Aquaculture Facility Certification

Pangasius Farms

Best Aquaculture Practices
Certification Standards, Guidelines

Community • Environment • Food Safety • Traceability

BEST AQUACULTURE PRACTICES CERTIFICATION

The following Best Aquaculture Practices standards and guidelines apply to the pond production of *Pangasius*. BAP standards are achievable, science-based and continuously improved global performance standards for the aquaculture supply chain that assure healthful foods produced through environmentally and socially responsible means. They are designed to assist program applicants in performing self-assessments of the environmental and social impacts, and food safety controls of their facilities, and to lead to third-party certification of compliance. For further information, please refer to the additional resources listed.

To obtain BAP certification, applicants must be audited by an independent, BAP-approved certification body. To apply for certification, contact:

Best Aquaculture Practices Certification Management (formerly Aquaculture Certification Council)
P. O. Box 2530 – Crystal River, Florida 34423 USA
Telephone: +1-352-563-0565 – Fax: +1-425-650-3001
Web: www.aquaculturecertification.org – E-mail: aquacert@tampabay.rr.com

The audit consists of an opening meeting, a site assessment, the collection of necessary samples, a review of management records and procedures, and a closing meeting. All points in the standards must be addressed. Any non-conformity raised during the evaluation is recorded by the auditor in the formal report as:

Critical – When there is a failure to comply with a critical food safety or legal issue, or a risk to the integrity of the program, the auditor immediately informs the certification body, which then informs Best Aquaculture Practices Certification Management. Pending clarifications, failure to certify or immediate temporary suspension can ensue.

Major – When there is a substantial failure to meet the requirements of a standard but no food safety risk or immediate risk to the integrity of the scheme, the auditor notifies the certification body and records this in the report. Verification of the implementation of corrective actions must be submitted to the certification body within 28 days of the evaluation. (Major non-conformities typically reflect issues with general policies.)

Minor – When full compliance with the intent of standards has not been demonstrated, the auditor notifies the certification body and records this in the report. Verification of the implementation of corrective actions must be submitted to the certification body within 28 days of the evaluation. (Minor non-comformities typically reflect general housekeeping issues.)

1. Community

Property Rights, 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, operation and waste disposal.

Reasons for Standard

Regulations are needed to assure that farms provide pertinent information to governments and pay fees to support relevant programs. The BAP program requires compliance with applicable business-related laws and environmental regulations, including those concerning protection of sensitive habitats, effluents, operation of landfills and predator control, because it recognizes that not all governmental agencies have sufficient resources to effectively enforce laws.

Some *Pangasius* farms have been sited in water bodies or on 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. Water bodies can also have other important uses for domestic water supplies, irrigation, recreation or tourism. Unauthorized installation of farms can displace landless people and interfere with the use of resources by local communities.

Implementation

Regulations regarding the operation and resource use of 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
- effluent permits
- predator control permits
- well operation permits
- protection of wetlands or other sensitive habitats
- environmental impact assessments.

BAP auditors cannot know all laws that apply to *Pangasius* farming 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. BAP auditors must also become familiar with the legal requirements within the areas they service.

The BAP program imposes repeated environmental audits on participating facilities. It strengthens existing regulations that may require aquaculture facilities to perform environmental impact assessments before beginning construction and to comply with effluent standards or other regulations during operation.

During the BAP site inspection, the representative of the farm will present all necessary documents to the auditor. Farms must 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.

Standards

1.1: Current documents shall be available to prove legal land use by the applicant.

1.2: Current documents shall be available to prove all business and operating licenses have been acquired.

1.3: Current documents shall be available to prove compliance with applicable environmental regulations for construction and operation.

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2. Community

Community Relations

Farms shall strive for good community relations and not block access to public areas, common land, fishing grounds or other traditional natural resources used by local communities.

Reasons for Standard

Aquaculture farms are often located in rural areas, where some individuals may rely on varied natural resources to supplement their livelihoods. Some local residents benefit from employment or infrastructure improvements associated with large-scale aquaculture development, but others may face limited access to areas used for fishing, hunting, gathering, domestic water supply or recreation.

Implementation

Farm management should accommodate traditional uses of natural resources through a cooperative attitude toward established local interests and environmental stewardship. For example, it may be necessary to provide designated access routes across a farm. To avoid conflicts with local communities, farms are encouraged to communicate regularly with local leaders.

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

Standards

2.1: The applicant shall accommodate local inhabitants by not blocking traditional access routes to fishing grounds, wetland areas and other public resources.

2.2: The applicant shall manage water usage to avoid restricting the amount of water available to other users.

2.3: The applicant shall demonstrate interaction with the local community to avoid or resolve conflicts through meetings, committees, correspondence, service projects or other activities performed annually or more often.

3. Community

Worker Safety, Employee Relations

Farms shall comply with local and national labor laws to assure adequate worker safety, compensation and, where applicable, on-site living conditions.

Reasons for Standard

Farm work is potentially dangerous because of the types of machinery employed, the risks of drowning and electrocution, and the use of potentially hazardous materials. Workers may not be well educated nor fully appreciate the risks at farms, and sometimes safety instruction may not be adequate.

Much aquaculture takes place in developing nations where pay scales are low and wage or labor laws may not be consistently enforced. Large farms that employ several hundred workers commonly provide on-site living quarters, which must provide decent living conditions.

Implementation

At a minimum, certified farms shall provide legal wages, a safe working environment and adequate living conditions. Auditors must take into account national regulations and local standards to evaluate this aspect. Efforts should be made to exceed the minimum requirements, because certified farms should be progressive and socially responsible.

Appropriate safety equipment shall be provided to workers where needed. A plan shall be available for obtaining prompt medical assistance for injured or ill workers.

Farms that use divers to clear sludge from pond bottoms shall develop a written plan to assure safety and require directly employed or contracted divers to follow the plan.The plan shall require specialized diver safety training, maintenance records for diving equipment and procedures for diving emergencies..

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

Standards

3.1: The applicant shall meet or exceed the minimum wage rate, including benefits, required by local and national labor laws.

3.2: The applicant shall comply with national labor laws.

3.3: If provided, employee housing shall meet local and national standards (e.g., water-tight structures, adequate space, heating/cooling).

3.4: If provided, employee housing shall be free of accumulated trash and garbage.

3.5: Safe drinking water shall be readily available to employees.

3.6: Running water, toilets and shower facilities shall be readily available to employees.

