline soil and freshwater. In such cases, water recirculation systems with adequate storage volume to prevent overflow after normal rainfall events should be used.

Saline water should not be discharged from inland farms, and farms should be surrounded by a ditch to intercept seepage. A vegetative barrier of salt-sensitive vegetation around farms can help detect movement of salt into adjacent areas. Inland farms shall monitor the chloride content of well water and nearby surface water quarterly to detect potential seepage.

Freshwater from wells should not be used to dilute salinity in brackishwater growout ponds. Monitoring static water levels in aquifers is the only means of determining if freshwater used for shrimp farming is causing the local water table to decline.

For Additional Information

World Aquaculture
Volume 32, Issue 1, 2001, pp. 10-12
"Inland Shrimp Farming and the Environment"
C. E. Boyd

Hydrology and Water Supply for Pond Aquaculture
K. H. Yoo and C. E. Boyd — 1994
Chapman and Hall
New York, New York, USA

Standard 8 — Environment
Postlarvae Sources

Certified farms shall not use wild postlarvae and shall comply with governmental regulations regarding the importation of native and non-native shrimp seedstock.

Reasons for Standard

Although some farms have their own hatcheries, there are often not enough postlarvae to supply the aquaculture demand. In some cases, artisanal fishermen catch wild postlarvae and sell them to farms for growout. Wild catches, however, are often sporadic, with variable animal sizes and high risk of disease. Wild catches also inevitably collect organisms other than shrimp, which can die during the separation of the catch.

Shrimp hatcheries produce abundant supplies of postlarvae on a year-round basis without affecting other coastal organisms. In addition, advances in hatchery technology are leading to disease-free stocks with production characteristics superior to those of wild postlarvae. Postlarvae production is not without concerns, however.

The escape of nauplii, postlarvae or broodstock of native species could possibly lead to an alteration of the gene pools of local shrimp. Escapement of imported non-native species could lead to competition with native shrimp that might lessen their abundance. Nevertheless, most nations allow the importation of native postlarvae, and some allow specified non-native postlarvae.

Among other factors, regulation is required because diseases can be transferred between countries and species by importations of postlarvae. Regulations can require health certificates and possible quarantine.

Should genetically modified shrimp be commercialized in the future, further regulation would be required, as possible escapees could compete with local shrimp populations. In addition, a small number of consumers who eat genetically modified foods experience allergic reactions, while others simply do not desire them.

Wild postlarvae are sometimes cheaper than hatchery postlarvae. It may also seem expedient to bypass governmental regulations when postlarvae are badly needed or nonapproved species offer improved production characteristics.

Implementation

Participating farms shall keep records of their postlarvae sources and purchases, and record the number stocked in each pond for each crop. A sample Pond-Level Traceability Form that records this data is provided in the Traceability section. In the future, farms that use GMO postlarvae must also note this information.

During site inspection, documentation of compliance with governmental regulations related to postlarvae importation shall be available. When imported postlarvae were purchased from another party, the producer shall provide copies of pertinent documents.

Due to varied international standards, the Aquaculture Certification Council cannot maintain complete records of governmental regulations that apply to postlarvae importation in all nations. Thus, it is the responsibility of ACC inspectors to become knowledgeable about these regulations in the areas they serve.

For Additional Information

Codes of Practice for Responsible Shrimp Farming
C. E. Boyd — 1999
Global Aquaculture Alliance
St. Louis, Missouri, USA

FAO Fisheries Technical Paper No. 402
Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals and the Beijing Consensus and Implementation Strategy
FAO/NACA — 2000
Rome, Italy

Case Studies of Ecuadorian Shrimp Farming
(In progress for public discussion)
S. Sonnenholzner, L. Massaut, C. Saldias, J. Calderón and C. E. Boyd — 2002
Prepared under the World Bank, NACA, WWF and FAO Consortium Program on Shrimp Farming and the Environment

Standard 9 — Environment
Storage and Disposal of Farm Supplies

Fuel, lubricants and agricultural chemicals shall be stored and disposed of in a safe and responsible manner. Paper and plastic refuse shall be disposed of in a sanitary and responsible way.

