Before Southland Regional Council

APP-20157616-V1

under: the Resource Management Act 1991

in the matter of: Applications by Sanford Limited to change the conditions of various resource consents that authorise the farming of salmon in Big Glory Bay, Stewart Island

by: **Sanford Limited**
Applicant

Statement of evidence by Jacobus Johannes Swart

Dated: 11 March 2019

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CHAPMAN TRIPP

INTRODUCTION

1 My full name is Jacobus Johannes Swart.

QUALIFICATIONS AND EXPERIENCE

2 I am the Big Glory Bay Salmon Farm Manager for Sanford Limited (*Sanford*). I have held this position for 15 months, prior to this I was the production manager overseeing the grower farm, and undertook that role for 1.5 years. I have worked for Sanford for more than 4.5 years, with a break between 2012 and 2016 when I was the manager at High Country Salmon. I have also been the manager for Benmore Salmon, both farms are fresh water salmon farms located in the central South Island.

3 I have the qualification of Master of Agricultural Science, majoring in Animal Physiology from University of Stellenbosch, South Africa.

4 I have been involved in the farming of finfish and salmon since I graduated university some 28 years ago. I have an in-depth knowledge of all aspects of the aquaculture fin fish industry, both in New Zealand and internationally.

5 Either myself, Sanford's Assistant Farm Manager, Bevan Ferguson, or Chris Tomlinson the Production Manager are physically present on Stewart Island, in all but exceptional circumstances.

6 I am authorised by Sanford to give evidence on its behalf. I am familiar with Sanford's application to change the conditions of the resource consents that it holds for salmon farming in Big Glory Bay to allow for increased nitrogen input (the *Application*).

SCOPE OF EVIDENCE

7 The purpose of my evidence is to set out:

7.1 A detailed description of the locations and layout of our salmon farms in Big Glory Bay;

7.2 A description of our farming operations, both as they exist now and how they will change over time;

7.3 How Sanford's use of technology has evolved and improved over time as we have moved from producing a frozen product to a fresh one;

7.4 Sanford's approach to technological advancement and our commitment to continuous improvement – i.e. what we have done, why and when;

7.5 How we ensure the mutually compatible objectives of product quality control and environmental sustainability; and

7.6 My summary and conclusions.

BIG GLORY BAY LOCATION

8 Big Glory Bay is located on the southeast arm of Patterson Inlet, Stewart Island. Patterson Inlet has three arms that reach in from Fouveax Strait. The north arm includes the village of Oban. Oban has a resident population of about 360 people. The middle (eastern) inlet is largely wilderness. Big Glory Bay is in the southeast arm, just past Bravo Island and located below 'The Neck' which is a long sandy beach. Big Glory Bay is extensively developed in aquaculture and is the only such area on Stewart Island, or for that matter Southland.

9 Big Glory Bay comprises approximately 1,100 hectares of sheltered water and is surrounded on three sides by national park. It is isolated and there are no roads and no walking tracks into the Bay. Therefore the only access is by boat. Sanford has a house at the head of the Bay that is used for short term (supplementary) accommodation for shift workers, due to the scarcity of accommodation in Oban and limitations of 'on farm' accommodation.

10 In my view Big Glory Bay in is ideally suited for growing salmon and is without doubt the best environment in New Zealand for growing King Salmon. The water is cool all year round, wave height is generally less than 1 meter and the Bay is sheltered from the prevailing southerly wind.

11 Boat access from Stewart Island to Big Glory Bay is via one of the two commercial wharfs, both of which are in the village of Oban. It takes about 35 minutes in a water taxi to travel out to the salmon farm from the Golden Bay wharf, and 45 minutes from the main wharf at Oban. The salmon farm is primarily using the Golden Bay wharf as the point of departure. The map below illustrates the location of Big Glory Bay, in relation to the rest of Stewart Island.

Map One: Stewart Island, Patterson Inlet and Big Glory Bay.

Patterson Inlet *Big Glory Bay*

SANFORD'S BIG GLORY BAY SALMON FARM LOCATION

12 Sanford has been farming salmon in Big Glory Bay since 1992 when it purchased Big Glory Bay Seafoods. While reference is often made to the Sanford business having one salmon farm, it is in fact three separate farms – a brood stock farm (which as the name suggests contains breeding fish), a smolt farm (where small fish are raised after they have been transferred to the island from our hatcheries) and a grower farm (where fish are grown to market size). Each farm has its own supervisor and staff. The three farms are all located within Big Glory Bay, in addition there is an emergency refuge 'salmon' site in the outer Bay, within the wider Patterson Inlet, that can be used in the event of a 'predicted' natural event such as a jellyfish incursion[1] within the Bay.

13 The Big Glory Bay salmon farm is supported by three fresh water hatcheries, one on the Waitaki River, one on the Clutha River and a supplementary hatchery on the banks of the Waimakariri River in Canterbury. The fish come onto the smolt farm at about 25g, and move to the grower farm at 1.5 - 2kg average weight where they are on-grown to a target weight of 4.5 kilos. It takes between 16 and 24 months to grow a

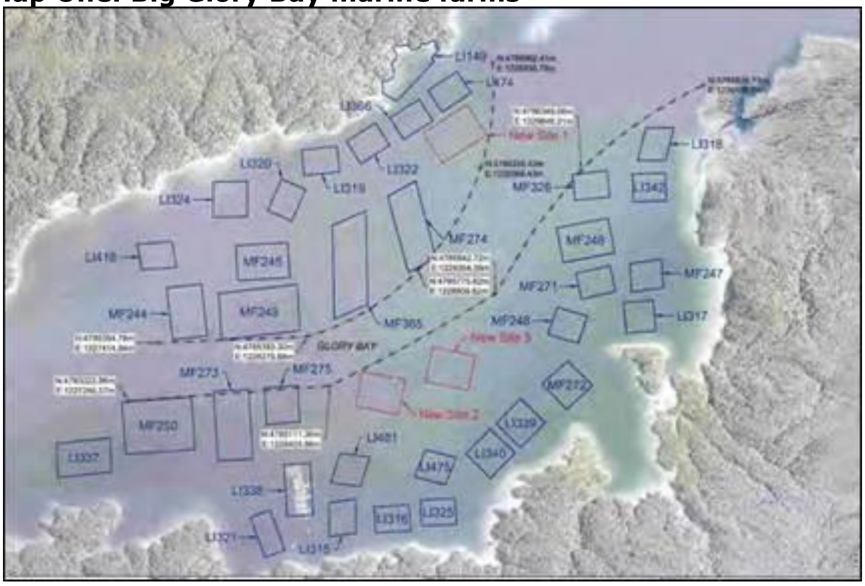
[1] For example, in 1998 following an extended due to a combination of period of strong Easterly winds, and a combination of a strong Norwest and a flood tide this weather pattern pushed the jellyfish into Patterson Inlet and the Bay and up against some of the pens. The jellyfish essentially blocked the nets, and stopped the water flow (and oxygen) through the pens and the fish suffocated weather.

4.5 kilo salmon and a salmon is between 2.5 and 3 years old at the time of harvest.

14 There are 10 salmon farming sites in BGB, owned by three separate entities but Sanford is the only active salmon farmer within Big Glory Bay. Sanford owns seven of these consents exclusively, and is in a partnership with the owners of the three other sites.

15 Sanford also owns 27 the total of the 38 mussel farms in the Bay. The following map shows the locations of all the existing marine farms in Big Glory Bay, and in red boxes the three proposed new mussel farms that are bring applied for and currently before the Council (Zane Smith and Jim Maass Barrett application APP-20181316).

Map One: Big Glory Bay marine farms



FARMING OPERATIONS – NOW AND IN THE FUTURE

16 The Sanford Aquaculture head office is located in Havelock, Marlborough Sounds and is responsible for the oversight of all aquaculture activities nation-wide. At the local 'Big Glory Bay' level, Sanford operates its salmon and Greenshell mussel farming operations as separate entities, but with high levels of co-operation. The mussel farms are managed by Ms Rebecca Diaz-Parry.

17 Both the salmon and mussels farms are supported by a small on-water administration office and staff quarters on the Kiwa barge, which is attached to the salmon grower farm. There is an on-site engineer in the Bay, and an engineering team and processing plant in Bluff. A replacement Kiwa barge has been commissioned and will be engineered in Tasmania, Australia.

18 The farm operates on self-generated diesel power and have 24/7 Wi-Fi. There are 5 Sanford-owned vessels based full time in the Bay to service the salmon and mussel farms, and one service ferry/work boat – the San Braz. A permanent commercial dive team is on call 24/7 and services both the salmon and mussel farms.

The Fish

19 Sanford farms King Salmon, which is also known as Chinook. These fish are widely considered to be the premier salmonid species and are distinguished from Atlantic salmon by their high fat content and creamy, silky textured flesh. New Zealand has a niche commercial opportunity as King Salmon can only be grown in a very narrow global geo-range. The only other place in the world where King Salmon are grown is at a single farm in Canada, although there is also limited seasonal, wild catch commercial fisheries in Canada and Alaska.

20 King Salmon prefer the company of other salmon and a school of fish generally swims in the same direction around the farm pens. Dominant fish swim in the middle of the school.

The Salmon Farms

21 All three kinds of salmon farms are constructed as a double row of square pens, joined by a metal walkway down the middle and along the sides. A service barge is also located at one end of each farm, noting that the grower farm service barge also operates as a feed storage and silo. The feed is contained in 1 tonne bags that are lifted into a hopper with a hoist. Fish are harvested by a separate harvest barge that moves along the row of pens and is tied alongside the pen being harvested. Harvesting a pen takes several days.

22 For a description of the feed and its component parts I refer you to **Mr Wybourne's** evidence.

23 The **brood farm** holds the breeding fish in all year classes. There are between 3000 and 4000 brood fish in total. Fish density in the brood pens is low, and the pens are fixed in location. Brood fish are identified with a pit tag, and those that are graded out at 16+ months as surplus to requirements are donated to the Stewart Island community. Once a year the Balclutha Lion's Club come and assist in a grading and take the un-required fish for a charity event.

24 The Sanford breeding programme dates back some 25 years and is the responsibility of the hatchery manager working with the geneticist and the farm fish veterinarian. Fish on the brood farm are fed a special diet specifically formulated for their requirements.

25 The **smolt farm** takes the fish raised at the freshwater hatcheries at about 25g and carries them through to 1.5 kilos. Juvenile fish are transferred into Big Glory Bay several times during each year, in order to ensure that there is a year round supply of market-sized fish available. The fish stay on

the smolt farm for 10 – 12 months. These fish are initially hand fed for the first 2 weeks after arrival and then fed with the auto feed system. Underwater cameras are used to observe fish behaviour during feeding.

26 The fish on the smolt farm are graded by size, and moved to the grower farm in a net transporter pen. Moving pens requires a lot of skill, the pen must move slowly so as to not stress the fish, become tangled or break free.

27 Fish are transferred to the **grower farm** where they remain until they reach their target harvest weight. The grower farm has close to 1 million fish between 1.5 and 4.5 kilos. There are between 50 - 60,000 fish in each pen depending on the time of year and customer specifications.

28 Fish weights in each pen are estimated once a month with the AM-100, a camera based system that analyses fish weight. Fish are sampled (and can also be autopsied by the farm veterinarian) each month in order to assist in ensuring excellent fish health. The feed is managed and targeted to different growth stages of the fish.

The salmon product

29 Up until 2014 the Big Glory Bay salmon farm primarily supplied a frozen product range of whole fish, fillets and portions into the Japanese market (1990s to 2013). In addition there was a small domestic sales line of fresh salmon. In 2014 Sanford's focus shifted to providing fresh product. This brought significant changes to the way that the salmon farm was managed such as needing to produce a consistent size and reliable supply of fresh product year round. About 69.5% of the fish grown on the farm are now sold into the New Zealand domestic market. The rest is either sold fresh into Australia or further afield. A small proportion is frozen down.

30 The farm now does three intakes of smolt a year, and we plan to eventually have six smaller intakes. The constraining factor is hatchery capability and the hatchery water temperature. On the grower farm growth (weight) and maturation of fish is managed via the use of lights in the pens which work by extending the summer daylight hours during the winter months.

The Premier Big Glory Bay brand

31 In 2016 Sanford launched a premier salmon brand called Big Glory Bay. It is a highly sought after product and we anticipate its popularity is such that we will soon be unable to satisfy market demand. The product specifications of this brand determine some of the farming operational perimeters such as the target size of fish and biomass density in the pen. Bigger fish will have less fish per pen.

32 Each pen is fed a quantity of food based on the water temperature, the size and the number of fish (biomass) present in that pen. On the grower farm fish are fed to different levels - feeding to appetite to accelerate growth, while others are held back to reach their peak size later in the season. This is one of the ways that we ensure a continuous year round supply of

consistently sized fish. Feed input is calculated by the pen and the biomass within the pen, and each pen is fed separately.

33 Compressed air is used to blow feed through the feed hopper and down the feed pipes. The feed is evenly dispersed in the pen by a roto spreader that sits one meter above the water level and sprays the pellets out as it spins around. The pellets blowing through the pipes makes a rattling noise and the fish quickly learn to associate this with feeding. As soon as the rattling begins the fish will rise to the surface and begin to porpoise in anticipation of feeding.