3.7: If provided, meals shall be wholesome and commensurate with local eating customs.

3.8: The applicant shall provide basic medical care, including access to or communication with medical authorities, in the case of emergencies or accidents.

3.9: An emergency response plan shall be prepared for serious illnesses or accidents.

3.10: Select workers shall be made familiar with details in emergency response plans and trained in the first aid of electrical shock, profuse bleeding, drowning and other possible medical emergencies.

3:11: Protective gear and equipment in good working order shall be provided for employees (e.g., eye protection for welding, gloves for shop work, boots for wet areas).

3.12: A first aid kit shall be readily available to employees.

3.13: The applicant shall comply with laws that govern diving on fish farms and develop a written dive safety plan that requires diver training and the maintenance of logs that document procedures, safety-related incidents and equipment maintenance.

3.14: The applicant shall provide written procedures and staff training for handling diving emergencies and regularly audit records and procedures.

4. Environment

Wetland Conservation, Biodiversity Protection

Aquaculture facilities shall not be located in mangrove or other sensitive wetland areas where they displace important natural habitats. Farm operations shall not damage wetlands or reduce the biodiversity of other ecosystems. Wetland area removed for allowable purposes shall be mitigated.

Reasons for Standard

Mangroves and other wetlands are important components of many coastal and inland ecosystems. They represent important breeding and nursery grounds for many aquatic species, and provide habitat for birds and other wildlife. Wetlands are often called the kidneys of the landscape because of their important role in improving the quality of water runoff before it enters streams, lakes or estuaries. Wetlands, and mangrove areas in particular, protect coastal areas from heavy winds, waves and storm surges. Both coastal and inland wetlands are also an important resource to local people.

Farm operations have the potential to alter aquatic ecosystems and cause a decline in biodiversity through wetland destruction, lethal predator control and eutrophication. Erosion and sedimentation at farm outfalls can have adverse impacts on benthic biodiversity.

Implementation

Farm construction shall take place outside areas with sensitive wetland vegetation. In coastal zones, aquaculture ponds should be located behind mangrove areas on land that is above the average tidal zone and inundated no more than a few times per month by the highest tides. Particular care should be taken to assure that hydrological conditions are not altered in a way that deprives mangroves or other wetland vegetation of contact with seawater or brackish water.

Excessive pond construction on a flood plain can reduce the cross-sectional area of flow and increase flood levels and water velocities. This can result in water overtopping pond embankments, erosion of farm earthwork and damage to other property on the flood plain. The problem usually can be avoided if not more than 40% of the flood plain is blocked by pond embankments.

Allowable Wetland Removal

It is sometimes necessary during construction to remove wetland vegetation to access water supplies and for drainage. This practice is allowable, provided no local regulations prohibit it.

Farms constructed in former wetland areas are encouraged to demonstrate environmental stewardship by reestablishing wetland vegetation or by contributing to wetland rehabilitation projects. When ponds constructed in former wetland areas are closed, embankments should be breached to restore natural water flow so that wetland vegetation can reestablish.

The most reliable mitigation procedure is to contribute to wetland restoration programs, for farm operators may not have suitable habitat and expertise for creating wetland areas. If replanting is conducted, the auditor will verify that it is viable by confirming it is initially healthy and still healthy at subsequent annual audits.

To prevent the impingement or passage of animals, screens shall be installed on both water inlet and water outlet pumps or pipes. Farms shall obey laws related to the destruction of predators. Where applicable, permits and records should be available.

During initial inspection, the auditor will record farm areas occupied by wetland vegetation. If dying vegetation is observed around farms, the auditor will deterine 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. Wetland removal for unapproved purposes or failure to mitigate allowable removal will result in loss of certification.

Prevention of erosion avoids resedimentation of soil material from effluents downstream from farms. Sedimentation can also result from the settling of particles in pond effluents.

The control of erosion from effluent involves reducing the impact energy of discharges upon soil and reducing water velocity in ditches to prevent scouring. Drainpipes should extend at least 1 m beyond embankments at an elevation near the ditch bottom. The pipe outlet area should be protected with a splash shield or riprap to reduce effluent energy. Drainpipes that discharge directly into streams should extend over the stream bank to prevent erosion and be located near the stream's normal water level.

For Additional Information

Ramsar Sites Information Service
http://ramsar.wetlands.org

Standards

4.1: If net loss of sensitive wetland habitat (delineated by evaluation of hydrological conditions and the presence of wetland vegetation) occurred on facility property since 1999, the loss shall have been due to allowable purposes.

4.2: If net loss of sensitive wetland habitat occurred on facility property since 1999, the loss shall have been mitigated by restoring an area three times as large or donation to restoration projects.

4.3: Farm operations shall not cause wetland vegetation at the facility perimeter to die off.

4.4: Dredge and fill activities aimed at increasing the area available for pond construction shall be avoided.

4.5: Screens shall be installed on both water inlet and water outlet pumps or pipes.

4.6: The applicant shall use humane methods of predator control and actively favor non-lethal methods. No controls, other than non-lethal exclusion, shall be applied to species that are on the World Conservation Union Red List or that are protected by local or national laws.

4.7: The applicant shall record the species and numbers of all avian, mammalllian and reptilian predator mortalities.

4.8: Measures shall be taken to control erosion and other impacts caused by outfalls.

5. Environment

Effluent Management

Aquaculture facilities shall monitor their effluents to confirm compliance with BAP effluent water quality criteria*. Water quality measurements taken during certification inspection shall meet both BAP criteria and those of applicable government permits. Facilities shall comply with BAP's final criteria within five years.

BAP Water Quality Criteria — *Pangasius* Farms

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)	50 or less	25 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 mmhos/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	Monthly

* **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 pH, dissolved oxygen and chloride.

Additional Data

After the first year of effluent monitoring, the auditor 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.

Pooled, anonymous data for loads and indices will be used as the basis for setting metric standards by June 2015.

Reasons for Standard

Only a portion of the nutrients added to aquaculture facilities to increase production is converted to animal tissue. The remainder becomes waste that can cause increased concentrations of nutrients, organic matter and suspended solids in and around culture systems.

Land-based farms discharge effluents during water exchange or when growout units are cleaned or drained for harvest. Effluents can contain nitrogen, phosphorus, suspended solids and organic matter at greater than ambient concentrations.

The substances in effluents can contribute to eutrophication, sedimentation and high oxygen demand in receiving water. Effluents with low dissolved-oxygen concentrations or high pH can negatively affect aquatic organisms in receiving water bodies.