Reasons for Standard

Shrimp farms use fuel, oil and grease to power and lubricate vehicles, pumps, aerators, and other mechanical devices. The main agricultural chemicals used in shrimp culture are fertilizers, liming materials, sodium metasilicate, sodium metabisulfite and zeolite. Some farms also use insecticides, herbicides and algicides.

Fuels and some fertilizers are highly flammable and/or explosive, and pesticides, herbicides and algicides are toxic. They shall therefore be considered potential hazards to workers.

Spills or careless disposal of petroleum products and agricultural chemicals can also affect aquatic organisms and other wildlife in the immediate vicinity, and result in water pollution over a wider area.

Shrimp farms generate considerable waste that can cause pollution, odors and human health hazards on the farm and in surrounding areas when not disposed of properly. Human food scraps, out-of-date shrimp feed and other organic waste can attract scavengers. Runoff from refuse piles can cause pollution and contaminate ground water.

Empty plastic bags and other containers used for feed, fertilizer and liming materials do not decompose quickly. They can be a hazard to animals that become entangled in them.

Implementation

Fuel, lubricants and agricultural chemicals shall be labeled and stored in a manner to prevent fires, explosions and spills. Used lubricants and unwanted or out-of-date chemicals shall be disposed of in a responsible manner.

Secondary containment shall be provided for individual fuel storage tanks over 2,500 liters in volume and multiple tanks with combined storage of over 5,000 liters. The containment volume should be equivalent to 110% of individual tanks or 110% of the largest tank in a multiple-tank storage system. “Flammable material” and “no smoking” signs shall be installed at fuel storage sites.

Oil leaks from tractors, trucks and other equipment should be prevented through good maintenance. Oil changes should avoid spills, with used oil sent to a recycling center. Out-of-date chemicals and wastes collected after chemical spills shall be confined in sturdy plastic containers, labeled and sent to a hazardous waste disposal site.

Chemicals such as insecticides, herbicides, algicides and sodium metabisulfite shall be stored in locked, well-ventilated, water-tight buildings. The buildings’ concrete floors should slope to a center basin for containing spills. Warning signs shall be posted.

Fertilizers, liming materials and other less hazardous agricultural chemicals should be stored under a roof, where rainfall will not wash them into surface water. Particular care shall be taken with nitrate fertilizers, which are strong oxidants that are particularly explosive when contaminated with diesel fuel or other oils. Nitrate fertilizers shall be protected from contact with petroleum products and open sparks.

Procedures should be developed for managing spills of oil, fuel, chemicals, feed, fertilizers and other products. The equipment and supplies needed for managing and cleaning up these spills shall be readily available and accessible. Workers should be trained to properly use the equipment and handle the contained waste.

Trash, garbage and other farm wastes shall not be dumped in mangrove areas and wetlands, or on vacant land. Such waste shall be burned, composted or put in a landfill in accordance with local laws. Composting shall be done by a procedure that does not create an odor problem or attract wild animals.

BAP encourages recycling of paper and plastic waste where it is possible. Effective management of these wastes depends upon the availability of convenient waste containers that are serviced at regular intervals.

For Additional Information

Protecting Water Quality on Alabama’s Farms
Alabama Soil and Water Conservation Committee — 1995
Montgomery, Alabama, USA

USDA NRCS AL Guide Sheet No. AL 701
Spill Prevention Control and Countermeasures
Available online at http://www.al.nrcs.usda.gov/SOsections/Engineering/BMPindex.html

Global Aquaculture Advocate
Volume 5, Issue 4, 2002, pp. 70-71
“Sodium Bisulfite Treatments Improve Shrimp Appearance But Require Proper Disposal”
C. E. Boyd and D. Gautier

Standard 10 — Food Safety
Drug and Chemical Management

Banned antibiotics, drugs and other chemical compounds shall not be used. Other therapeutic agents shall be used as directed on product labels for control of diagnosed diseases or required pond management, not prophylactic purposes. Shrimp shall be periodically monitored for residues of suspect pesticides, PCBs and heavy metals that are confirmed in the vicinity.