34 While fish are feeding a trained feed technician is observing the fish's behaviour using underwater cameras. There's one camera in each of the grower and smolt farm pens. The feed technician can change the position and depth of the camera to monitor the feed being delivered to each pen. This enables them to slow down the feed supply when the fishes' appetites start to decrease and therefor ensures feed is not wasted. Our aim is to eliminate any feed falling through the pen.

35 Oxygen levels and temperature are continuously monitored in each pen. Good oxygen levels are needed to ensure fish health and the health of the wider environment. Fish feeding decisions (such as the time of day feeding occurs) are made relative to oxygen levels in situations where the water temperature is also evaluated.

36 Fish are graded on average once a year to separate out the larger more dominate feeders. This ensures that fish of similar size are together, allowing equal feeding opportunity so that growth in a pen is more likely evenly distributed. This is another means of maximising feed utilisation. Weight assessments to measure fish performance (growth) against feed is occurring monthly.

37 Sanford is also working with Plant and Food on a unique fish identification software that will use smart technology to track fish health and growth from the hatchery through to harvest. This coupled with new fish pellet recognition software currently under development by AKVA (our feed equipment supplier) will in the future reduce residual risk of overfeeding (for example by automating decisions that are currently made by the human eye). These improvements all positively reduce our footprint on the seafloor.

OUR HISTORY OF TECHNOLOGICAL ADVANCEMENT

38 Two of the most significant technology developments on Sanford's salmon farm have been the automatic feeding system and having the ability to monitor fish underwater. These technologies, coupled with improved diets and a move to 'high energy and extruded' diets, in tandem with the improved genetic programme, has produced much better performing fish that are strong, will eat more and waste less.

39 When salmon farming was pioneered in Big Glory Bay the fish were fed by the farmer standing beside the pen and tipping the sack of feed upside down into the water. In fact early salmon feed was made by a commercial cake mixer and 'sun baking' the feed slabs to a dry hard mass, before manually breaking it up and sifting it to remove large chips.

40 Many of the locals on Stewart Island remember these days, and tell stories of the cloud of dust that would hang in the air as the bags were being emptied. The dust was caused by the pellets breaking up during manufacturing, in transport and during feeding. Today dust has been totally eliminated from feed. The first investment in automatic feed systems on the farm was in 2009 and further refinement in technology has occurred on average every three years.

41 Knowing what the fish are doing and being able to detect early signs of stress by the feed technician being able to see into the cage (i.e. without a diver needing to go into the water) has opened up many opportunities to better manage fish health, feeding rates as well as, for example, knowing if there are predators in the area. Sanford is in the process of investing in underwater remote operated vehicles (*ROV*) and cameras that can be operated from the walkway. These will afford even better visibility and will allow us to monitor the seabed, the performance of the pens and whether there are holes in the net as a result of seven gill sharks.

42 Underwater cameras were first installed on the farm in 2009, ROVs were trialled in 2017 and 2018. The speed and usefulness by which the software and hardware has developed and the total costs of this technology is not prohibitive and is within our reach. Staff will need to be specifically trained in using this new technology.

43 As already noted, feed is the most expensive input on the farm and the biggest determinant in optimising fish performance. The type of feed fish are eating influences their weight gain, health, and the attributes of the final salmon products (taste, colour, texture and omega 3 levels). The important role that feed plays in the success of the salmon business is reflected in the evolution and sophistication of fish feed, as described in **Mr Wybourne's** evidence. Sanford partners with Skretting, which is a global fish feed manufacturer committed to science and research investment so that we can access their expertise.

44 Two recent changes in feed at Big Glory Bay has been the use of high energy feed (2018 – 19) with natural metabolic activators that increases the utilisation of digestible energy – meaning we are able to feed more fish with less feed and extruded feeds. Extruded feeds are essentially being forced through a die so they can be made in to the required pellet size for the fish. The feed condenses all the ingredients (nutrients) into pellet format which does not break up during transportation to the farm, during feeding or as it falls through the water column. This maximises the potential of the feed to grow fish, which is both an environmental and cost benefit.

45 In 2017 Sanford invested in technology that accurately grades and automatically reports fish growth. Prior to this fish were graded once in their life, they are now graded once a year. Having fish in the pen of the same size means that the feed volume is more accurately modelled and distributed. Grading also increases the opportunity for the fish to be of a similar size at harvest.

46 Keeping the nets around the pen free of marine growth is fundamental to maintaining water flow (and oxygen) within the pens, thereby maintaining health of fish and the seabed below the pen. Prior to 2016 Sanford anti-foul treated the nets used in the fish pens with the same chemicals that was used on the hulls of boats. In 2016 such treatments were stopped, and all the nets were manually cleaned. Successfully advancements in underwater net cleaners has sped up the process, to the point where nets are now only required to be given a weekly light brushing while in the water and removed annually for a more intense cleaning and strength test at a shore based facility.

TECHNOLOGICAL ENHANCEMENT AND CONTINUOUS IMPROVEMENT

47 Many of the technological improvements on the farm outlined above have had the added benefit of being good for the environment and often also reducing cost. Initiatives around feed specifications, feed conversion, feeding precision, reduction in fish meal and benthic protection have enabled us to farm more fish on our consented footprint. As I explained earlier, fish feed is by far the biggest cost on the farm, so feed budgets and actual use are being reviewed weekly on the farm, and monthly as part of the Sanford Supply and Operation Planning meetings.

48 The advancements made on the farm have been through collaboration and partnership with others, for example with Skretting, as I described earlier, who have supplied Sanford for more than 20 years.

49 Sanford also has a close relationship with its feeding-system equipment supplier AKVA. Both Skretting and AKVA are global companies with a strong presence in the salmon industry and Sanford benefits greatly from their extensive knowledge, experience and research capability.

50 Enabling technology improvements requires an engaged staff. Sanford is investing in its staff. Staff living on the Island are paid an 'Island living allowance' which recognises the additional costs families have when they live remotely. Staff are encouraged to attend training sessions, and most staff have taken NZITO aquaculture learning programmes to Level 3 Unit Standard. This requires 6 to 8 months of learning.

51 As part of Sanford's continuous learning initiatives, opportunities are taken up to send staff to other salmon farms in New Zealand and management to Tasmania and Norway. Most recently representatives from Leroy, a leading salmon producer in Norway, spent four days with management and farm staff discussing sustainability initiatives and innovations.

52 What I learnt from these visits was that collaboration is important. The challenges we face in Big Glory Bay are not fundamentally different to those faced by aqua farmers in other areas. Fish health, care of the environment and farming the ocean from a perspective of farming for eternity.

53 Sanford provides internships to students from both the Nelson Marlborough Institute of Technology (Aquaculture) and Otago University Marine Science Department. The objective is to encourage people into aquaculture and for our staff to discuss and debate new ideas.

54 I am very supportive of the proposed consent condition committing the farm to a three year technological update report. I think it is important for the farm to benchmark its continuous improvement commitments and to stay in touch with smart technological developments.

COMITTMENT TO PRODUCT QUALITY CONTROL AND ENVIRONMENTAL MANAGEMENT

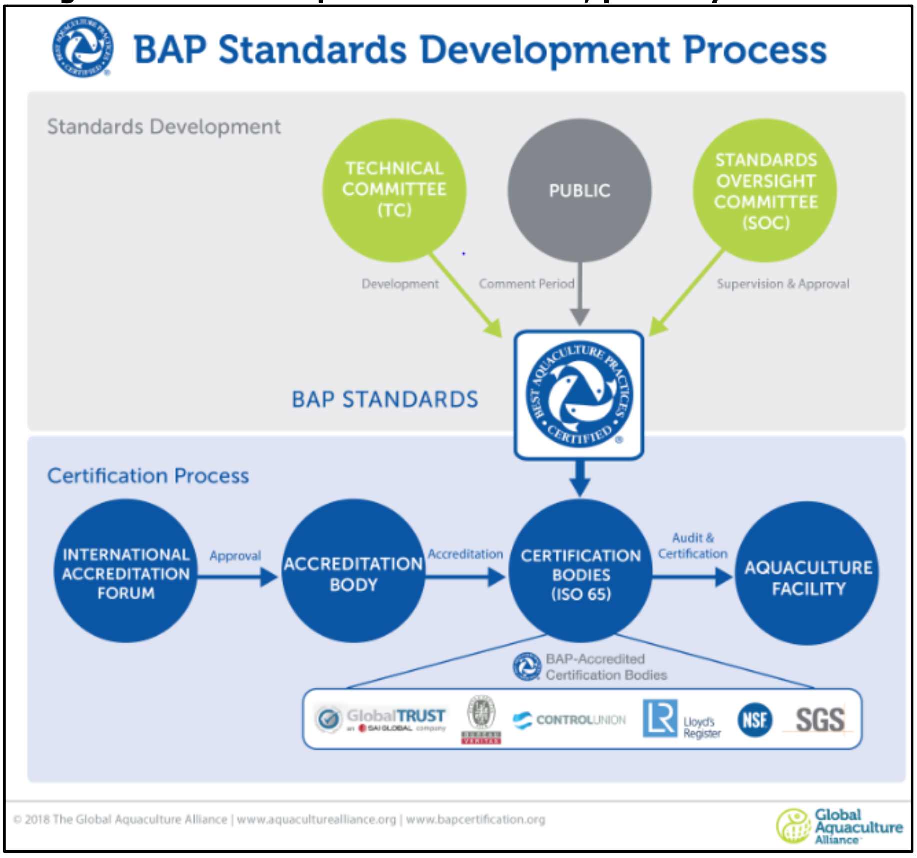
55 Fish need first and foremost a clean house – below, above and surrounding them. It is not possible to grow beautiful fish in an unhealthy environment. Fish need clean water and to be free of disease. In Big Glory Bay each consented area is farmed intermittently and rested between rotations. As explained in detail by **Mr Culley** and others, this is referred to as 'fallowing'. It takes two months of planning and logistical management to move a farm, which includes chartering support vessels and rostering on additional staff and divers. Fallowing the site, and ensuring that we do not stock the pens too densely and not overfeeding fish are the key ways that we look after the environment.

56 Sanford has a fish health management plan, which has been prepared by the farm veterinarian Dr Gary Knowles. Dr Knowles goes to the hatcheries, the farm and to the processing plant once a month to monitor and sample fish.

57 The farmed fish are managed in a manner that replicates natural conditions as much as possible, and although they are fed by artificial technology, the feed is specifically formulated and contains no unnatural additives, nor are any medicinal or chemical treatments administered.

58 Sanford's salmon farm business is three star Best Agriculture Practice (*BAP*) certified, and the 4^{th} star (for the hatchery) assessment was passed and is will be awarded soon. BAP is a global sustainability and production assurance standard that is independently audited each year. A star is awarded for each stage of the process including the feed manufacturing company, hatchery, farm and processing. The criteria on which the salmon farm was assessed is attached to my evidence as **Appendix 1**.

Diagram One: Best Aquaculture Practice, pathway for certification



59 This diagram shows the pathway to certification, Sanford has four facilities that have been through assessment (two hatcheries – Kaitangata and Waitaki, the three salmon farms in Big Glory Bay and the fish processing plant in Bluff). Skretting, the feed manufacturer, has also been assessed and is certified.

60 In addition to the mandatory reporting to MPI through shell fish sanitation plans (that relate to our mussel farms), and the monitoring required by our resource consents, Sanford also collects water quality and water current data on a monthly basis.

61 Sanford supports beach clean ups and staff have been active in both Big Glory Bay and Patterson Inlet as well as more organised clean-ups to remote Southland Islands and coastal areas.

62 Staff are trained in fuel and accident procedures, firefighting and first aid including exercise drills and first responses.

SUMMARY AND CONCLUSIONS

63 As Sanford's salmon farm manager in Big Glory Bay it is my responsibility to ensure the farm produces a consistent supply of healthy fish and that it does so sustainably and with enthusiastic local community support.

64 The farms are a window into Sanford's commitment to collaboration, care of the oceans and commitment to sustainability.

Jacobus Swart
11 March 2019

Appendix 1

Aquaculture Facility Certification

Finfish and Crustacean Farms

Best Aquaculture Practices

Certification Standards, Guidelines

Aquaculture Facility Certification

Finfish and Crustacean Farm Standard (FCFS)

Issue 2.4 – 23-May-2017

Best Aquaculture Practices

Certification Standards, Guidelines

Community • Environment • Animal Welfare • Food Safety • Traceability

BEST AQUACULTURE PRACTICES CERTIFICATION

The following Best Aquaculture Practices standards and guidelines apply to the farming of all crustacean and finfish species except salmonids reared in cages and net pens in marine waters (refer to BAP's Salmon Standards). They cover all production methods, including flow-through, partial exchange, and closed or recirculating water systems operated in ponds, cages, net pens, tanks, raceways or closed-containment vessels.

Some requirements are system-specific, applying, for example, only to earthen ponds, farms that produce effluents, farms using cages or marine cages. Each section of the standards and guidelines identifies which standards apply to the different production systems. Please reference the chart on the following page. Several species-specific standards for shrimp and tilapia appear at the end of this document.

The 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, thereby eliminating the most significant negative impacts. For further information, please refer to the additional resources listed throughout this document.

BAP standards demand compliance with local regulations as the first step toward certification. However, not all regulations are equally rigorous. For this reason, BAP standards set out requirements for documentation and procedures that must be in farm management plans, whether they are prescribed by local regulations or not. By so doing, they seek, where possible, to impose consistency in performance among facilities in different producing regions and to engage the industry as a whole in a process of continuous improvement.