Implementation

This standard is designed to demonstrate that compliance with other BAP standards through the application of good management practices is effective in reducing the volume and improving the quality of farm effluents. The water quality criteria also assure that effluents from aquaculture facilities have no greater concentrations of pollutants than typically allowed for effluents from other point sources.

Where possible, farms should adopt practices that reduce effluent volume, such as harvesting by seining rather than draining, and maintaining water quality by mechanical aeration rather than pond flushing.

Applicants in the BAP program shall maintain records for effluent data (see sample forms on pages 7 and 8). To confirm compliance with BAP water quality criteria at farms, the auditor will sample effluents during the inspection process and have them analyzed by an independent laboratory.

Sampling

- Samples shall be collected near the point where effluents enter natural water bodies or exit the farm property. A water 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.
- Water shall be collected directly from the discharge stream of pipes or dipped from the surface of ditches or canals with a clean plastic bottle. The sample will be placed on ice in a closed, insulated chest to prevent exposure to light.

- Samples or direct measurements for temperature, 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 or growout units being drained for harvest at the time of sampling shall be recorded.
- Source water samples shall be collected quarterly directly in front of the pump station or from the pump discharge outlet but before pumped water mixes with the supply canal. These samples enable the calculation of annual loads (Equation 2 below) and establish if the limited option is applicable.

Analyses

- Analysis shall be done by a private or government laboratory following standard methods as published by the American Public Health Association, American Water Works Association and Water Environment Federation – www.standardmethods.org.
- Hach and Merck water analysis equipment is approved for total ammonia nitrogen, soluble phosphorus, and chloride analyses. However, auditors can reject analytical results if sampling, in situ measurements or lab protocols are deficient.
- Measurements for temperature, dissolved oxygen and pH shall be taken in situ with portable meters. Auditors must verify the correct application of calibration procedures.
- Salinity should be determined by a conductivity meter with a salinity scale, rather than a hand-held, refractometer-type salinity meter. Alternatively, specific conductance can be measured. Assume that water with specific conductance above 2,000 mmhos/cm exceeds 1.5 ppt salinity, and water with specific conductance over 1,500 mmhos/cm exceeds 1.0 ppt salinity. Note: 1 mS/m = 10 mmhos/cm, and 1 mmho/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 no more than one annual case of non-compliance for each variable. For variables measured quarterly, one non-compliance is initially permitted for each variable during a 12-month period. The target after five years is no more than one case of non-compliance for each variable during a 24-month period. When non-compliances occur, farms should make every effort to correct the problems within 90 days.

Irrigation Systems

Where the farm is within an irrigation system and effluents are used only for crop irrigation, operations shall be exempt from water quality monitoring and effluent limitations.

Annual Effluent Volume

After the first year of effluent monitoring, an estimation of annual effluent volume shall be determined using the following equation:

Equation 1
Effluent = (Water added + Precipitation + Runoff) – (Seepage + Evaporation) + (Farm volume, day 1 – Farm volume, day 365).

The terms of this equation can be estimated as follows:

Water added (m^3) = Pump capacity (m^3/hr) x Pump operation (hr/yr) or other appropriate method.

Precipitation (m^3) = Annual precipitation (m) x Farm water surface area (m^2).

Runoff (m^3) = Annual precipitation (m) x Watershed area (m^2) × 0.25.

Seepage (m^3) = Farm water surface area (m^2) × 0.55 m/yr.

Evaporation (m^3) = Class A pan evaporation (m/yr) x 0.8 × Farm water surface area (m^2).

Farm volume = [Average depth of ponds (m) – Average distance of water level below overflow structure (m)] x Farm water surface area (m^2).

Annual Effluent Loads

Loads of water quality variables are more indicative of the pollution potential of farm effluents than separate measurements of concentrations of these variables and effluent volume. After the first year of effluent monitoring, annual loads for total suspended solids, soluble phosphorus, total ammonia nitrogen and five-day biochemical oxygen demand shall be calculated as follows:

Equation 2
Load of variable (kg/yr) = Farm discharge (m^3/yr) x [Mean annual variable concentration in effluent – mean annual variable concentration in source water (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 3
Water use index (m^3/kg fish) = Annual effluent volume (m^3) ÷ Annual fish production (kg)

Equation 4
Load index (kg variable/mt fish) = Annual load of variable (kg/yr) ÷ Annual fish production (mt/yr).

Production Practices

Compliance with the effluent management standard usually requires farms to improve their production practices in some areas. These areas can include practices for erosion control, feed management, water and bottom soil quality, 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 water quality criteria shall apply to its final outfall.

In cases where source water has high concentrations of suspended solids, a presettling basin to improve water quality before the water reaches production ponds can lessen sediment accumulation in ponds and possibly benefit effluent quality.

In some cases, the use of a natural or constructed "filter strip" can provide effective treatment for effluents before they are discharged into public waters. Effluent water flows in a thin sheet across the strips, which allows the capture of sediment, organic matter and other pollutants by deposition, infiltration, absorption, decomposition and volatilization.

Another approach is the use of retention, evaporation or percolation ponds in areas with highly porous soils. For freshwater effluent, application for irrigation purposes to fields with sustained vegetative cover at less than the rate that causes runoff into natural waters is an option.

Standards

5.1: If the applicant's facility operates within an irrigation system such that effluent water is exclusively destined to irrigate agricultural crops, Standard 5 does not apply.

5.2: If the applicant's facility avoids all regular or temporary discharges of effluents into natural water bodies, for example, by reusing all water, Standard 5 does not apply.

5.3: Records on intake water and effluent monitoring shall be maintained and available.

5.4: Effluent water quality concentrations shall comply with BAP water quality criteria, or if this is not possible because of high concentrations in the intake water, concentrations shall reflect no increase between intake and discharge.

Water quality measurements taken during certification inspection must meet BAP's initial criteria, except as excluded above, and those of applicable government permits. Farms must continue compliance with these criteria to maintain certification and comply with BAP's final criteria within five years.

Sample Effluent Monitoring Form: Dissolved Oxygen and pH

Date (day/month/year)	Dissolved Oxygen (mg/L)			pH (standard units)			Number of Units 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 Units 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 Units Being Harvested
1				
2				
3				
4				
Annual Average				

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

A 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 source water of the farm contains an averag 10 mg/L total suspended solids (TSS), 0.03 mg/L soluble phosphorus (SP), 0.15 mg/L total ammonia nitrogen (TAN) and 1.5 mg/L biochemical oxygen demand (BOD).