Critical Points:

- Chloramphenicol and nitrofuran antibiotics are banned for use in food production in all countries.
- Other drugs and chemicals, such as antibiotics, heavy metals, pesticides, and hormones, may be banned in specific countries.
- Drugs and chemicals approved for use in shrimp-producing countries may only be used if not banned in the shrimp-importing country, and provided residues in shrimp products do not exceed limits set by importing nations.
- Records for disease diagnoses should support the use of therapeutants.
- Required records for every application of antibiotics, drugs and other chemicals shall include the date, compound used, reason(s) for use, dose and harvest date for treated ponds.
- Statements from feed and postlarvae suppliers that declare no prohibited antibiotics, drugs or other chemicals were applied to feed or larvae are required.
- Shrimp shall be tested for the presence of residual pesticides, PCBs and heavy metals.

Reasons for Standard

Some of the therapeutic agents used to treat shrimp diseases can result in residues in shrimp tissue that are a potential health hazard to humans. Governments have therefore banned certain compounds and mandated residue limits for others. Failure to comply with such regulations can have serious economic consequences to all involved in the import chain.

Improper use of chemicals can harm the aquatic organisms that live in the water into which shrimp farms discharge. Moreover, continued use of antibiotics can lead to antibiotic resistance in shrimp disease organisms.

Some shrimp farms are built on land previously used for agricultural or other purposes. Pesticides and other chemicals applied during these previous uses can remain in the land's soil and water in small amounts and be taken up by shrimp in production ponds. Heavy metals and other by-products of previous land use can similarly affect farmed shrimp. Such compounds pose a potential health risk to some elements of the human population.

Implementation

Good shrimp health management focuses on the prevention of disease rather than disease treatment with chemical compounds. The best ways of controlling diseases in shrimp aquaculture are to avoid stocking diseased postlarvae, reduce water exchange for less exposure to disease organisms in intake water, and maintain good bottom soil and water quality to avoid environmental stress to shrimp.

Farms should develop shrimp health management plans that indicate procedures to avoid the introduction of disease, protocols to maintain water and soil quality in ponds, and shrimp health monitoring and disease diagnosis techniques. Plans should also explain the steps to be taken when a diagnosed disease will be treated with approved chemicals. Lists of approved chemicals can usually be obtained from processing plants or governmental fisheries agencies.

During inspections, inspectors shall have access to full records as described above for all applications of drugs and antibiotics. A sample Pond-Level Traceability Form that records this data is provided in the Traceability section.

Farms should conduct a survey of chemical use in the surrounding watershed to evaluate potential sources of contamination. Farmed shrimp shall be analyzed to evaluate the potential presence of suspect pesticides, PCBS and heavy metals to assure they are less than the levels below. These levels are based on U.S. Food and Drug Administration HACCP criteria for environmental chemical contaminants.

Maximum Allowable Levels of Pesticides, PCBs and Heavy Metals in Farmed Shrimp

Substance	Level (ppm)
Pesticides and PCBs	
Aldrin/Dieldrin[a]	0.3
Chlordane	0.3
Chlordecone (Kepone)	0.3
DDT, TDE, DDE[b]	5.0
Diquat	3.0
Heptachlor/Heptachlor epoxide[c]	0.3
Mirex	0.1
Polychlorinated biphenyls (PCBs)	2.0
2,4-D	1.0
Heavy Metals	
Arsenic	76
Cadmium	3
Chromium	12
Lead	1.5
Nickel	70
Methyl mercury	1

[a] Level is for each substance or combination thereof. In combining, do not count substances found at below 0.1 ppm.
[b] Level is for each substance or combinations thereof. In combining, do not count substances found at below 0.2 ppm.
[c] Level is for each substance or combination thereof. In combining, do not count substances found at below 0.1 ppm.

Certified facilities should also routinely monitor changes in land use practices in the surrounding area that might affect chemical residue levels in shrimp.