In common with ISO usage, these standards use the words "shall" to mean compliance is required and "should" to mean compliance is recommended. Auditable points are "shall" statements listed at the end of each standard.

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

Best Aquaculture Practices Management
2 International Drive – Suite 105
Portsmouth, NH 03801
Telephone: +603-317-5000
Web: www.bestaquaculturepractices.org – E-mail: info@aquaculturecertification.org

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 shall 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, social compliance or legal issue, or a risk to the integrity of the program, the auditor immediately informs the certification body, which then informs BAP 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 social accountability or immediate risk to the integrity of the program, the auditor notifies the certification body and records this in the report. Verification of the implementation of corrective actions shall 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 the standards has not been demonstrated, the auditor notifies the certification body and records this in the report. Verification of the implementation of corrective actions shall be submitted to the certification body within 28 days of the evaluation. (Minor non-conformities typically reflect general housekeeping issues.)

BAP standards are developed by committees of technical experts following a process aligned to the FAO Technical Guidelines on Aquaculture Certification. See www.gaalliance.org/bap/standardsdevelopment.php.

BAP Standards Compliance Requirements

BAP Standard	Applies To
1. Community: Property Rights and Regulatory Compliance	All production systems
2. Community: Community Relations	All production systems
3. Community: Worker Safety and Employee Relations	All production systems
4. Environment: Mangrove and Wetland Conservation	Ponds and other land-based systems only
5. Environment: Effluent Management	Ponds and other land-based systems only
6. Environment: Water Quality and Sediment Control	Cages or pens in fresh or brackish water only
7. Environment: Sediment Control	Marine cages only
8. Environment: Soil and Water Conservation, Pond Sludge Management	Ponds and other land-based systems only
9. Environment: Fishmeal and Fish Oil Conservation	All production systems
10. Environment: Stocking Sources and GMOs	All production systems
11. Environment: Control of Escapes	All production systems, several sections for cages only
12. Environment: Biodiversity and Wildlife Protection	All production systems
13. Environment: Storage, Disposal of Farm Supplies and Wastes	All production systems
14. Animal Health and Welfare: Culture Conditions and Practices	All production systems
15. Food Safety: Drug and Chemical Management	All production systems
16. Food Safety: Microbial Sanitation, Hygiene, Harvest and Transport	All production systems
17. Biosecurity: Disease Control	All production systems
18. Traceability: Record-Keeping Requirement	All production systems
19. Shrimp-Specific Standards	Shrimp farms only
20. Tilapia-Specific Standards	Tilapia farms only

1. Community (All Production Systems)

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, 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 aquaculture farms have been sited in water bodies or 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. Water bodies in which cages have been installed can be an important fishery for local people. These waters can also have other important uses for domestic water supplies, irrigation, recreation or tourism.

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
- protection of mangroves or other sensitive habitats
- effluent permits
- adherence to veterinary and animal health regulations
- therapeutics use
- permits related to non-native species
- predator control permits
- well operation permits
- landfill operation permits
- adherence to environmental regulations
- environmental impact assessments.

Individual auditors cannot know all laws that apply to aquaculture farms 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, aquaculture, water management and transportation, as well as local aquaculture associations. Auditors shall 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 shall present all necessary documents to the auditor. 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

Standards

1.1: Current documents shall be available to prove legal land and water 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.

2. Community (All Production Systems)

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 reduced access to areas used for fishing, hunting, gathering, domestic water supply or recreation.

Implementation

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

Farms shall maintain a neat and attractive appear-ance to avoid becoming an eyesore to local residents. Sanitary measures shall be employed to prevent odors from affecting nearby neighbors. (See Section 11.) Machinery shall be maintained in good repair to avoid unnecessary noises that may disturb neighbors.

During facility inspection, the auditor shall verify compliance with this standard through examination of maps that define public and private zones; inspection of fences, canals and other barriers; and interviews with local people and farm workers. The auditor shall select the individuals for interview. This selection can include, but not be limited to, interviewees provided 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 (All Production Systems)

Worker Safety and Employee Relations

Farms shall comply with local and national labor laws, including those related to young and/or underage workers,
to assure adequate worker safety, compensation and, where applicable, on-site living conditions.

Reasons for Standard

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

Both local and foreign workers may be employed at farms. Instances of employment of illegal foreign workers have been reported in some countries. Therefore, BAP certification requires proof of legal foreign worker documentation.

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

Implementation
At a minimum, certified farms shall provide legal wages, a safe working environment and adequate living conditions. Auditors shall 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. When hiring foreign workers, farms shall require documentation of legal status.

Safety equipment such as goggles, gloves, hard hats, life jackets and ear protection, shall be provided when appropriate. Machinery shall have protective guards or covers where appropriate, and electrical devices shall be correctly and safely wired. Tractors should have roll bars, shields over power take-offs and other appropriate safety devices.

Staff and workers shall be given initial training as well as refresher training on safety in all areas of farm operations. Workers shall also be trained in first aid for electrical shock, profuse bleeding, drowning and other possible medical emergencies. A plan shall be available for obtaining medical assistance for injured or ill workers.

Living quarters shall be well ventilated and have adequate shower and toilet facilities. Food services, where provided, shall provide wholesome meals for workers, with food storage and preparation done in a responsible manner. Trash and garbage shall not accumulate in living, food preparation or dining areas. (See Section 11.)

Farms that use divers to clear sludge from pond bottoms or perform other underwater tasks 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. If sulphites are used during harvesting, procedures shall be adopted to minimize health risks to employees.

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.

Standards

Wages and Benefits

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

3.2: The facility shall not make deductions from wages as part of a disciplinary process.

3.3: The facility shall maintain all relevant documents that verify piece workers (those paid a fixed “piece rate” for each unit produced or action performed regardless of time) are paid in compliance with local law, including regulations regarding equivalence to or exceeding minimum requirements for wages, hours, overtime and holiday pay.

Working Hours

3.4: The applicant shall abide by the national mandated work week where applicable.

3.5: The applicant shall comply with national labor laws for pay, overtime and holiday compensation for hours worked beyond the regular work day or week.

Forced, Bonded, Indentured, Trafficked, and Prison Labor

3.6: All work, including overtime, must be voluntary. The facility shall not engage in any form of forced or bonded labor. This includes human trafficking, the holding of original identity papers, prohibiting workers from leaving the premises after their shift or other coercion intended to force anyone to work. Where the holding of original identity papers is required by national law, such papers must be immediately returned to employees upon request and readily available to them at all times.

3.7 The facility shall not require the payment of deposits, deduction from wages or withholding of pay that is not part of a legal contractual agreement with the employee and/or that is not provided for or permitted by national law.

3.8: Workers shall have the right to terminate their employment after reasonable notice.

Child Labor and Young Workers

3.9: The applicant shall not engage in or support the use of child labor. The applicant shall comply with national child labor laws regarding minimum working age or ILO Minimum Age Convention 138, whichever is higher. ILO Minimum Age Convention 138 states the minimum age shall be 15, unless local law in developing nations is set at 14 – in accordance with developing nations exceptions under this convention.

3.10: The employment of young workers above the minimum age but under 18 years old shall be in compliance with local laws, including required access to compulsory school attendance and any restrictions on hours and time of day.

3.11: Young workers above the minimum age but under 18 years old shall not be subjected to hazardous work that can compromise their health and safety.

3.12: The applicant shall only employ legally documented workers, whether nationals or migrants.

3.13: The facility shall maintain all relevant documents that verify any contracted/subcontracted workers, whether contracted through a labor service or otherwise, are paid in compliance with all local wage, hour and overtime laws.

3.14: All labor, recruiting or employment services used by the facility must be licensed to operate by the local or national government as a labor provider.

3.15: The facility shall provide to all workers, whether hourly, salaried, piece-rate, temporary, seasonal or otherwise, prior to hire and during employment, written and understandable information regarding the terms of employment, worker rights, benefits, compensation, hours expected, details of wages for each pay period and facility policies regarding disciplinary actions, grievance procedures, authorized deductions from pay and similar labor-related issues. This information must be provided in the prevalent language of the majority of employees.

3.16: Where contracted/subcontracted or temporary workers are hired through a labor or employment service, the facility shall ensure that the labor or employment service provides the above information prior to and during hire, in appropriate languages, to ensure workers are aware of their rights and conditions of employment as described above.

3.17: The facility shall appoint a management person responsible for ensuring worker health, safety and training.

3.18: The facility shall identify and eliminate or minimize any workplace health and safety hazards by conducting a thorough risk assessment. This includes a requirement for accident investigation.

3.19: If provided, employee housing shall meet local and national standards (e.g., water-tight structures, adequate space, heating/ ventilation/cooling), and shall be free of accumulated trash and garbage.

3.20: Safe drinking water shall be readily available to employees. If meals are provided, they shall be wholesome and commensurate with local eating customs.

3.21: Running water, toilets and hand-washing facilities shall be readily available to employees.

3.22: In the event of accidents or emergencies, the applicant shall provide basic medical care, including access to or communication with medical authorities. Additionally, first aid kits shall be readily available to employees, and any expired content shall be replaced.

3.23: The applicant shall provide training in general health, personal hygiene and safety (including aquatic safety and the use of boats and associated equipment), first aid and contamination risks to all employees. Safety documents must be available in a language understood by the workforce.

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

3.25: 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.

3.26: 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). Auditor to verify deployment.

3.27: Electrical pumps and aerators shall be wired according to standard safe procedures. Machinery shall have proper driveshaft and/or drive belt safety guards.

3.28: The applicant shall comply with laws that govern diving on aquaculture 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. Limits for time under water shall be established and monitored.

3.29: The applicant shall provide written procedures and staff training for handling diving emergencies and regularly audit records and procedures. Emergency response equipment for divers shall include oxygen for resuscitation.

Discrimination, Discipline, Abuse and Harassment

3.30: The facility shall provide for equal opportunity with respect to recruitment, compensation, access to training, promotion, termination and retirement.

3.31: The facility shall treat workers with respect and not engage in or permit physical, verbal or sexual abuse, bullying or harassment.

Freedom of Association and Collective Bargaining

3.32: Workers shall have the right to collective bargaining, or at least one employee shall be elected by the workers to represent them to management.

3.33: There shall be a written worker grievance process, made available to all workers, that allows for the anonymous reporting of grievances to management without fear of retaliation.

4. Environment (Ponds and Other Land-Based Systems Only)

Mangrove and Wetland Conservation

Aquaculture facilities shall not be located in mangrove or other wetland areas where they displace important natural habitats. Farm operations shall not damage wetlands except for allowable purposes, which shall be mitigated.

Mangroves and other wetlands are important components of many coastal and inland ecosystems in aquaculture producing nations. 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 important resources for local people.

Implementation

For the purposes of this standard, wetlands are defined as areas that are inundated or saturated by surface or ground--water at a frequency and duration sufficient to support – and that under normal conditions do support – a prevalence of perennial vegetation typically adapted for life in saturated soil conditions. This standard does not apply to former wetland habitats converted or lost prior to the publication of the Global Aquaculture Alliance’s *Codes of Practice for Responsible Shrimp Farming* and the signing of the Ramsar treaty in 1999.

Farm construction and operations, including all building works, shall take place outside wetland areas and not lead to their loss. In coastal zones, aquaculture ponds shall 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 shall be taken to assure that hydrological conditions are not altered in a way that deprives or leads to the loss of wetland vegetation, including erosion and sedimentation at farm outfalls.

In some cases, the use of constructed wetlands can provide effective treatment for effluents before they are discharged into public waters. Constructed wetlands must be wholly within farm boundaries, or the farm must have the necessary permits for off-site land use.

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 no more than 40% of the plain is blocked by pond embankments.

Allowable Wetland Removal

If a farm operation requires access to water resources, removal of wetland vegetation shall only be allowed for the installation of inlet and outlet canals, pump stations and docks. Wetland removed for such purposes shall be mitigated by restoring an appropriately diverse area of wetland three times the size of the area removed. This practice is only allowable if local regulations don't prohibit it.

Farms constructed in former mangrove or wetland areas are encouraged to demonstrate environmental stewardship by re-establishing mangrove or wetland vegetation, or by contributing to mangrove or wetland rehabilitation projects. When ponds constructed in former mangrove or wetland areas are closed, embankments shall be breached to restore natural water flow so that wetland vegetation can reestablish. The most reliable mitigation procedure is to contribute to mangrove or wetland restoration programs, for farm operators may not have suitable habitat and expertise for creating wetland areas. The donation should be equivalent to the local cost of mangrove or wetland restoration of an appropriately sized area. Whether the restoration is conducted by the farm or through an independent restoration program, the auditor will verify that the wetland is viable by confirming it is initially healthy, appropriately diverse and still healthy at subsequent annual audits. In cases where the auditor has not been able to inspect the restored wetlands in person, the farm shall provide the auditor with evidence (e.g., maps, GPS coordinates, recent photographs and aerial photographs) of the wetland viability.

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

Standards

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

4.3: Farm activities shall not alter the hydrological conditions of the surrounding watershed, and the normal flow of brackish water to mangroves or freshwater to wetlands shall not be altered, unless specific permits apply.