The farm effluent contains an average of 45 mg/L TSS, 0.19 mg/L SP, 0.87 mg/L TAN and 9.6 mg/L BOD. Fish production for the past year was 230,000 kg (230 mt).

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 = (45 – 10 g/m^3)(9,200,000 m^3/yr)10^{-3} = 322,000 kg/yr

SP load = (0.19 – 0.03 g/m^3)(9,200,000 m^3/yr)10^{-3} = 1,472 kg/yr

TAN load = (0.87 – 0.15 g/m^3)(9,200,000 m^3/yr)10^{-3} = 6,624 kg/yr

BOD load = (9.6 – 1.5 g/m^3)(9,200,000 m^3/yr)10^{-3} = 74,520 kg/yr

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

$$\text{TSS index} = \frac{322{,}000\ kg/yr}{230\ mt\ fish} = 1{,}400\ kg\ TSS/mt\ fish$$

$$\text{SP index} = \frac{322{,}000\ kg/yr}{230\ mt\ fish} = 6.4\ kg\ SP/mt\ fish$$

$$\text{TAN index} = \frac{6{,}624\ kg/yr}{230\ mt\ fish} = 28.8\ kg\ TAN/mt\ fish$$

$$\text{BOD index} = \frac{74{,}520\ kg/yr}{230\ mt\ fish} = 324\ kg\ BOD/mt\ fish$$

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

A farm has two pumps that discharge a combined volume of 136 m^3/min. The pumps operate an average of 8 hr/day. The source water of the farm contains an average 10 mg/L total suspended solids (TSS), 0.03 mg/L soluble phosphorus (SP), 0.15 mg/L total ammonia nitrogen (TAN) and 1.5 mg/L biochemical oxygen demand (BOD).

The farm effluent contains 91 mg/L total suspended solids, 0.23 mg/L soluble phosphorus, 1.20 mg/L total ammonia nitrogen and 12.7 mg/L biochemical oxygen demand (BOD). Fish production during the past year was 378,000 kg (378 mt).

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)(91 – 10g/m^3)10^{-3} = 1,930,000 kg

SP load = (23,827,200 m^3/yr)(0.23 – 0.03 g/m^3)10^{-3} = 4,765 kg

TAN load = (23,827,200 m^3/yr)(1.20 – 0.15 g/m^3)10^{-3} = 25,018 kg

BOD load = (23,827,200 m^3/yr)(12.7 – 1.5 g/m^3)10^{-3} = 266,865 kg

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

$$\text{TSS index} = \frac{1{,}930{,}000\ kg/yr}{378\ mt\ fish} = 5{,}106\ kg\ TSS/mt\ fish$$

$$\text{SP index} = \frac{4{,}765\ kg/yr}{378\ mt\ fish} = 12.6\ kg\ SP/mt\ fish$$

$$\text{TAN index} = \frac{25{,}018\ kg/yr}{378\ mt\ fish} = 66.2\ kg\ TAN/mt\ fish$$

$$\text{BOD index} = \frac{266{,}865\ kg/yr}{378\ mt\ fish} = 706\ kg\ BOD/mt\ fish$$

6. Environment
Sludge Management

***Pangasius* farms shall use sedimentation basins to collect sludge from fish ponds to prevent negative ecological impacts on surrounding land and water.**

Reasons for Standard
Aquaculture ponds have high hydraulic retention times and function as sedimentation basins, but negative environmental impacts can arise when sediments are resuspended during harvest or when sediment is pumped from ponds during the culture period and discharged as a highly fluid sludge. The sludge contains organic material from feces and uneaten feed, but mainly comprises mineral particles that enter the ponds in source water from a river.

Discharge of sludge may not be an issue for ponds with production of less than 20 mt/ha/crop, but above this threshold, the use of sedimentation basins for sludge disposal is needed.

Implementation
The minimum required sedimentation basin volume can be estimated using the following equation:

Sedimentation basin volume = 37.5 x
[Fish production (mt) ÷ Sludge transfers (times/crop)] +
[Fish production (mt) ÷ 0.6]

In the above equation, fish production is the total quantity of fish produced in all ponds that discharge into the sedimentation basin, and sludge transfers are the mean frequency at which sludge is moved from ponds to the sedimentation basin. It is also assumed that:

- The minimum hydraulic retention time to allow coarse and medium solids to settle out is six hours.
- One mt of fish production equates to 1 mt sediment.
- Sludge removal can be spread over a 24-hour period.
- Sediment bulk density is 0.6 t/m^3.
- The solids content of sludge is 6.5kg/m^3.
- Accumulated sediments in the basin are removed at the end of each crop to return the basin to its original capacity.

Note: If sludge is removed more frequently from fish ponds, the required size of the sedimentation basin is reduced.

The farm operator shall provide the auditor with mean values for fish production and sludge tranfer frequency so the required sedimentation basin volume can be calculated. The auditor shall verify that the farm has the required volume of basins in use and available for sludge containment. The table below helps farmers estimate the proportion of farm surface area needed for sedimentation basins.

Basins should be configured so that raw sludge enters at the top of the basin and resulting effluent exits at the top on the other side of the basin. Five or six calibrated poles should be installed in basins to allow the build-up of settled solids to be monitored and ensure the remaining capacity supports a minimum six-hour hydraulic retention time.

Sediments removed from sludge basins shall be confined at the farm or used for landfill or agriculture. See Standard 7.

Additional Information

Environmental Impact Assessment of the *Pangasius* Sector in the Mekong Delta
R. H. Bosma, C. T. T. Hanh and J. Potting – 2009
MARD/DAQ, Wageningen University, The Netherlands

Bottom Soils, Sediment and Pond Aquaculture
C. E. Boyd – 1995
Chapman and Hall
New York, New York, USA

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

Physical and Chemical Characteristics of Bottom Soil Profiles in Ponds at Auburn, Alabama, USA
P. Munsiri, C. E. Boyd and B. F. Hajek – 1995
Journal of the World Aquaculture Society 26:346-377

Treatment of Channel Catfish Pond Effluents in Sedimentation Basins
G. Ozbay and C. E. Boyd – 2004
World Aquaculture 35(3):10-13

Percentage of Farm Surface Area Needed for Sedimentation Basins

Frequency of Sludge Removal	Mean Harvest Density (mt/ha/crop)							
	50	100	150	200	250	300	350	400
16	1.0	2.0	3.0	4.0	5.0	6.1	7.1	8.1
14	1.1	2.2	3.3	4.3	5.4	6.5	7.6	8.7
12	1.2	2.4	3.6	4.8	6.0	7.2	8.4	9.6
10	1.4	2.7	4.1	5.4	6.8	8.2	9.5	10.9
8	1.6	3.2	4.8	6.4	8.0	9.5	11.1	12.7
6	2.0	4.0	5.9	7.9	9.9	11.9	13.9	15.8
4	2.8	5.5	8.3	11.0	13.8	16.6	19.3	22.1
2	5.1	10.2	15.3	20.4	25.5	30.7	35.8	40.9
1	9.8	19.6	29.4	39.2	49.0	58.7	68.5	78.3

Note: These values assume basins are 2 m deep. If basins are only 1 m deep, double the indicated surface area.