For Additional Information

Codes of Practice for Responsible Shrimp Farming
C. E. Boyd — 1999
Global Aquaculture Alliance
St. Louis, Missouri, USA

Mississippi Cooperative Extension Service Publication 1873
Catfish Quality Assurance
M. W. Bronson — 1996
Mississippi State
Mississippi, USA

Health Management in Shrimp Ponds
P. Chanratchakool, J. F. Turnbull,
S. Funge-Smith and C. Limsuwan — 1994
Aquatic Animal Health Research Institute
Department of Fisheries
Bangkok, Thailand

Guide to Drug, Vaccine, and Pesticide Use in Aquaculture
Federal Joint Subcommittee on Aquaculture — 1994
Texas Agricultural Extension Service College Station
Texas, USA

Food Safety Issues Associated With Products From Aquaculture
Report of a Joint FAO/NACA/WHO Study Group
World Health Organization — 1999
Geneva, Switzerland

Standard 11 — Food Safety
Microbial Sanitation

Human waste and untreated animal manure shall be excluded from shrimp growout ponds. Domestic sewage shall be treated and not contaminate surrounding areas.

Reasons for Standard

Sewage contains microorganisms that can be harmful to humans. It can also pollute the water into which it is discharged.

Organic fertilizers have been used widely in pond aquaculture for promoting phytoplankton blooms. These materials include animal manure, grass, by-products from harvesting or processing agricultural products, fisheries and aquaculture processing plant waste, trash fish and human sewage. Trash fish and processing wastes are also used as feed.

There is a possibility of health hazards to humans who consume inadequately cooked shrimp grown in ponds that receive human waste, untreated animal manure or organic fertilizers containing salmonella or other food-poisoning organisms.

Manure from animal production facilities can be contaminated with drugs added to animal feed for the prevention or treatment of disease. These substances can potentially pass from the manure to shrimp and cause food safety concerns.

Farms should not use uncooked organisms and their by-products as feed in shrimp ponds, as this encourages the spread of shrimp diseases. Also, this raw food has a high oxygen demand that can deteriorate pond water quality.

Implementation

Sewage from bathrooms, kitchens and other facilities shall be treated in septic tanks. Waste oxidation lagoons are also an acceptable treatment method on large farms. In all cases, raw sewage shall not be discharged into shrimp ponds, farm canals or natural waters. Septic runoff from humans and animals shall also be avoided.

Shrimp producers are not likely to intentionally dispose of human sewage in ponds. However, some farms draw water from rivers or estuaries that receive untreated human waste in the immediate vicinity of the farm. In such cases, water holding or pretreatment is recommended. Also, some farms can have toilets located near canals or waste treatment systems that discharge or leak into ponds or farm canals. Such situations shall be corrected.

It is in the best interest of the shrimp culture industry to use chemical fertilizers, properly treated organic manure and pelleted feed in ponds. Although some uncooked food organisms are allowed in broodstock ponds, where special diets are needed for gonadal maturation, certified farms shall not use any untreated manure or uncooked organisms in growout ponds.

For Additional Information

Pond Aquaculture Water Quality Management
C. E. Boyd and C. S. Tucker — 1998
Kluwer Academic Publishers
Boston, Massachusetts, USA

Food Safety Issues Associated With Products From Aquaculture
Report of a Joint FAO/NACA/WHO Study Group
World Health Organization — 1999
Geneva, Switzerland

Environmental Engineering
P. A. Vesilind, J. J. Peirce and R. F. Weiner — 1994
Butterworth-Heinemann
Boston, Massachusetts, USA

Standard 12 — Food Safety
Harvest and Transport

Shrimp shall be harvested and transported in a manner that maintains temperature control and minimizes physical damage and contamination. Shrimp treated with sulfites or other allergens shall be labeled accordingly.

Reasons for Standard

Shrimp are highly perishable organisms that shall be properly handled during harvesting and transport to the processing plant. Microorganisms living on the surface of shrimp can rapidly multiply at ambient temperature and cause deterioration of flavor, odor, texture and color.

Spoilage and decomposition can be prevented by reducing the temperature to retard bacterial growth. Improper handling can result in the breaking or crushing of tissues that facilitates the penetration of bacteria and hastens spoilage.