4.4: If wetland restoration has been conducted, the restored vegetation shall be maintained in a healthy state, viable and appropriately diverse.

5. Environment (Ponds and Other Land-Based Systems Only)

Effluent Management

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

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.

At farms supplied by naturally saline groundwater with over 550 mg/L of chloride, pond effluent should be captured in a reservoir and reused. When effluents are regularly released, applicants in the BAP program shall maintain records for effluent data. (See sample form in Appendix B). To minimize discharges of pollutants to natural waters, farms that release effluents are encouraged to use this water for irrigation or other beneficial purposes where possible.

To confirm compliance with BAP water quality criteria at farms, the auditor will during the inspection process witness effluent sampling and preparation for analysis by an independent laboratory.

Analysis of the samples collected under the supervision of the auditor 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 – http://www.standardmethods.org.

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 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 (see Appendix C) and establish if the Limited Option is applicable.

Analysis

- Hach and Merck water analysis equipment are 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 dissolved oxygen and pH shall be taken in situ with portable meters. Auditors shall 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. Initially, for each variable measured monthly, at least 10 values obtained during a 12-month period shall 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.

Limited Option: Allowable Deviation From Standard Water Quality Criteria

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, in the case of dissolved oxygen, decrease) between the source water and farm effluent is an acceptable alternative to compliance with the criteria. This option does not apply to pH and chloride.

To qualify for the Limited Option, farms must collect samples of both influent and effluent water according to the frequencies stated in Appendix A.

Exemptions from Effluent Monitoring Requirements

Irrigation Systems – Freshwater Farms

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.

Limited-Exchange Systems

Where the farm maintains water-exchange rates below 1% daily on an annual basis, including harvest effluents, operations shall be exempt from water quality monitoring and effluent nutrient limitations. This exemption may not be applied for farms with more than 50 ha of production ponds

Farms qualifying for this exemption are required to report an annual effluent discharge volume.

Annual Effluent Volume

An estimation of annual effluent volume, water use and nutrient load indices shall be determined as described in Appendix C.

Production Practices for Ponds

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.

The main practices for improving water quality are the use of stocking and feeding rates that do not exceed the assimilative capacity of ponds, application of good-quality feed and feed management, installation of mechanical aeration, liming of acidic ponds and erosion control.

Management practices that reduce effluent volume include harvesting by seining rather than draining, maintaining storage volume to capture normal rainfall and runoff by diverting excess runoff around ponds, and maintaining water quality by mechanical aeration rather than pond flushing.

If adoption of these practices is not sufficient to meet the 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 pre-settling 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.

Effluent Management – Flow-Through or Water-Reuse Systems

Flow-Through Systems

Fish culture in flow-through systems shall be in compliance with BAP effluent criteria. An exception shall be allowed for culture in irrigation systems where effluent is discharged back into the irrigation system, and the irrigation water has no use other than application to crops. Such culture operations shall be exempt from water quality monitoring and effluent limitations.

Water-Reuse Systems

Some water reuse systems exchange water between outdoor treatment ponds and culture units. Treatment ponds can overflow during periods of heavy rainfall or when they are drained for renovation.

Effluent samples shall be collected during discharge and shall comply with BAP effluent criteria. Indoor systems treat water from culture units for reuse by mechanical and biological means, and then discharge when dissolved-solids concentrations need to be reduced. Flushing occurs by means of exchange of culture water for fresher water or when parts of the system are cleaned.

Standards

5.1: If the facility is claiming the Limited Option as a justification for deviating from standard water quality criteria, it shall collect the requisite influent and effluent water quality data.

5.2: If the applicant's facility operates within an irrigation system such that effluent water is exclusively destined to irrigate agricultural crops, Clauses 5.5 and 5.6 do not apply. Must be verified by auditor.

5.3: Clauses 5.5 and 5.6 do not apply for farms of less than 50 ha that avoid regular discharges of effluents into natural water bodies such that less than 1% of the culture water is exchanged daily on an annual basis – for example, by reusing all water or practicing infrequent, limited exchange of water.

5.4: Records on volume of farm intake water use and results of effluent monitoring (if applicable) shall be maintained and available, as detailed in the Implementation Guidelines.

5.5: Effluent water quality concentrations shall comply with BAP water quality criteria or applicable regulations if they are equivalent or more rigorous, or if this is not possible because of high concentrations in the intake water, concentrations shall reflect no deterioration between intake and discharge.

5.6: Farms shall continue compliance with these criteria to maintain certification and comply with BAP's final criteria within five years.

5.7: The farm shall provide the auditor with an estimated annual water use during the last calendar year, as illustrated in Appendix C, and the input data shall also be available for review.

6. Environment (Cages or Pens in Fresh or Brackish Water Only)

Water Quality and Sediment Control

Aquaculture facilities with cages or net pens shall monitor water quality in compliance with BAP water quality criteria, and when limits are exceeded, shall reduce feeding rates as required until water quality improves. In lakes, reservoirs and estuaries, operations shall comply with feeding rate limits and shall monitor benthic conditions as required.

Additional Data

After the first year of water quality monitoring, the auditor will use data provided by the facility's application forms to calculate annual load indices for total suspended solids, soluble phosphorus, total ammonia nitrogen and five-day biochemical oxygen demand, determined as described below.

Load indices for nitrogen and phosphorus will be estimated for cage and net pen culture operations in lakes and reservoirs.

Implementation

Applicants to the BAP program shall maintain records for water quality data as detailed in Appendix D.

Sampling – Cages, Net Pens in Lakes, Reservoirs

- A minimum of four sampling stations shall be established. One shall be in the approximate center of the cage farm or net pen area. The other three stations must be from 50 to 500 m away from the cages, considering the direction of the predominant wind, and at regular intervals away from the cage farm or net pen area so as to create a sampling transect.
- The auditor must approve the locations of the stations, which shall be set following a study on prevailing surface currents. For methods, refer to: Estimating Surface Currents Using Dyes and Drogues, U.S. Army Corps of Engineers – http://chl.erdc.usace.army.mil/library/publications/chetn/pdf/chetn-vi-37.pdf.
- Water should be collected with a Kemmerer or van Dorn water sampler, or by use of a weighted bottle from which the stopper can be removed by jerking the calibrated line. Samples should be transferred to clean plastic bottles and placed on ice in a closed, insulated chest to avoid exposure to light.

Analysis

- Analysis of the samples 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 dissolved oxygen and pH should be taken in situ with portable meters. Auditors must verify the correct application of calibration procedures.

Cages, Net Pens

Growout cages and net pens may be installed in lakes, reservoirs, rivers, streams, irrigation systems, ponds, estuaries and embayments. They do not discharge point source effluents, but uneaten feed, fish feces and metabolic excretions of fish enter the water bodies that contain the cages or net pens.

Natural water bodies can already be eutrophic when certification is sought. Sites at which water quality in the water body containing cages or net pens does not comply with BAP effluent guidelines shall not be eligible for certification.

Rules for compliance with the BAP effluent standard differ among the types of water bodies in which the cages and pens are installed.

Cages, Net Pens in Lakes, Reservoirs
The potential of cage and net pen culture to cause eutrophication of lakes and reservoirs depends primarily upon the location of facilities, the amount of feed input compared with the assimilation capacity of the water body, and the hydraulic retention time (HRT) or flushing rate of the water body.

Cages or net pens placed in areas with restricted water circulation, such as narrow embayments, can cause localized eutrophication without causing generalized water quality problems in the entire water body. The assimilation capacity is impractical to measure for purposes of aquaculture certification, but major factors governing the ability of a water body to assimilate wastes are its size and especially its volume.

Nutrients and organic matter are removed from water bodies by outflow, and systems with short HRTs are less likely to become eutrophic as a result of aquaculture operations than systems with longer HRTs. Of course, the nutrients and organic matter flushed from lakes and reservoirs enter downstream waters and can have adverse impacts.

Lakes and reservoirs used for cage and net pen culture shall be classified according to HRT as follows:

- Long HRT – Over 3 years
- Moderate HRT – 1-3 years
- Short HRT – Less than 1 year

Applicants for certification may choose to determine HRT by one of the techniques below.

Annual lake discharge is measured and recorded.
HRT = Lake volume (m^3) ÷ Lake discharge (m^3/yr)

Stream inflow to lake is measured and recorded.
HRT = Lake volume (m^3) ÷ [Stream inflow (m^3/yr) + Direct rainfall (m^3/yr)] – Lake evaporation (m^3/yr)

Where lake evaporation = Pan evaporation (m/yr) x 0.7 x Lake surface area (m^2) and direct rainfall = Annual rainfall (m/yr) x Lake surface area (m^2).

Catchment area is known, but discharge or stream inflow is measured:
HRT = Lake volume (m^3) ÷ [Catchment runoff (m^3/yr) + Direct rainfall (m^3/yr)] – Lake evaporation (m^3/yr)
Where catchment runoff = Catchment area (m^2) x Annual rainfall (m/yr) x 0.3.

See methods for direct rainfall and lake evaporation above Otherwise, the auditor and applicant seeking certification will agree upon the HRT level according to the following indicators.
Long HRT: Arid climate, catchment area:water surface area ratio of 5 or less, discharge occurs only after periods of heavy rainfall, annual water level fluctuation of 2 m or more.

Moderate HRT: Humid area, catchment area:water surface area ratio 5-15, frequent or continuous discharge, annual water level fluctuation of 2 m or less.

Short HRT: Humid area, catchment area:water surface area ratio more than 15, continuous large discharge, annual water level fluctuation of 0.5 m or less, riverine system. Note: Some riverine lakes and reservoirs in arid climates have short HRTs.

The BAP maximum allowable daily feed input to cages and net pens in lakes and reservoirs shall be based on HRT as follows.

- Long HRT – 2.5 kg/ha/day x lake water surface area (ha)
- Moderate HRT – 5.0 kg/ha/day x lake water surface area (ha)
- Short HRT – 7.5 kg/ha/day x lake water surface area (ha)

If cages or net pens are installed in an embayment with restricted water exchange, the maximum daily feed input shall be reduced by 50%. If there are multiple cage and net pen operations in a water body, the total daily feed inputs of all operations shall not exceed the maximum allowable daily feed input based on HRT.

Once every three months, a water sample shall be taken and the percentage of blue-green or other potentially harmful algae assessed. See phytoplankton methods manual at http://npsi.gov.au/files/products/national-river-health-program/pr990300/pr990300.pdf.

Feed input shall be reduced until water quality improves when:

- Dissolved-oxygen concentrations are consistently below 5 mg/L in early morning at any sampling location.
- The average annual Secchi disk visibility decreases by 25% after certification is achieved.
- Blue-green algae or other potentially harmful algae comprise more than 60% of the phytoplankton.
- The thermocline becomes 25% shallower after certification is achieved.

Discharges from water bodies containing cages or net pens can cause water pollution downstream. Thus, if the feed input to the water body must be reduced because of signs of increasing eutrophication, the discharge of the lake shall be monitored. Aquaculture operations shall not be eligible for certification unless the discharge is in compliance with BAP effluent criteria.

Cages, Net Pens in Ponds

Ponds are privately owned but usually discharge into public waters. Effluents from ponds containing cages or net pens shall comply with BAP water quality criteria.

Cages, Net Pens in Streams and Rivers

Stream and river flow is variable and too difficult to measure to use as a guide to establish maximum daily feed inputs. Thus, soluble phosphorus and total ammonia nitrogen concentrations shall be used as indicators for cage and net pen operations.

Soluble phosphorus and total ammonia nitrogen shall be measured monthly at a depth of 50 cm and immediately upstream of cages and 200 m downstream of the cages. The downstream concentrations shall not exceed the upstream concentrations by more than 25%. Feed input shall be adjusted downward when compliance cannot be achieved.

Cages, Net Pens in Irrigation Systems

Where water from irrigation systems is used only for crop irrigation, cage and net pen operations shall be exempt from feed input limits and water quality monitoring and effluent limitations. However, if water has other uses, production facilities in irrigations systems shall be treated for BAP certification as facilities installed in streams.

Cages, Net Pens in Estuaries

As a general rule, cage and net pen areas in estuaries are well flushed. Thus, daily feed input of 7.5 kg/ha of the surface area of the estuary is allowed. Monitoring shall be the same as for operations in lakes or reservoirs with two exceptions: There is not a thermocline in estuaries as in lakes and reservoirs, and it is not necessary to monitor discharges of estuaries for compliance with BAP water quality criteria.

Load Indices for Cages, Net Pens

Water use indices cannot be applied to cages and pens. The loads of nitrogen and phosphorus imposed by cages and net pens on receiving water bodies can be estimated as indicated in Appendix E.

Production Practices for Cages, Net Pens

The most reliable way of reducing nutrient outputs from cage and net pen culture is to increase feed use efficiency. This can be done mainly by using high-quality feed that contains no more nitrogen and phosphorus than necessary and by assuring that fish consume all of the feed offered.

Thus, fish should have access to the feed for enough time so that they consume it before the pellets pass through the cage or pen mesh. Also, feeding rates should be monitored to avoid overfeeding. Observations of fish-feeding activity are enhanced by using floating feed for certain species. For waters less than 30 m deep, a diver should periodically go beneath cages to determine if uneaten feed is accumulating on the bottom.