Standards

6.1: If the applicant's facility produces less than 20 mt fish/ha/crop, Standard 6 does not apply.

6.2: The facility shall possess sufficient sedimentation basin capacity to handle the sludge volume associated with the facility's production.

6.3: The facility shall process all sludge in sedimentation basins and not dump sediment in senstive wetland or mangrove areas, or public water bodies.

7. Environment
Soil, Water Conservation

Farm construction and operations shall not cause soil and water salinization or deplete groundwater in surrounding areas. Farms shall properly manage and dispose of sediment from ponds, canals and settling basins.

Reasons for Standard

In some locations, freshwater from underground aquifers is used to dilute salinity in brackish water ponds or as the main water supply for freshwater ponds. Farming can cause salinization if saline water from ponds infiltrates freshwater aquifers or is discharged into freshwater lakes or streams. Farms can potentially lower water tables and negatively affect groundwater availability. Where other suitable water sources are available, the use of well water is discouraged.

Sediments that accumulate in canals, ponds and settling basins can negatively impact water movement and affect pond soil and water conditions, necessitating periodic dredging and removal. Sediments are mostly mineral soil enriched with organic material, but at some farms also contain water-soluble salt from contact with saline water. Improper disposal of salt-laden sediments from ponds can cause salinization of soil and water.

Implementation

Salinization can result from pond culture in coastal areas where ponds are filled with brackishwater. Several practices can be adopted to lessen the risk of salinization. One of the most important is to avoid constructing ponds in highly permeable, sandy soil, or to provide clay or plastic liners to minimize seepage. Other useful practices:

- Do not discharge saline water into freshwater areas.
- Avoid excessive pumping of groundwater from freshwater aquifers, and do not use freshwater from wells to dilute salinity in growout ponds.
- Monitor chloride concentration in freshwater wells near farms to determine if salinization is occurring.

In freshwater levee and embankment ponds, use the drop-fill method to capture rainfall and runoff, and reduce the use of water from other sources. Water should not be added to ponds during dry weather until the water level has fallen 15 to 20 cm below the overflow level. Water should then be added to increase the water surface level by not more than 7.5 to 10 cm. This practice provides storage volume sufficient to capture normal rainfall and runoff.

Where freshwater from wells is used to supply ponds or other production facilities, water levels in nearby wells should be monitored to determine if aquaculture use is contributing to a decline in the water table level. Use of water from irrigation systems should be in accordance with regulations, and effluent should be returned to the irrigation system.

Water removal from lakes, streams, springs and other natural sources should not be excessive and cause ecological damage or conflicts with other water users. Where possible, seine harvest fish and do not drain ponds for several years. This practice is highly recommended, for it conserves water, reduces effluent volume and lessens pumping costs.

Farm ponds should be surrounded by a ditch to intercept seepage. This ditch should be large enough to capture overflow from ponds following rainfall. When ponds are drained for harvest, water should be stored in a reservoir or transferred to other ponds for reuse.

When ponds must be drained into a freshwater stream, the water should be discharged when stream flow is high. The water should be discharged slowly to avoid increases in chloride concentration greater than 250 mg/L in the receiving water body.

A vegetative barrier of salt-sensitive vegetation around farms can help detect movement of salt into adjacent areas. Where freshwater from wells is used to supply ponds or other production facilities, water levels in nearby wells should be monitored by appropriate regulatory agencies to determine if aquaculture use is contributing to a decline in the water table level.

Farms shall manage sediment so that it does not cause salinization or other ecological nuisances in surrounding land or water. Sediment accumulation in ponds and canals should be reduced by implementating proper earthen infrastructure design to lessen erosion and placing aerators to avoid impingement of water currents on embankments. Erosion-prone areas should be reinforced with stone or other lining materials. Bare areas should be covered with gravel or grass.

When sediment is stored, it shall be confined within a diked area so that solids suspended by rainfall can be retained. When sediment must be removed, it shall ideally be reused to repair pond earthworks or applied as fill material. The sediment can also be spread in a thin layer over the land and vegetative cover established.

For Additional Information

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

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

Standards

7.1: If ponds are constructed on permeable soil, measures such as the use of pond liners shall be taken to control seepage and avoid contamination of aquifers, lakes, streams and other natural bodies of freshwater.

7.2: Quarterly monitoring of neighboring well and surface water shall not show that chloride levels are increasing due to farm operations.

7.3.: Water levels in nearby wells shall be monitored to establish that aquaculture is not significantly lowering the water table.

7.4: Use of water from wells, lakes, streams, springs or other natural sources shall not cause ecological damage or subsidence in surrounding areas.

7.5: Any accumulated sludge removed from ponds or sedimentation basins shall be confined within the farm property or consolidated and used locally for landfill or agriculture.

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8. Environment
Fishmeal, Fish Oil Conservation

Farms shall accurately monitor feed inputs and minimize the use of fishmeal and fish oil derived from wild fisheries.

Reasons for Standard

The majority of feeds manufactured for use in aquaculture contain fishmeal and fish oil as protein and lipid sources. Although fishmeal and fish oil are renewable resources derived primarily from small fish that are not generally utilized for direct human consumption, there are limits to the amounts of these products the world's oceans can supply.

The BAP program therefore supports the use of protein feed ingredients derived from terrestrial sources, as well as fishmeal and fish oil produced from fish processing and fishery by-products. Fishery-based ingredients from wild sources should come from sustainable fisheries.

In addition, by improving the efficiency with which feed is converted into fish biomass, farmers can lessen the amount of fishmeal and fish oil used. More efficient feed conversion also has a direct beneficial impact on water quality and limits the release of excess nutrients to the environment.