Implementation

Shrimp should be iced immediately after harvest to rapidly reduce and maintain temperature at or below 4.4° C (40° F). Slurries of ice and shrimp or alternating layers of ice and shrimp are recommended to avoid pockets of elevated temperature and prevent temperature fluctuations.

The equipment and containers used to harvest and transport shrimp should be clean and prevent the contamination of shrimp with lubricants, fuel, metal fragments or other foreign materials. Nonapproved food additives such as dyes, preservatives and chemicals should not be applied directly or indirectly to shrimp at harvest.

If shrimp are treated on-farm at harvest with sulfites, the protocol for this practice shall be provided. Since used sulfite solutions can cause localized dissolved-oxygen depletion in discharge water bodies, these solutions should be held in a tank or small pond until the sulfites have oxidized completely. Mechanical aeration accelerates the oxidation.

When the dissolved oxygen concentration of the solution reaches 4 or 5 mg/L, the sulfite has been completely converted to sulfate. The solution should then be treated with 0.4 kg lime/liter to neutralize acidity before final disposal into natural waters.

For Additional Information

USFDA Center for Food Safety & Applied Nutrition
Fish and Fisheries Products Hazards and Controls
Guidance: Third Edition, June 2001
Appendix 4: Bacterial Pathogen Growth and Inactivation
Available online at http://www.cfsan.fda.gov/~comm/haccp4x4.html

Global Aquaculture Advocate
Volume 3, Issue 4, 2000, pp. 57-61
"Mechanized Shrimp Harvesting"
Les Hodgson, Keith Gregg, Robins McIntosh

Traceability
Record-Keeping Requirement

To establish product traceability, the following data shall be recorded for each pond and each production cycle:

- pond identification number
- pond area
- stocking date
- quantity of postlarvae stocked
- source of postlarvae (hatchery)
- antibiotic and drug use
- herbicide, algicide and other pesticide use
- manufacturer and lot number for each feed used
- harvest date
- harvest quantity
- sulfite use and protocol
- processing plant or purchaser.

Reasons for Requirement

Product traceability is a crucial component of the ACC Aquaculture Facility Certification Program. It interconnects links in the shrimp production chain and allows each processed lot to be traced back to the pond and inputs of origin. Results of food quality and safety analyses by accredited laboratories can also be included. Traceability ultimately assures the purchaser that all steps in the production process were taken in compliance with environmental, social and food safety standards.

Implementation

Participating farms can maintain paper records of the required data in notebooks or files (sample form follows). If possible, the information should also be transferred to computer database files, with the original files kept to allow verification of the electronic data.

This information shall also be added via the Internet to ACC's online traceability system developed by TraceRegister, Inc. To participate in the traceability system, the hatchery shall pay a basic annual fee and an incremental fee for each registered traceability document.

Some of the data referenced in BAP's standards on postlarvae sources and chemical management is required for product traceability. This information and other pond-related records needed for BAP certification can be captured on the sample Pond-Level Product Traceability Form on page 26.

The record-keeping process requires a high degree of care and organization. On a large shrimp farm, pond managers could collect initial data for those ponds for which they are responsible. A single clerk could then be given the task of collecting the data from pond managers and transferring it to a computer database. Farm management shall of course review the effort at intervals to verify it satisfies BAP requirements.

Sample Pond-Level Product Traceability Form

Farm Name	Pond Number / Pond Area (ha)
POSTLARVAE	**FEED**
Stocking Date	Feed Type
Stocking Quantity	Manufacturer
Hatchery Name	Lot Number(s)
"No Banned Chemical Use" Statement Available? Y N	"No Banned Chemical Use" Statement Available? Y N
THERAPEUTIC DRUG USE	**PESTICIDE USE**
Compound 1	Compound 1
Disease Treated	Condition Treated
Application Rate	Application Rate
Application Period	Application Period
Compound 2	Compound 2
Disease Treated	Condition Treated
Application Rate	Application Rate
Application Period	Application Period
HARVEST	Harvest Purchaser Name/ Address
Harvest Date	
Harvest Quantity (kg)	
Sodium Bisulfite Treatment Used? Y N	Dip Concentration / Exposure Time