Dead fish should be removed promptly and disposed of on land by responsible procedures. Carcasses should never be discarded in water bodies where cage culture is conducted.
Nets of cages and pens often are removed and cleaned on shore. Cleaning waste shall be diverted into a sedimentation pond, sanitary sewer or other treatment system.

It is not feasible to treat wastes from cages and net pens. The main precaution against pollution is to locate culture units in open-water areas where water circulation is sufficiently high to transport wastes away from cages and rapidly mix and dilute wastes. The distance between cage bottoms and the bottoms of water bodies should be at least 1 to 2 m to promote water movement beneath cages.

High biomass in a particular location can obviously increase the likelihood of pollution. While there are no specific guidelines for the biomass that can be safely sustained at a particular cage site, monitoring shall be used to track the status of water quality.
In bodies of water that stratify thermally, a high biomass can result in severe organic enrichment and dissolved-oxygen depletion in the hypolimnion. Subsequent sudden thermal destratification can result in dissolved-oxygen depletion throughout the water column. This phenomenon has been responsible for serious fish mortality both inside and outside cages.

Wastes can accumulate beneath cages and cause deterioration of sediment quality. This is environmentally undesirable and can have negative impacts on the fish in cages, as well. Sediment quality in areas with fish cages can be protected by fallowing – periodically moving cages to new sites and allowing the original sites to recover. Observations on sediment quality shall be used to determine when to move cages.

Standards

Cages, Net Pens in Lakes, Reservoirs

6.1: The water quality of the water body, including its discharge point if applicable, shall meet the BAP effluent water quality criteria, with sampling conducted following the implementation guidelines above.

6.2: Facilities shall maintain accurate records of daily feed inputs that reflect compliance with the BAP maximum allowable daily feed input levels.

6.3: Total feed input for all culture operations on the lake or reservoir shall not exceed the BAP maximum allowable daily feed input.

6.4: Water quality-monitoring records shall be applied in the management of feeding rates when dissolved oxygen levels are consistently below 5 mg/L in the early morning.

6.5: Water quality-monitoring records shall be applied in the management of feeding rates when mean annual Secchi disk visibility decreases by 25% since initial certification.

6.6: Water quality-monitoring records shall be applied in the management of feeding rates when blue-green or other potentially harmful algae comprise more than 60% of total phytoplankton.

6.7: Water quality-monitoring records shall be applied in the management of feeding rates when the thermocline becomes 25% shallower since initial certification.

6.8: For cages in water less than 30m deep where sediments are (in the absence of cages) usually aerobic, divers or cameras shall periodically, at least once per production cycle, inspect for accumulation of feces and uneaten feed and where necessary sites shall restore aerobic benthic conditions by fallowing or other means.

Cages, Net Pens in Streams and Rivers

6.9: Monthly records of upstream and downstream total ammonia nitrogen and soluble phosphorus concentrations shall be available.

6.10: Maximum daily feeding rates shall be managed such that downstream concentrations of nutrients do not exceed upstream concentrations by more than 25%.

Cages, Net Pens in Estuaries

6.11: Feeding records shall demonstrate that the maximum daily feeding rate of 7.5 kg/ha of estuary is not exceeded.

6.12: Water quality-monitoring records shall be maintained as specified.

7. Environment (Marine Cages Only)

Sediment Control

Marine cage farms shall be located and operated such that they minimize negative impacts on sediment quality outside a defined sediment impact zone.

Reasons for Standard

Marine cage farms have the potential to cause environmental harm due to sediment accumulation under farms. The causes include settlement of feces and uneaten food, detachment of fouling debris from nets or sloughing of antifouling materials. Sediment monitoring is the most practical means of detecting change.

Implementation

In some countries and regions, cage farms are subject to specific regulations on benthic impacts, but in other places, regulations may be inadequate or non-existent. This standard reinforces any existing regulations and describes minimum requirements where effective rules are not already in place.

Cage farms are usually located following a hydrographic, biological and physical study of the site to determine that farm operations will not have significant negative impacts on animal populations that comprise the benthos under or near the farm. Then “allowable” benthic impacts are set as conditions in the operating permits for the farm, which are defined in terms of one or more of several chemical properties of the sediments. Sometimes these are then correlated with species density and diversity determinations, which are based on prior knowledge of local sediment biology or analysis of sediment reference samples collected from the farm location.

Production cycles and fallowing shall be coordinated with other neighboring BAP applicants or BAP-certified farms, or with members of an established Area Management Agreement. Neighbors should participate in the creation and implementation of Area Management Agreements to address cumulative impacts associated with multiple farms. BAP-certified operations that operate in isolation should have a statement of intent to enter an AMA, should another operation move into the area.

Farm permits and/or local regulations usually define an allowed “sediment impact zone,” “allowable zone of effect” or “footprint of deposition,” and prescribe monitoring protocols to check it. Because biological sampling of sediments requires special expertise and is time-consuming and expensive, chemical sediment properties are usually used as leading indicators of sediment condition. Biological sampling is only required in some jurisdictions if an indicator trigger point is exceeded.

Chemical indicators used for this purpose include oxygen con-centration in the sediment, sulfide, REDOX potential, total organic carbon or total volatile solids, or visual inspection with documentation by video. Some methods are better suited to some environments than others.

For example, sulfide determination works well in silt or clay sediments containing up to 50% sand, as does determination of total organic carbon. Above this level of sand, an indicator such as total organic carbon works better. On hard bottoms with over 10% gravel, visual recording by video is best because grab sampling is impossible, and many such sea bottoms are erosional in nature, not depositional.

Since different methods or combinations of methods may be required in different jurisdictions based on local hydrographic or benthic conditions, no preferred method is specified in this standard, only that whatever method is used shall be undertaken using standard methods of sampling and analysis that conform to generally accepted international standards.

In situations where sediment monitoring is a statutory requirement and allowed sediment impact zones are defined, all applicants for BAP certification shall:

- Provide documents that describe local standards for benthic impacts under cage farms.
- Existing farms shall provide at least three years of monitoring data to show that the farms meet or exceed benthic standards required by operating permits at current production levels.

- New farms shall have completed a baseline study, with review by an independent expert, that describes hydrographic and benthic conditions at the farm site, and that in the expert's opinion (given without liability), the farm can meet or exceed the benthic standards required by its operating permits at current or proposed production levels. This opinion shall be verified by reference to sampling results at the next audit.
- Provide documents to show that sediment quality was determined using generally accepted sample collection and analytical methods.
- Collect and store data from which the farm's feed-based carbon and nitrogen discharges can be calculated. This means recording the carbon and nitrogen content of feed fed, the weight of all fish harvested plus dead fish removed during farming, less the weight of the juveniles stocked.

In countries or regions where sediment monitoring is not required as described above and/or where an allowed sediment impact zone is not defined, applicants shall write and implement a monitoring plan that requires them to:

- Nominate an independent individual or company with demonstrated expertise in sediment sampling and analysis to design a sediment sampling and analysis program appropriate to the farm conditions and to conduct sediment monitoring as required below.
- Chart an allowable sediment impact zone that shall not exceed the total area of the farm plus a boundary zone of 40 m around it. The footprint may be shifted in any direction to account for normally occurring uneven current patterns, as long as the total area remains the same.
- Monitor the organic build-up on the seabed within this zone by the method deemed best for the type of sediment that exists there. The choice of method shall be justified by prior documentation of the type of sediments over which the farm is located.
- Conduct sediment sampling to coincide with the period of peak feeding during each crop cycle. Samples shall be taken along at least two transects that pass directly through the farm and align with the dominant flow of water at the farm site. One sample with three replicates shall be taken at the edge of the farm and another at the 25-m or 40-m boundary. (See above.)
- Five replicate samples shall also be taken from at least two reference stations within 1 km of the farm that have similar depth and sediment characteristics as occur at the farm and where there is no fish production.
- Demonstrate by statistical analysis of the results that there is no organic build-up due to farm activity at the boundary of the allowable sediment impact zone in comparison to the reference station, as determined by the monitoring method chosen.
- Collect and store data from which the farm's feed-based carbon and nitrogen discharges can be calculated.

Additional Information

Australia Marine Farm License Conditions, Schedule 3
Farm Site Inspection Checklist
British Columbia Salmon Farmers and Province of British Columbia – 2001
http://www.salmonfarmers.org

Guide to the Assessment of Sediment Condition at Marine Finfish Farms in Tasmania
C. Macleod and S. Forbes (editors)
Tasmanian Aquaculture and Fisheries Institute
University of Tasmania
Hobart, Tasmania, Australia
http://www.imas.utas.edu.au/__data/assets/pdf_file/0011/68384/AquafinCRC_ProjectNo4.1.pdf

Norwegian Standard N.S. 9410.E
Environmental Monitoring of Marine Fish Farms

Code of Good Practice for Scottish Finfish Culture
Scottish Salmon Producers' Organization
http://www.scottishsalmon.co.uk

Washington State Legislature, WAC 173-204-420
Sediment Impact Zone Maximum Criteria
http://apps.leg.wa.gov/WAC/default.aspx?cite=173-204-200

FAO Fisheries and Aquaculture Technical Paper No. 527
Environmental Impact Assessment and Monitoring in Aquaculture, pp. 455–535
A. Wilson, S. Magill, K. D. Black – 2009
FAO. Rome, Italy

Standards

7.1: The applicant shall provide documents that describe local standards for benthic impacts under cage farms, which shall include the benthic indicator "trigger level" above which the farm would not be in full compliance with the local standard, where this is clearly defined, or with its intent where it is not clearly defined.

7.2: For established farms, the applicant shall provide three years of monitoring data to show that the farm meets or exceeds sediment quality criteria specified in its operating permits and/or its own monitoring plan at current operating levels.

7.3: For newly established farms or farms that have expanded and do not yet have enough monitoring data, the applicant shall provide an independent study that characterizes the hydrographic and benthic characteristics of the area and provides a consultant's opinion (without liability) that the farm can meet or exceed sediment and water quality criteria if operated correctly. This opinion shall be verified by reference to sampling results at the next audit.

7.4: Monitoring of sediment conditions shall be undertaken at the time of peak feeding during the production cycle and shall be conducted according to the requirements of the farm's operating permits or its own plan in countries or regions where sediment monitoring is not required, and as specified in the implementation requirements.

7.5: Sediment sampling and analysis performed as part of the monitoring program shall apply generally accepted international methods and be adapted to the local hydrographic or benthic conditions.

7.6: The results of sediment monitoring shall be reported to and reviewed and accepted by the appropriate regulators. Where regulatory approval is conditional upon implementing a program of remedial action, this shall have been implemented and completed.

7.7: Data that will enable the farm's feed-based carbon and nitrogen discharge to be calculated shall be collected and recorded.

7.8: Production cycles and fallowing shall be coordinated with other neighboring BAP applicants or BAP-certified farms, or with members of an established Area Management Agreement.

7.9: Where an AMA has not been established, applicants shall nevertheless demonstrate cooperation on matters of stocking, fallowing, animal health and biosecurity with BAP-certified farms within an area twice the regulatory minimum separation distance to an upper limit of a 5-km radius.

8. Environment (Ponds and Other Land-Based Systems Only)

Soil and Water Conservation

Pond Sludge Management

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

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 ponds, use the drop-fill method to capture rainfall and runoff, and reduce the use of water from other sources. In applying this method, 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.

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. A vegetative barrier of salt-sensitive vegetation around farms can help detect movement of salt into adjacent areas.

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

Where possible, seine harvest fish and do not drain ponds for several years. This practice is highly recommended, for it conserves water, and reduces effluent volume and pumping costs.

Sediment and Sludge Management
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 often 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. 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 non-saline soil or into freshwater can cause salinization. Downward seepage can result in salinization of freshwater aquifers.

Implementation
The first principles of sediment management on 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 pre-sedimentation

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 shall 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.

Farms shall not dredge or fill in sensitive wetlands or wetland buffers to increase the area available for pond construction.

Prevention of erosion avoids re-sedimentation of soil material from effluents downstream from farms. 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.

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

In inland shrimp farming, saline sediment shall be confined to prevent overflow after rainfall events. The confinement structures shall 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.

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 should 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.

Sedimentation Basins

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 6.5 kg/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 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 transfer frequency so the required sedimentation basin volume can be calculated. The auditor will verify that the farm has the required volume of basins in use and available for sludge containment.

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.
Raceways or similar flow-through systems have short retention times, and in high-intensity operations, sediment loads can often exceed acceptable limits. Therefore, such farms must incorporate suitably sized settling zones or other engineered solutions that assure removal of the majority of settleable solids.
Accumulated solids must be pumped or siphoned periodically to offline sludge basins, where they can be dewatered and subsequently removed for use as fertilizer in land-based agriculture crops

Standards

8.1: 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.

8.2: For inland brackish ponds, quarterly monitoring of neighboring well and surface water shall not show that chloride levels are increasing due to farm operations.

8.3: If a farm is extracting groundwater, water levels in nearby wells shall be monitored at least annually during the dry season to establish that aquaculture is not lowering the water table.

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

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

8.6: Dredge and fill activities shall not be conducted in sensitive wetlands or wetland buffers to increase the area available for pond construction.

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

8.8: Removed sediment shall be properly contained and located to prevent the salinization of soil and groundwater and not cause other ecological nuisances.

8.9: Facilities shall avoid the creation of degraded areas such as borrow pits and piles of soil.

8.10: Dredged material shall be properly contained and not placed in mangrove areas or other sensitive habitats.