Implementation

Pangasius feed is typically manufactured at commercial facilities and delivered to farms. Farmers shall obtain feed from suppliers that provide reliable information on the crude protein and fishmeal and fish oil content in the feeds. Farmers shall record the characteristics of all feeds used, the total amounts of each feed used each year and the total annual fish production.

Although a BAP standard for feed conversion has not been established, producers should strive to reduce their facilities' feed-conversion ratios as low as practicable. Also, certified farms should maintain or lower feed conversion in the years following their initial certification. Harvest size must be considered when assessing the evolution of FCR.

Additional Data

Feed-Conversion Ratio

The feed-conversion ratio is a measure of the amount of feed needed to produce a unit weight of the culture species. Farms shall calculate and record FCR yearly using the following:

Equation 1
Feed-conversion ratio = Annual feed use (mt) ÷
Fish harvested (mt).

"Fish In:Fish Out" Ratio

The so-called "fish in:fish out" ratio is one means of measuring the ecological efficiency of an aquaculture system. It compares the amount of fish consumed by the system (usually in the form of fishmeal and fish oil) with the amount of fish produced.

Pangasius producers should strive to obtain the lowest fish in:fish out ratio practicable in order to conserve industrial fish resources. Since *Pangasius* diets typically incorporate only small amounts of fishmeal and fish oil, *Pangasius* farms typically have fish in:fish out ratios of less than 1, indicating they actually make a net contribution to global fish supplies.

Farms shall calculate and record a final yearly fish in:fish out ratio using Equation 2 below. In the absence of better, specific data from the feed supplier, the transformation yields for industrial fish to fishmeal and fish oil should be 22% and 8%, respectively.

Anonymous pooled FCR and fish in:fish out data shall be used to establish metric standards before June 2015.

Equation 2
Fish in:fish out ratio = Feed fish inclusion factor of feed (from manufacturer) x Feed-conversion ratio

Where feed fish inclusion factor = {Level of fishmeal in diet (%) + Level of fish oil in diet (%)] ÷ [Yield of fishmeal from wild fish (%) + Yield of fish oil from wild fish (%)]

The inclusion levels in Equation 2 should include any meal or oil derived from wild-caught fish, squid, krill, mollusks or any other wild marine animals. However, they should exclude meal or oil derived from fishery by-products such as trimmings, offal and squid liver powder, and aquaculture by-products such as shrimp head meal.

Additional Information

The State of World Fisheries and Aquaculture
FAO Fisheries and Aquaculture Department – 2006
ftp://ftp.fao.org/docrep/fao/009/a0699e/a0699e.pdf

Fish In:Fish Out Ratios Explained
International Fishmeal and Fish Oil Organisation
http://www.iffo.net/intranet/content/archivos/100.pdf

Standards

8.1: The applicant's facility shall use feed that indicates its wild fishmeal and fish oil content or feed fish inclusion factor.

8.2: The facility shall record the characteristics of all feeds used, the total amounts of each feed used each year and the total annual fish production.

8.3: The facility shall calculate and record FCR yearly.

8.4: The facility shall calculate and record a final yearly fish in:fish out ratio.

9. Environment
Control of Escapes, Use of GMOs

Certified farms shall take measures to minimize escapes of farm stock and comply with governmental regulations regarding the use of native and non-native species, and genetically modified *Pangasius*.

Reasons for Standard

The escape of non-native culture species or the release of their eggs or larvae could lead through interbreeding to the alteration of the gene pools of local fish populations. Escapes of non-native species could also lead to competition with native species and possibly have other detrimental ecological consequences. Diseases can also be transmitted from escapees to wild fish.

Most nations allow the importation of native species, and some allow specified non-native imports. Among other factors, regulation is required because diseases can be transferred between countries and species by importations of eggs, fry and broodstock. Regulations usually require health certificates and quarantine.

Genetically modified organisms (GMOs) are defined as organisms whose genomes have been modified by the introduction or deletion of specific genetic material. Sex-reversed organisms and their offspring, and organisms created by hybidization and polyploidy are not GMOs.

Should genetically modified *Pangasius* be commercialized in the future, producers shall comply with all regulations regarding such organisms. Some consumers do not desire genetically modified foods and should be provided with reliable information to enable informed food choices.

Implementation

Participating farms shall keep records of their sources and purchases of stocking material, and record the number stocked in each culture unit 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 fish must also note this information. All incidents involving animal escapes shall be accurately documented. Farms should demonstrate reductions in escapes over time.

All systems shall be designed to minimize the escape of culture animals. For example, ponds and other culture systems shall have intact screens on water inlets and outlets. Acceptable filter devices include a series of mesh screens capable of screening all water, dry-bed filters constructed with gravel and sand, microscreen solids filters, and pond traps with screened discharge.

Production facilities should be constructed to prevent overtopping by storm surges, waves or flood water. When heavy rainfall is expected, pond levels should be drawn down to prevent the rain from raising water levels and overtopping embankments.

During site inspection, documentation of compliance with government regulations relating to the import of fry shall be available. Regulations differ by country, and the certification body cannot maintain complete records of the requirements in every country. Auditors should become familiar with relevant regulations in countries that they serve.

For Additional Information

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

Standards

9.1: The facility shall maintain accurate records of the species farmed and, where relevant, any significant stock characteristics, including but not limited to non-native, specific pathogen-free, specific pathogen-resistant, hybrid, triploid, sex-reversed or genetically modified status.

9.2: If government regulations control the use or importation of any of the species or stocks farmed, relevant permits shall be made available for inspection, even if imported fry were purchased from an intermediary.

9.3: The facility shall keep records of sources and purchases of stocking material, and record the number stocked in each culture unit for each crop.

9.4: All holding, transport and culture systems shall be designed, operated and maintained to minimize the escape of eggs, larval forms, juveniles and adult animals. Screens sized to retain the smallest animals present shall be installed on water outlet pumps, pipes or sluices.

9.5: All incidents involving fish escapes shall be accurately documented.

10. Environment

Storage, 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

Farms use fuel, oil and grease to power and lubricate vehicles, pumps, aerators and other mechanical devices. The main agricultural chemicals used in aquaculture include fertilizers, liming materials and zeolite. Some farms use insecticides, herbicides, parasiticides and algicides. Other products employed include preservatives, paints, disinfectants, detergents, and antifoulants.

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.

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 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 safely stored. Used 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.

Oil leaks from tractors, trucks and other equipment should be prevented through good maintenance. Oil changes and refueling should avoid spills, with used oil sent to a recycling center.

Fertilizers, liming materials, salt 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.

Procedures should be developed for managing spills of chemicals and other products, and the supplies needed for cleaning up spills should be readily available. Workers should be trained to properly use the equipment and handle the contained waste.

Trash, garbage and other farm wastes shall not accumulate on farm property, and should be disposed of responsibly. Composting shall be done by a procedure that does not create an odor problem or attract wild animals.

Paper and plastic should be recycled if possible. Waste collection for recycling requires readily accessible waste containers that are serviced at regular intervals. All containers must be appropriately labeled with risk indicators (poisonous/explosive, etc.).

For Additional Information

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

Standards

10.1: Fuel, lubricants and agricultural chemicals shall be labeled, and stored and disposed of in a safe and responsible manner.

10.2: Fuel, lubricants and agricultural chemicals shall not be stored near feed, in employee housing or kitchen areas, or near harvest equipment and supplies.

10.3 Fuel, lubricants and chemical storage areas shall be marked with warning signs.

10.4: Precautions shall be taken to prevent spills, fires and explosions, and procedures and supplies shall be readily available to manage chemical and fuel spills or leaks.

10.5: Garbage from housing and food waste shall be retained in water-tight receptacles with covers to protect contents from insects, rodents and other animals.

10.6: Garbage and other solid waste shall be disposed of to comply with local regulations and avoid environmental contamination and odor problems (e.g., recycling, burning, composting or placing in a landfill). Trash and farm wastes shall not be dumped in mangrove areas, wetlands or other vacant land.

10.7: Measures shall be taken to prevent infestation by animal and insect vectors and pests.

10.8: Secondary fuel containment shall conform to BAP guidelines for fuel storage.

11. Environment
Animal Welfare

Producers shall demonstrate that all operations on farms that involve fish are designed and operated with animal welfare in mind, and maximum surival shall be sought. Employees shall be trained to provide appropriate levels of husbandry.

Reasons for Standard
Since society seeks to avoid needless animal suffering, numerous regulations address animal welfare. Although few such regulations address fish, many consumers would like to know that farmed fish were produced by humane techniques.

When farmed fish are exposed to continuing stress, their feed consumption and growth rates can decline. Stressed animals are also less resistant to diseases, and mortality usually increases. Animal suffering can be prevented and production efficiency enhanced by applying good husbandry techniques to avoid stressful culture conditions.

Implementation
This standard seeks to assure a high level of welfare for aquaculture species. The following good aquatic animal husbandry practices should therefore be applied.

Farms must provide well-designed facilities for holding and rearing fish with adequate space and shade. The temperature and chemical composition of culture water should be appropriately maintained, and changes in water quality should be made slowly so the fish can adjust to the changes. Adequate levels of dissolved oxygen must be maintained.

High-quality feed should be offered at regular intervals. Although fasting periods are often needed to enable harvesting in hygienic conditions, they should be minimized.

Farms should minimize stressful situations during handling by limiting crowding to two hours and time out of water to 15 seconds. Culture management should also avoid stress, injury or disease through rapid diagnosis and treatment of disease.

Dead animals must be removed from ponds at least daily and disposed of properly. Ill fish and unwanted animals in the pond environment must be eliminated in a humane fashion by breaking their necks or a blow to the head.

Farm staff shall regularly inspect the culture facility, noting water quality as well as the appearance (e.g., fin condition) and behavior (e.g., loss of appetite) of the fish. Swift action should be taken to correct deficiences or symptoms.

Reliable scientific data on the effects of stocking density on fish welfare are limited, and many factors influence this relationship.

For Additional Information

Farm Animal Welfare Council
http://www.fawc.org.uk/freedoms.htm

Standards

11.1: The applicant's facility shall apply a maximum biomass limit based on fish health and survival records.

11.2: Feeding shall be managed to avoid stress through underfeeding or overfeeding.

11.3: The facility shall apply maximum periods for fasting, crowding and time out of water.

11.4: Facility staff shall make regular inspections of the culture facility, water quality, and behavior and condition of fish.

11.5: Disease outbreaks shall be managed through rapid diagnosis and treatment and, when necessary, humane slaughter.

11.6: When ill, deformed or unmarketable fish and unwanted species are removed, they shall be documented and killed by humane techniques, with the carcasses disposed of responsibly in accordance with applicable local and state regulations.

11.7: Health management procedures shall be recorded in a health management plan or operating manual.

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12. Food Safety

Drug, 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.

Critical Points:

- Chloramphenicol and nitrofuran antibiotics are banned for use in food production in all countries. Other drugs and chemicals, such as antiobiotics, malachite green, heavy metals, parasiticides and hormones, may be banned in specific countries.
- When antibiotics are used for therapeutic purposes, antibiotic residues test should be carried out after the withdrawal period.
- Records for disease diagnoses should support the use of therapeutants.

Reasons for Standard

Residues of some therapeutic agents can accumulate in fish tissue and present a potential health hazard to humans. Therefore, certain compounds have been banned, and residue limits mandated for others. Apart from compromising food safety, failure to comply with such regulations can have serious ecomomic consequences to all involved in the food supply chain.

Improper use of chemicals can harm other organsisms that live around farms. Moreover, prolonged use of antibiotics can lead to antibiotic resistance in disease organisms that affect fish and other aquaculture species.

Some farms are built on land previously used for agricultural or other purposes. Pesticides, heavy metals 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 fish in production ponds. Such compounds pose a potential health risk to some elements of the human population.

Implementation

When considering site locations for new pond construction, soil samples should be taken in areas of high-risk contamination, such as low areas where runoff collects, previously used pesticide storage or disposal sites, and washing and loading sites for spray applicators and agricultural aircraft.

Good health management focuses on the prevention of disease rather than disease treatment with chemical compounds. The best ways of controlling disease are to avoid stocking diseased fish and avoid environmental stress by maintaining good water quality in culture systems. In pond culture, limiting water exchange lessens the risk of disease spreading from one farm to another.

Health management 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, agricultural agencies, or university fisheries research and extension programs.

During inspections, auditors shall have access to full records as described above for all applications of drugs and antibiotics. A sample Traceability Form for use at the pond, tank or cage level is provided in the Traceability section.