8.11: The applicant shall take measures to control erosion and other impacts caused by outfalls.

8.12: If the applicant's facility produces more than 20 MT/ha/crop, the facility shall possess sufficient sedimentation basin capacity to handle the associated sludge/sediment. The facility shall process all sludge/sediment in sedimentation basins and not dump material in sensitive wetland or mangrove areas, or public water bodies.

9. Environment (All Production Systems)

Fishmeal and 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 responsibly managed 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

Aquaculture feeds are 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 BAP criteria for feed conversion have 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 shall be considered when assessing the evolution of feed conversion.

To promote the responsible sourcing of marine ingredients, the applicant shall obtain feed from a BAP-certified feed mill or a feed mill that declares and documents compliance with BAP feed mill standards 3.1 and 3.3. These standards address sourcing policies on marine ingredients, covering traceability for species and origin, and the exclusion of any species designated on the IUCN Redlist as endangered or critically endangered.

The BAP Feed Mill Standard requires that: After June 2015, for fishmeal and fish oil derived from reduction fisheries, at least 50% (calculation based on mass balance) shall come from sources that are certified by either the Marine Stewardship Council (MSC) or to the International Fishmeal and Fish Oil Organization Responsible Supply standards (IFFO RS).

Alternatively, where MSC- or IFFO RS certified fishmeal and fish oil are not produced nationally, the above minimum percentage can comprise material from active approved improvers programs as verified by IFFO (http://www.iffo.net/node/493), the Sustainable Fisheries Partnership (SFP, http://fisheryimprovementprojects.org/view-fips/) or World Wildlife Fund (WWF, https://sites.google.com/site/fisheryimprovementprojects/home). This 50% target will be periodically reassessed with the ultimate goal that all fishmeal and fish oil are derived from certified sources.

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) ÷ Net fish harvested (MT)

The feed-conversion ratio is also known as the economic FCR. Note that economic FCR is very sensitive to survival rate, rising sharply if the survival rate drops significantly. For precise calculation, the total weight of stocked juveniles is subtracted from the total weight of the harvested fish.

"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.

Aquaculture producers should strive to obtain the lowest fish in:
fish out ratio practicable in order to conserve industrial fish resources. Since many aquaculture diets incorporate only small amounts of fishmeal and fish oil, farms that use these feeds can 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 to be used are 22.5% and 5%, respectively.

Metric standards for some key aquaculture species have been set, and anonymous, pooled fish in:fish out data shall be used in the future to establish metric standards for other species.

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 shall include any meal or oil derived from wild-caught fish, squid, krill, mollusks or any other wild marine animals. However, they shall 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.

Standards

9.1: The applicant's facility shall use feed for which the manufacturer has provided data on the wild fishmeal and fish oil content or feed fish inclusion factor.

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

9.3: The facility shall calculate and record a yearly feed-conversion ratio for completed crops.

9.4: The facility shall calculate and record a final yearly fish in:fish out ratio for completed crops.

9.5: The fish in:fish out ratio shall not exceed the following values: *Litopenaeus vannamei* – 1.2, *Penaeus monodon* – 1.7, tilapia – 0.7, *Pangasius* – 0.5. Limits have not yet been fixed for other species, and will be added once adequate data has been accumulated. For other species the values shall be recorded as information only.

9.6: The applicant shall obtain feed from a BAP-certified feed mill or a feed mill that declares and documents compliance with standards 3.1 and 3.3 of the BAP feed mill standards.

(Note: the referenced BAP Feed Mill Standards are **FM 3.1**: The applicant shall obtain declarations from suppliers on the species and fishery origins of each batch of fishmeal and fish oil. **FM3.3**: The applicant shall develop and implement a clear, written plan of action defining policies for responsibly sourcing fishmeal and fish oil.)

10. Environment (All Production Systems)

Stocking Sources and GMOs

Wild juveniles shall not be stocked. Certified farms shall comply with governmental regulations regarding the use of native and non-native species, and genetically modified aquaculture species.

Reasons for Standard

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.

GMOs

Genetically modified organisms (GMOs or transgenic organisms) are defined as organisms that have been genetically modified by artificial transfer of genetic material from another species. Sterile or sex-reversed organisms and their offspring, and organisms created by hybridization and polyploidy are not GMOs.

Should genetically modified fish or crustaceans be commercialized in the future, producers shall comply with all regulations in producing and consuming countries regarding such organisms. Since some consumers do not desire genetically modified foods, they 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 Traceability Form that records these data is provided in Appendix F. In the future, farms that stock GMO species shall also note this information. During site inspection, documentation of compliance with government regulations relating to the import of fry or postlarvae shall be available. The applicant should establish a link to the domestic competent authority (veterinary authority or other government body) to verify international importation requirements and follow the International Health Certificate protocol defined by OIE.

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.

Non-Native Species

Introductions of species to countries where such species are not native, not feral or not already farmed shall be subject to the provisions of the 2005 ICES Code of Practice on the Introductions and Transfers of Marine Organisms or, in the case of freshwater species, FAO 1988: Codes of Practice and Manual of Procedures for Consideration of Introduction and Transfers of Marine and Freshwater Organisms. To reduce the potential impact of escapes, technologies such as sterility, ploidy and monosexing are encouraged.

Additional Information

ICES Code of Practice on Introductions and Transfers of Marine Organisms 2005

International Council for the Exploration of the Sea
http://www.ices.dk/publications/Documents/Miscellaneous%20pubs/ICES%20Code%20of%20Practice.pdf

Codes of Practice and Manual of Procedures for Consideration of Introduction and Transfers of Marine and Freshwater Organisms

European Inland Fisheries Advisories Commission Food and Agriculture Organization of the United Nations
Rome – 1988
ftp://ftp.fao.org/docrep/fao/009/ae989e/ae989e.pdf

OIE Aquatic Animal Health Code

http://www.oie.int/doc/ged/D7821.PDF

OIE Manual of Diagnostic Tests for Aquatic Animals

http://www.oie.int/en/international-standard-setting/aquatic-manual/access-online

Standards

10.1: 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 (GMO) status.

10.2: 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.

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

10.4: Wild juveniles shall not be stocked, other than as incidental introductions when extensive ponds are first filled.

10.5: Where the species farmed is not native, not feral or not already farmed, further documents shall be provided to demonstrate that regulatory approval for farming is based on the 2005 ICES Code of Practice on Introductions and Transfers of Marine Organisms or, for freshwater species, the Codes of Practice and Manual of Procedures for Consideration of Introduction and Transfers of Marine and Freshwater Organisms, FAO 1988.

11. Environment (All Production Systems, several sections for cages only)

Control of Escapes

Certified farms shall take all practical steps to prevent escapes and minimize possible adverse effects on aquatic wildlife if escapes occur.

Reasons for Standard

The escape of domesticated and/or 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 crustacean or fish populations. Escapes of non-native species could also lead to competition with native species for food and/or habitat, and possibly have other detrimental ecological consequences. Diseases can also be transmitted from escapees to wild fish.

Typically escapes occur when holes develop in nets due to wear and tear, collisions with boats, human error or attack by large predators. Damage can also occur during severe weather, which can tear nets and lead to substantial losses. Escapes sometimes happen when fish are removed from the water for grading or harvesting, or if net meshes are too large for the smallest fish stocked in the cages.

Implementation

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 shall be constructed so as 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.

Cages, Net Pens

Cages, nets and pens shall be tagged and maintained in good condition, and records of repairs shall be kept. Periodic inspections of mooring lines shall be documented. Jump nets that extend above the water line should surround the perimeters of net cages. Applicants shall adhere to any local cage design and construction standards approved by local producer associations.

Every effort shall be made to assure that fish do not escape from enclosures in water bodies. Cages and net pens shall be constructed of sturdy material and maintained in good condition to minimize the likelihood of holes and rips through which fish can escape. It is particularly important to use material that does not corrode, as holes can suddenly appear without warning in nets made of corrodible wire.

Cages and pens should be placed in areas where there is little danger of collisions with boats or floating debris and where heavy waves are not likely to damage them. Placement of cages and pens in navigable waters may need approval from governmental authorities. Divers or underwater cameras shall periodically inspect cages for holes, rips and tears.

Cages – Fish Containment Plan

Applicants operating cages shall have a written Fish Containment Plan that covers escape prevention and deals with known or suspected escapes.

Escape Prevention

- Documents shall show the farm's moorings were installed according to the manufacturer's and/or marine engineer's specifications.
- A site risk analysis updated at least annually shall identify the potential and actual causes of fish escapes, determine their relative likelihood of occurrence or recurrence at the farm site, and identify critical control points for effective escape risk monitoring, reduction and response by farm staff.
- Procedures based on the risk analysis shall include management protocols and actions designed to monitor escape risks, reduce them when identified and respond to escape events in a timely and effective manner. The efficacy of these measures shall be verified and documented through the year.
- Procedures shall require the main surface components of the system to be inspected at least annually and repaired or replaced as needed. The sub-surface components must be inspected and replaced as needed at least every two years or between each crop cycle, whichever is shorter. Equipment shall be replaced as needed.
- Net inventory management procedures shall track the ages of all nets on the farm or in storage, and provide strength tests on all nets between crops or every two years, whichever period is shorter. Nets shall be retired when their strength is below levels specified in local regulations or, where there are none, below the manufacturer's or supplier's recommendations.

- Cage inspection procedures shall ensure all operational nets are surface checked for holes at least weekly and checked sub-surface at least every four weeks. Nets and cage superstructure shall be checked for holes and other indications of structural damage after risk events such as storms or big tides.
- Predator deterrence procedures shall minimize the risk that predators can make holes in nets.
- Boat equipment shall include guards on propellers and staff training procedures that minimize the risk of contact between boats and farm nets.
- At marine sites, procedures and equipment consistent with local Coast Guard rules shall warn non-farm marine traffic of the farm's presence.
- Procedures for handling live fish shall prevent "spillage."
- As part of their initial training, all staff shall receive training on all procedures in the Fish Containment Plan.

Known and Suspected Escapes

- BAP applicants shall maintain equipment for attempted recapture of escaped animals and have written procedures for its use. The procedures must enable rapid response, subject to legal constraints on the types of equipment that can be used.
- If an escape is known or suspected to have occurred, the cause shall be investigated immediately, and steps shall be taken to correct it. These actions shall be documented in farm records.
- If, after investigation, there are grounds for believing an escape occurred, the fish remaining in the cage or cages shall be counted, if and/or when water and welfare indicators indicate this can be done without causing excessive distress to the fish, and any loss of inventory shall be recorded.

Standards

All Production Systems

11.1: All holding, transport and culture systems shall be designed, operated and maintained to minimize the release of eggs, larval forms, juveniles and adult animals.

11.2: Screens and nets sized to retain the smallest farmed animals present shall be installed on water outlet pumps, pipes or sluices. Screens, nets or other controls shall be installed on or near pump intakes to minimize the introduction of local aquatic fauna.

11.3: During harvesting and stock transfer operations, effective secondary containment measures shall be applied to control the escape of animals.

11.4: All incidents involving escapes of aquaculture animals shall be accurately documented.

Cages

11.5: Cages, nets and pens shall be tagged and maintained in good condition, and records of repairs shall be kept. Periodic inspections of mooring lines shall be documented. Jump nets that extend above the water line should surround the perimeters of net cages.

11.6: Applicants shall adhere to any local cage design and construction standards approved by local producer associations.

11.7: The applicant shall demonstrate that the farm meets the BAP procedural, performance, documentation and reporting requirements for fish containment required by the Fish Containment Plan outlined in the implementation requirements.

11.8: The applicant shall provide documents to show that all staff members have received training in the Fish Containment Plan, which shall be verifiable by training certificates in employees' files and verified at audit by a subset of interviews

11.9: If an escape is suspected or has occurred since the last audit, the applicant shall provide reports and farm records to show that the incident was dealt with in a manner consistent with the Fish Containment Plan.

12. Environment (All Production Systems, several standards for cages only)

Biodiversity and Wildlife Protection

Certified farms shall manage physical interactions with wildlife.

Reasons for Standard

Farms shall obey laws related to the destruction of birds and other predators. Where applicable, permits and records shall be available. The BAP program strongly encourages farms to employ humane, non-lethal measures for predator control, even when lethal methods are permitted.

Implementation

Farms shall record all predator mortalities (species and numbers). Additionally, all species listed as "endangered" and "critically endangered" by the International Union for Conservation of Nature (IUCN) Red List or protected by local or national laws shall be subjected to passive deterrence methods only, and no active or lethal means shall be used.

Cages – Wildlife Interaction Plan

Applicants operating cages shall have a written Wildlife Interaction Plan (WIP) that includes provisions stipulated in local laws and the farms' operating permits, as well as the following requirements, if not so stipulated.