For Additional Information

Guide to Drug, Vaccine, and Pesticide Use in Aquaculture
Federal Joint Subcommittee on Aquaculture – 1994
Texas Agricultural Extension Service College Station
Texas, USA
April 2007 revision – http://www.aquanic.org/jsa/wgqaap/drugguide/drugguide.htm

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

Responsible Use of Antimicrobials in Fish Production.
http://www.ruma.org.uk

Standards

12.1: The applicant's facility shall have a written health management plan that includes procedures to avoid the introduction of diseases, protocols for water quality management and fish health-monitoring and disease diagnosis techniques.

12.2: If used, drug treatments shall be based on recommendations and authorizations overseen by a fish health specialist only to treat diagnosed diseases in accordance with instructions on product labels and national regulations.

12.3: Records shall be maintained for every application of drugs and other chemicals that include the date, compound used, reason(s) for use, dose and harvest date for treated ponds. See the Traceability requirement.

12.4: Antibiotics or chemicals banned or unapproved in the producing or importing country shall not be used in feeds, pond additives or any treatment that could result in residue in fish.

12.5: Documentation from feed manufacturers that antibiotics or other drugs are not present in non-medicated feed used at the facility shall be available.

12.6: Antibiotics or hormones shall not be used as growth promoters.

12.7: The facility shall conduct a survey of chemical use in the watershed surrounding the facility and monitor changes in land use practices to identify potential contaminants such as pesticides, PCBs and heavy metals.

13. Food Safety
Microbial Sanitation, Biosecurity

Human waste and untreated animal manure shall be prevented from contaminating pond waters. 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 processing wastes are also used as feed.

There is a possibility of health hazards to humans who consume inadequately cooked fish grown in waters 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 feeds for the prevention or treatment of disease. These substances can potentially pass from the manure to aquatic animals and cause food safety concerns.

The use of uncooked organisms and their by-products or trash fish as feed in fish ponds encourages the spread of fish diseases. Also, this raw food has a high oxygen demand that can deteriorate pond water quality.

Implementation

Housing for owners or workers sometimes is located near fish ponds. 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 and runoff from barns and other facilities for holding livestock must not enter ponds.

Domestic animals other than family pets or watch dogs shall not circulate freely within farms. Livestock is permitted in pastures that serve as pond watersheds, but fences must be installed to prevent the animals from drinking or wading in ponds.

In the unlikely case that culture water is drawn from water bodies that could receive untreated human waste in the immediate vicinity of the farm, water holding or pretreatment is recommended.

It is in the best interest of the *Pangasius* culture industry to use chemical fertilizers, properly treated organic manure and pelleted feed in 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

Standards

13.1: Domestic sewage shall be treated and properly disposed of to avoid contamination of surrounding areas (e.g., sewer system, septic system, portable toilet, outhouse).

13.2: Human waste and untreated animal manure shall not be used to fertilize ponds.

13.3: Uncooked organisms and their by-products shall not be used as feed in growout ponds.

13.4: A plan for prompt and responsible disposal of massive mortalities of culture animals by incineration, burial, composting or removal by a competent contractor shall be available.

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14. Food Safety
Harvest and Transport

Fish shall be harvested and transported to processing plants or other markets in a manner that maintains temperature control and minimizes stress, physical damage and contamination.

Reasons for Standard
The crowding and handling of fish during harvesting and transport are potentially stressful, so measures should be taken to prevent unnecessary animal suffering. Unclean water and transport containers can cause contamination of fish during transit from ponds to plants or markets.

Implementation
When fish are rendered insensitive or their physiological activity greatly reduced during transport, the process should be accomplished by humane methods. For fish placed on ice at the farm, the process must be done properly or the quality of the organisms can deteriorate. Alternating layers of ice and fish are recommended to avoid temperature fluctuations.

Fish that are accidentally dropped on the ground during harvest shall not be left out of water to suffocate.

Live transport of fish in well boats or trucks should not take longer than 24 hours, and adequate water quality should be maintained during transport. This usually requires the application of mechanical aeration or oxygenation in the transport containers. Temperature control may also be necessary. Transport density shall not exceed 10% fish volume/water volume.

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

Standards

14.1: Fish shall be harvested and transported in a manner that maintains temperature control and minimizes stress.

14.2: Equipment and containers used to harvest and transport fish shall be clean and free of lubricants, fuel, metal fragments and other foreign material.

14.3: Ice shall be made from potable water.

14.4: The adequacy of transport methods shall be assessed through documented mortality rates.

14.5: The duration of live fish transport shall be kept below 24 hours to minimize stress.

14.6: Non-approved chemicals shall not be applied directly or indirectly to fish during transport.

14.7: Prior to slaughter, fish shall be rendered insensible by means of carbon dioxide, ice or ice slurry, a blow to the head or an alternative stunning process.

Traceability

Record-Keeping Requirement

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

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

Reasons for Requirement

Product traceability is a crucial component of the BAP program. It interconnects links in the fish production chain and allows tracing of each processed lot back to the culture unit and inputs of origin. Food quality and safety analyses by accredited laboratories can also be included. Traceability ultimately assures purchasers that all steps in the production process were in compliance with environmental, social and food safety standards.

Implementation

Farms can maintain paper records of the required data in notebooks or files. If possible, the information should also be transferred to computer database files, with the original files kept to allow verification of the electronic data.

Required information and other records can initially be captured on the sample form on the following page. Each form corresponds to the harvest on a particular day from a particular culture unit.

Where the facility claims inputs such as feed or juveniles from other BAP-certified facilities, segregation of the BAP inputs and outputs, and accompanying records, are required. In addition, some buyers request that chain of custody data be added to the BAP online traceability database via the Internet. Participation in the online system is optional. On-site audits include chain of custody verification of records and product segregation.

The record-keeping process requires a high degree of care and organization. On large farms, managers could collect initial data for those fish 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.

Standards

Traceability records shall be maintained via the BAP-approved online traceability system for each of the specified parameters for every production unit and every production cycle to allow tracing of fish back to the unit and inputs of origin.

Sample Product Traceability Form

Farm Name	Pond Number	Pond Area (ha)

FINGERLINGS Stocking Date		**FEED** Feed Type
Stocking Quantity		Manufacturer
Hatchery	BAP No.	Lot Number(s)
"No Banned Chemical Use" Statement Available? Y N		"No Banned Chemical Use" Statement Available? Y N
THERAPEUTIC DRUG USE Compound 1		**PESTICIDE USE** 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 Date		Harvest Purchaser Name/ Address
Harvest Quantity (kg)		