The WIP shall include but not be limited to:

- A list of relevant local laws and specific conditions of the farm's operating permits that apply to wildlife management and protection.
- A list of local species classified as endangered or threatened under local laws and/or listed as "Critically Endangered" or "Endangered" on the IUCN Red List.
- At marine sites, a map that identifies officially designated "critical" and/or "sensitive" marine and coastal habitat in the region. If the farm is in an area so designated, a list of the classified or endangered sedentary species within a 2-km radius of the farm and of mobile coastal species within the region, updated where necessary to show wildlife established after the farm was started, shall also be included.
- Training for farm staff in recognizing endangered, threatened and protected species they may see from the farm and a system for recording and reporting such observations to farm management and members of the public who have expressed interest.
- Designation of one member of staff to carry out lethal control measures, if needed, and for training of that individual in humane slaughter methods.
- Description of the farm's passive measures to deter the entry into cages of predatory birds or small mammals.
- At marine sites with carnivorous marine mammals, description of the farm's passive measures to protect cages from underwater attack.
- Procedures for the regular inspection of cages to check and report the integrity of the passive measures.
- Documentation to show that any active but non-lethal deterrent measures used are approved by regulators through a review of environmental impacts with specific reference to endangered, protected, threatened or cetacean species in the area. Such devices shall not be deployed if the review shows they can adversely affect these species.
- Reporting procedures in the event that control measures cause the accidental death of wildlife and for proposed action to prevent the same from happening again.
- Procedures that state lethal methods shall only be used after all non-lethal methods are attempted and must be legally approved.
- Procedures that make it clear that deliberate lethal controls on species classified as endangered or critically endangered are not to be used except under exceptional circumstances, such as risk to human life, and

then only after specific written authorization is obtained from regulators.

- Procedures for regulatory authorization, implementation and reporting of lethal control measures when these are deemed necessary.

Standards

All Production Systems

12.1: The facility shall use humane methods of predator deterrents and actively favor non-lethal methods. Where applicable, government permits for predator control shall be made available for review. No controls, other than non-lethal exclusion, shall be applied to species that are listed as endangered or highly endangered on the IUCN Red List or that are protected by local or national laws.

12.2: The facility shall record, and report where required, the species and numbers of all avian, mammalian and reptilian mortalities.

Cages

12.3: The applicant shall have a written Wildlife Interaction Plan consistent with the implementation requirements listed above and that complies with the procedural, performance and reporting requirements therein.

12.4: Farm employees shall be familiar with the provisions of the WIP and trained in aspects of it that they may be called upon to implement.

13. Environment (All Production Systems)

Storage, Disposal of Farm Supplies and Wastes

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 prompt, sanitary and responsible way. Excessive accumulation of waste and/or discarded farm supplies and equipment shall be removed and disposed of responsibly.

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, other organic waste, and discarded equipment or supplies can attract pests and 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.

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 or multiple fuel storage tanks. The containment volume shall be equivalent to the total stored volume plus 10%.

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

Chemicals such as insecticides, herbicides, algicides, sodium metabisulfite used in shrimp, and detergents 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.

Feed shall be properly stored off the floor and away from walls, and protected from moisture, pests and other contaminants.
Fertilizers, liming materials, salt and other less hazardous agricultural chemicals shall 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 shall be developed for managing spills of chemicals and other products, and the supplies needed for cleaning up spills shall be readily available. Workers shall be trained to properly use the equipment and handle the contained waste.

Trash, garbage and other farm waste, including discarded farm machinery and equipment, shall not be dumped in mangrove areas, wetlands or vacant land, or allowed to accumulate on farm property. Such waste shall 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.).

Standards

- 13.1: Fuel, lubricants, feed and agricultural chemicals shall be labeled, stored, used and disposed of in a safe and responsible manner.
- 13.2: Fuel, lubricants and agricultural chemicals shall not be stored near feed, in employee housing or kitchen areas, or near harvest equipment and supplies.
- 13.3: Fuel, lubricant and chemical storage areas shall be marked with warning signs.
- 13.4: 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. Designated staff shall be trained to manage such spills and leaks.
- 13.5: Garbage from housing and food waste shall be retained in water-tight receptacles with covers to protect contents from insects, rodents and other animals.
- 13.6: Garbage and other solid waste, including fouling organisms, 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 legal landfill).
- 13.7: Household trash and other farm wastes shall not be dumped in mangrove areas, wetlands or other vacant land and shall be removed promptly and properly to avoid accumulation.
- 13.8: Discarded farm supplies and equipment (e.g., tires, pallets, bags, barrels, aeration paddles or engines) shall not be dumped in mangrove areas, wetlands or other vacant land, and shall be removed properly to avoid excessive accumulation.
- 13.9: Measures shall be taken to prevent infestation by animal and insect vectors and pests.
- 13.10: Secondary fuel containment shall conform to BAP guidelines for fuel storage.

14. Animal Health and Welfare (All Production Systems)

Culture Conditions and Practices

Producers shall demonstrate that all operations on farms are designed and operated with animal welfare in mind, and maximum survival 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 crustaceans and fish, many consumers would like to know that farmed aquatic animals were produced by humane techniques.

When farmed animals 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
Farms shall provide well-designed facilities for holding and rearing crustaceans and 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 species being cultivated can adjust to the changes. Adequate levels of dissolved oxygen shall be maintained.

Feed appropriate for the culture species should be offered at regular intervals. Although fasting periods may be needed to enable harvesting in hygienic conditions, they should be minimized.

Aquaculture farms should minimize stressful situations during handling by limiting crowding time and time out of water. Culture conditions should be managed to avoid situations that could lead to stress, injury or disease.

Accessible, dead animals shall be removed from ponds or cages at least daily and disposed of properly. Ill and unwanted fish specimens shall be eliminated in a humane fashion, for example by dispatching them with 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 animals in their charge. Swift action shall be taken to correct deficiencies or symptoms.
Although reliable scientific data on the effects of stocking density on aquatic animal welfare are limited, and many factors influence this relationship, the BAP standard requires operators to establish and implement their own limits.

The crowding and handling of aquacultured animals during harvesting and transport are potentially stressful, so measures shall be taken to prevent unnecessary animal suffering.
When aquacultured animals are rendered insensitive or their physiological activity greatly reduced during transport, the process shall be accomplished by humane methods.

Animals that are accidentally dropped on the ground during harvest should not be left out of water to suffocate. Live transport of animals should maintain adequate water quality during transport. This usually requires the application of mechanical aeration or oxygenation in the transport containers. Temperature control may also be necessary.

Standards
14.1: The applicant's facility shall apply a maximum biomass limit based on performance measures for aquatic animal health and survival records, and any applicable national regulations.
14.2: Feeding shall be managed to avoid stress caused by under- or overfeeding.
14.3: The facility shall define upper limits for time periods of fasting, crowding and time out of water to ensure best welfare practices and provide accurate records showing that these limits are respected.
14.4: Facility staff shall make regular inspections of the culture facility, water quality, and behavior and condition of crustaceans or fish.
14.5: Disease outbreaks shall be managed through rapid diagnosis and treatment, and when necessary, humane slaughter.
14.6: Humane slaughter techniques shall be used that are appropriate for the culture species.

14.7: When ill, deformed or unmarketable specimens 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.

14.8: Health management procedures shall be defined in a health management plan or operating manual, reviewed and approved by a fish health professional, that includes procedures to avoid the introduction of diseases, protocols for water quality management, health monitoring and disease diagnosis techniques.

14.9: The adequacy and duration of live haul transport methods shall be assessed through documented mortality rates during transport.

15. Food Safety (All Production Systems)

Chemical and Drug Management

Proactively prohibited 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, and not for prophylactic purposes without veterinary oversight.

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 proactively prohibited, and residue limits mandated for others. Apart from compromising food safety, failure to comply with such regulations can have serious economic consequences to all involved in the food supply chain.

Improper use of chemicals can harm other organisms 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. It is also important to ensure that feed and feed ingredients do not contain unsafe levels of these or other contaminants.

Use of certain antifouling materials on farm facilities and containment structures can introduce potential environmental contaminants. The application of certain approved food additives to maintain product quality or appearance during harvest, transport and various stages of post-harvest processing can exceed recommended levels or duration of exposure and impart a residual level in excess of legal food safety limits or product-labeling requirements regarding prior use.

Critical Concerns for Antibiotic Use

- Chloramphenicol and nitrofuran antibiotics are proactively prohibited for use in food production in all countries.
- Other drugs and chemicals, such as antibiotics, malachite green, heavy metals, parasiticides and hormones, may be proactively prohibited in specific countries.

When antibiotics that are not proactively prohibited for use in both the local and importing country are used for therapeutic purposes, antibiotic residue tests shall be carried out after the withdrawal period to ensure regulatory limits on residues are met. Where available, farms may use residue testing data from government surveillance or processing plant preharvest screening programs.

- Records for disease diagnoses should provide supporting evidence to justify cases where therapeutants are used.
- Vaccines and anesthetics, where employed, shall be approved and used only according to manufacturers' instructions.
- Cage farms making use of antifoulants shall obtain all necessary authorizations for their use. Land-based farms shall obtain any required discharge permits from government agencies.

Implementation

When considering site locations for new pond construction, soil samples shall 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.

In addition to the above-mentioned risks, producers should consider prior use of a site for crops where pesticides have been used and periodically review land use changes in the immediate vicinity that may result in potential increases in environmental contaminants. Surveys of land use or agricultural practice changes can be an internally conducted and documented risk-based analysis. If contamination is suspected, laboratory analysis of the surrounding watershed may be required to verify safety of the water supply.

Any use of approved food additives must involve monitoring the amount and method of application to prevent illegal residues in the edible portion of the products and assure product labeling to designate prior usage.

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, adopt fallowing and "all in, all out" stocking procedures at cage and net pen sites, 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 shall 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 regulatory authorities, processing plants, health and agricultural agencies, or university fisheries research and extension programs. The BAP program aims to exclude the use of antimicrobials that the World Health Organization (WHO) categorizes as 'critically important' to human medicine and sensitivity testing shall accompany any application of antibiotics. To promote awareness and to assess the feasibility of this target, farms shall report usage data for all antimicrobials.

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

For Additional Information: WHO (2011) Critically Important Antimicrobials for Human Medicine, 3rd Revision, 32pp. http://www.who.int/foodsafety/publications/antimicrobials-third/en/

Standards

15.1: The facility shall conduct an assessment of the watershed surrounding the facility to identify any potential watershed contamination risks. This includes monitoring any changes to land use practices over time. Potential watershed contamination risks may involve such things as pesticides, PCBs and heavy metals introduced from nearby industrial or agricultural operations.

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

15.3: Records shall be maintained for every application of drugs and other chemicals that include the date, compound used, reason(s) for use, antibiotic sensitivity test results, dose and harvest date for treated production lots. See the Traceability requirement. Periodic verification testing of the effectiveness of the withdrawal period shall be conducted. The auditor shall collect usage data for all antimicrobials

15.4: Any use of antifouling agents must involve recognized applications of approved materials in a manner that can be monitored for potential contamination of the aquacultured animals.

15.5: Any use of food additives shall involve approved materials and be monitored for time and method of application.

15.6: Antibiotics or chemicals that are proactively prohibited in the producing or importing country shall not be used in feeds, pond additives or any other treatment.

15.7: Statements from fry, fingerling or postlarvae suppliers that declare no proactively prohibited drugs or other chemicals were applied to seed are required.

15.8: For feed suppliers that are not BAP-certified, statements are required attesting to the application of production procedures that exclude proactively prohibited drugs, by-products from same species, unsafe levels of heavy metals and physical or other contaminants.

15.9: Feed, nutritional supplements or pond additives used, manufactured, or prepared on the farm shall include procedures to ensure these substances do not contain unsafe levels of contaminants and contain only substances permitted by the appropriate national authorities.

15.10: Antibiotics, antimicrobials or hormones shall not be used as growth promoters.

15.11 All records specified in Section 15 shall be retained for a period that exceeds both 12 months and the expected shelf life of the aquaculture products.

16. Food Safety (All Production Systems)

Microbial Sanitation, Hygiene, Harvest and Transport

Human waste and untreated animal manure shall be prevented from contaminating pond waters. Domestic sewage shall be treated and not contaminate surrounding areas. Aquacultured products shall be harvested and transported to processing plants or other markets in a manner that maintains temperature control and prevents physical damage or contamination.

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, and 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 or crustaceans grown in waters that receive human waste, untreated animal manure or organic fertilizers containing *Salmonella* or other potential food-borne pathogens.

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 production 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 shall 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 shall 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. 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.

At cage farms, workers often spend long hours on the floating cage platforms. Portable toilets shall be provided, and sanitary procedures for disposal of wastes onshore shall be established.

It is in the best interests of the aquaculture industry to use pelleted or extruded feeds, and in ponds to use chemical fertilizers or organic manure that has been treated to kill potential food-borne pathogens.

Transport
Unclean water and transport containers can cause contamination of fish during transit from ponds to plants or markets. For fish or crustaceans placed on ice or in iced water at the farm, alternating layers of ice and product are recommended to avoid temperature fluctuations.

For Additional Information

CODEX Alimentarius, Code of Practice
for Fish and Fishery Products
ftp://ftp.fao.org/docrep/fao/011/a1553e/a1553e00.pdf

Standards

16.1: Domestic sewage shall be treated and properly disposed of to avoid contamination of surrounding areas (e.g., sewer system, septic system, portable toilet or outhouse).
16.2: Farm animals and domestic pets shall not be allowed to access production ponds.
16.3: Human waste and untreated animal manure shall not be used to fertilize ponds.
16.4: Uncooked organisms and their by-products shall not be used as feed in growout ponds.
16.5: Fish and crustaceans shall be harvested and transported in a manner that maintains temperature control.
16.6: Ice shall be made from water that complies with microbial limits for potable water.
16.7: Equipment and containers used to harvest and transport fish or crustaceans shall be cleaned, sanitized, and be free of lubricants, fuel, metal fragments and other foreign material.
16.8: Non-approved chemicals shall not be applied directly or indirectly to aquacultured products during transport.
16.9: Workers with wounds, open sores or skin infections shall be prohibited from handling harvested products.
16.10: Workers shall be trained in good hygienic practices to ensure they are aware of their roles and responsibilities for protecting aquaculture products from food safety risks such as contamination and deterioration.

17. Biosecurity (All Production Systems)

Disease Control

Biosecurity controls shall be in place to prevent the introduction and/or spread of disease agents and disease on the farm. These include regular disease surveillance, sanitation of equipment and personnel, quarantine of diseased animals and controlled movement of personnel and equipment. Farm staff and visitors shall be trained in and apply biosecurity measures.

Reason for Standard
Disease of aquacultured animals is considered by many to be the single largest threat to the growth and stability of the global aquaculture industry. The spread of diseases affecting aquaculture crops has been traced, in many cases, to poor biosecurity at farms.

Mass mortalities occasionally occur at aquaculture farms, and dead carcasses or animal remains can potentially spread disease. When these mortalities occur, facilities shall have a plan to dispose of the carcasses through incineration or sanitary burial.

Implementation
Measures shall be taken to avoid the spread of disease within the BAP farm or to neighboring farms or client farms to which animals are transferred for further growout. For marine cage farms, see also area management requirements, Standard 7.

Proper biosecurity controls shall prevent the introduction or spread of disease agents within the farm. The likely vectors for these risks shall be identified in a detailed written biosecurity plan that identifies specific farm staff responsible for its implementation, includes specific control measures and at a minimum:

- Identifies the likely disease risks for the culture species within its culture region.

- Links the biosecurity plan to the overall farm animal health and welfare plan.
- Requires routine disease surveillance and characterization of the health status of the farm.
- Identifies critical control points such as movement of animals and equipment, and farm access by visitors.
- Establishes active control measures to reduce the risk of introduction and/or spread of disease agents past these control points.
- Establishes hygiene and sanitization protocols and standards for equipment and personnel.
- Establishes quarantine protocols for diseased animals, where possible.
- Prevents the movement of personnel and equipment from diseased areas both within the applicant farm and from neighboring farms.
- Establishes protocols that allow the tracking of animal and equipment movements.
- Establishes a visitor and delivery log.
- Establishes a method of tracking actions taken to reduce the risk of disease and/or control disease if it occurs.

Where movement of equipment and personnel from diseased or suspect areas to other areas is unavoidable, cleaning and sanitization measures shall be employed to disinfect all equipment and personnel prior to entry to non-diseased areas.

Where slaughtering is conducted at the farm, blood water and other effluents generated through processing shall be contained or treated so they do not contaminate the environment or present a biosecurity risk.

Standards

17.1: The applicant shall have in place biosecurity controls that seek to prevent the introduction and spread of disease agents and disease on the farm, including the sanitization of equipment and personnel when disease is suspected or confirmed at the farm site, and these shall be detailed in a biosecurity plan as described in the Implementation guidelines above.

17.2: Farm staff shall be trained in biosecurity procedures and shall, along with all visitors, comply with them.

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

17.4: Where slaughtering is conducted at the farm, blood water and other effluents generated through processing shall be contained or treated so they do not contaminate the environment or present a biosecurity risk.

18. **Traceability** (All Production Systems)

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 or postlarvae stocked
- source of fingerlings or postlarvae (hatchery)
- antibiotic and drug use
- sulfite use in shrimp
- herbicide, algicide and other pesticide use
- manufacturer and lot number for each feed used
- harvest date
- harvest quantity
- movement document number (if applicable)
- processing plant(s) or purchaser(s) (identify all if any harvest quantity goes to more than one plant or purchaser)

Reasons for Requirement

Product traceability is a crucial component of the BAP program. It interconnects links in the 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 may utilize any traceability system that meets the BAP requirements. This can be an online system; the farm's own in-house database, paper records, files and documents; or a combination thereof.

Where paper records, documents or notebooks are used, if possible, the information should also be transferred to computer database files to allow electronic transmission. The original files or paper records shall be kept to allow verification of the electronic data.

The data referenced in BAP's standards on egg, postlarvae and fingerling sources, chemical management, etc., are required for traceability. This information and other pond-, net pen- or cage-related records can be captured on the sample Product Traceability Form in Appendix F. Each form corresponds to the harvest on a particular day from a particular culture unit.

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

Product Identity Preservation

To assure the integrity of the Best Aquaculture Practices "star" system, traceability controls must be in place that allow verification of all facilities that contribute to the claim of multiple-star BAP-certified status.

To insure the proper separation and traceability of all farm inputs and outputs, the following components must be in place:

- Farms that purchase all of their shrimp postlarvae, fish fry or fingerlings, and feed from BAP-certified sources shall maintain records of the sources of stocking material and feeds used.
- Farms that purchase stocking material and feed from both BAP- and non-BAP-certified sources shall identify all sources and have adequate systems in place to prevent mixing of BAP and non-BAP production lots.
- To enable mass balance verification of multiple-star products, certified farms shall maintain a list, including harvest dates and volumes, of the processors to which they sell or deliver products.
- The number of backward and forward trace exercises conducted by the auditor will be determined by farm volume.

BAP Logo Use

Use of the Best Aquaculture Practices logo, a registered trademark of the Global Aquaculture Alliance, for any purpose shall be approved by BAP in advance and used in compliance with the BAP trademark usage agreement.

Customer Complaints

The applicant must prepare and implement an effective system for the management of complaints and complaint data to control and correct shortcomings related to its products' compliance with the BAP standards.

Standards

18.1: The facility shall operate an effective record-keeping system that provides timely, organized, accurate entries, performed and overseen by a designated trained person or team responsible for collecting the data, ensuring it is complete and accurate, and that traceability requirements are met.

18.2: The facility shall keep complete and accurate records for each culture unit and production cycle, including the culture unit identification number, unit area and volume, species stocked and, if applicable, species specifications such as triploid or GMO.

18.3: The facility shall keep complete and accurate records concerning any antibiotic or other drug use at both the hatchery and the farm.

18.4: Complete and accurate records shall be maintained on the use of sulfites or other approved food-processing aids/additives in shrimp, as well as the use of herbicides, algicides and other pesticides.

18.5: Complete and accurate records regarding manufacturer and lot numbers for each feed used shall be maintained.
18.6: The facility shall maintain complete and accurate records of the sources and numbers of postlarvae or fingerlings stocked, stocking dates and all feeds used for each culture unit.
18.7: Complete and accurate records regarding the harvest date, harvest quantity, movement document number (if applicable) and processing plant(s) or purchaser(s) shall be maintained. If product lots are destined to more than one plant or purchaser, each lot shall be separately identified.
18.8: In order to use the BAP logo, facilities shall have such use approved and registered in advance with BAP Management.
18.9: The facility shall keep records of any customer complaints related to its products' compliance with the BAP standards.
18.10: The facility shall keep records of investigations of such complaints and actions taken to address/correct them.

19. Shrimp-Specific Standards

Environment

Effluent Management

Water exchange shall be limited to reduce overall environmental impacts.

Food Safety

Harvest and Transport

Sulfites shall be handled responsibly to control risks to consumers and the environment.
If shrimp are treated on farm at harvest with sulfites, the protocol for this practice shall be provided. Because used sulfite solutions can cause localized dissolved-oxygen depletion in discharge water bodies, these solutions shall be held in a tank or small pond until the sulfites have oxidized completely, typically for at least 48 hours. 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. Example: Sulfite solution can be treated with 0.4 kg lime/L to neutralize acidity before final release into natural waters.

Standards

19.1: The mean water exchange rate shall not exceed 10% per day (i.e., on an annual basis, 36 x total pond volume). This limit does not apply to shrimp ponds in deserts.
19.2: If used, sulfites shall be applied in a manner that will yield a tissue concentration within regulatory limits.
19.3: Sulfite solutions shall be deactivated or neutralized, for example by 48-hour retention, prior to release into natural water bodies.

20. Tilapia-Specific Standards

Environment

Use of Hormones for Producing All-Male Fry

When hormones are used to produce all-male fry, records of hormone applications shall be maintained. Employees who work with methyl testosterone shall be instructed to wear protective clothing and masks with air filters. The facility shall avoid releasing methyl testosterone-treated water directly into the environment.

Implementation

Analyses of tilapia fillets have shown that the use of methyl testosterone or related hormones for producing all-male fry has not resulted in residues of testosterone higher than those naturally found in control fish. Nevertheless, producers are encouraged to use other methods of obtaining all-male fry. To minimize any environmental impacts, onsite biofiltration/bioremediation, such as a trickling filter or constructed wetlands, can be used.

Standard

20.1: If hormones are used during fry production, workers shall be trained in the handling of hormones and wear protective clothing and masks with air filters.

20.2: The facility shall avoid releasing methyl testosterone-treated water directly into the environment, for example by retaining for a minimum of 48 hours.

20.3: Any antibiotic usage shall not exceed 3 treatments per on-growing cycle, where a treatment comprises a single course of antibiotics given to address a specific disease issue over a prescribed period.

20.4: Antimicrobials that are critically important for human medicine* shall not be used.

20.5: In watersheds where Tilapia species are not indigenous and not established**, tilapia farms shall have at least two independent containment systems to prevent escapes. Additionally, they shall only stock monosex juveniles (minimum 99% phenotypically monosex).

*Critically Important Antimicrobials for Human Medicine, 3rd Revision World Health Organization, 2011
http://www/who.int/foodsafety/publications/antimicrobials-third/en

** A non-indigenous species is considered established if it has a reproducing population within the watershed, as inferred from multiple discoveries of adult and juvenile life stages over at least two consecutive years. Given that successful establishment may require multiple introductions, species are not considered established if their records of discoveries are based on only one or a few non-reproducing individuals whose occurrence may reflect merely transient species or unsuccessful invasions. (adapted from National Oceanic and Atmospheric Administration).

Appendix A

BAP Effluent Water Quality Criteria – All Pond Farms

Variable (units)	Initial Value	Final (after 5 years)	Collection Frequency
pH (standard pH 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

Appendix B

Sample Effluent Monitoring Form – pH and Dissolved Oxygen

Date (day/month/ year)	pH (standard units)			Dissolved Oxygen (mg/L)			No. 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 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 Harvested**
1				
2				
3				
4				
Annual Average				

Appendix C

Calculation of Annual Effluent Volume

An estimation of annual effluent volume shall be determined using one of the following equations.

Farm Discharge Calculation

Equation 1 – Pump Discharge Method

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

Equation 2 – Water Exchange Method

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]

Equation 3 – Watershed Method

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) x 0.55 m/yr

Evaporation (m^3) = Class A pan evaporation (m/yr) x
0.8 x 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)

Additional Data

The BAP program will 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.

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 4

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

While not a recommended practice, 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 5

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

Equation 6

Load index (kg variable/MT fish or shrimp) =
Annual load of variable (kg/yr) ÷ Annual fish production (MT/yr)

Example: Water Use, Load Indices
For Annual Effluent 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 average of 10 mg/L total suspended solids (TSS), 0.03 mg/L soluble phosphorus (S.P.), 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 S.P., 0.87 mg/L TAN and 9.6 mg/L BOD. Shrimp/ 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

Annual effluent volume = [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

S.P. 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

Water use index = (9,2000,000 m^3/yr) /
(230,000 kg shrimp or fish/yr) = 40 m^3/kg shrimp/fish

TSS index = (322,000 kg/yr) / (230 MT shrimp or fish) = 1,400 kg TSS/MT shrimp/fish

S.P. index = (1,472 kg/yr) / (230 MT shrimp or fish) =
6.4 kg S.P./MT shrimp/fish

TAN index = (6,624 kg/yr) / (230 MT shrimp or fish) = 28.8 kg TAN/MT shrimp/fish

BOD index = (74,520 kg/yr) / (230 MT shrimp or fish)= 324 kg BOD/MT shrimp/fish

Example: Water Use, Load Indices
For Annual Effluent 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 (S.P.), 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. Fish production during the past year was 378,000 kg (378 MT).

Calculations
Annual effluent volume = 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/yr

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

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

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

Water use index = (23,827.200 m^3/yr) /
(378,000 kg shrimp or fish/yr) = 63.0 m^3/kg shrimp/fish

TSS index = (1,930,000 kg/yr) / 378 MT shrimp or fish) = 5,106 kg TSS/MT shrimp/fish

S.P. index = (4,765 kg/yr) / (378 MT shrimp or fish) =
12.6 kg S.P./MT shrimp/fish

TAN index = (25,018 kg/yr) / (378 MT shrimp or fish) = 66.2 kg TAN/MT shrimp/fish

BOD index = (266,865 kg/yr) / (378 MT shrimp or fish) = 706 kg BOD/MT shrimp/fish

TAN index = (6,624 kg/yr) / (230 MT shrimp or fish) =
28.8 kg TAN/MT shrimp/fish

BOD index = (74,520 kg/yr) / (230 MT shrimp or fish) =
324 kg BOD/MT shrimp/fish

Appendix D

BAP Water Quality Monitoring
Cages and Net Pens in Lakes and Reservoirs

Variable	Sample Depth	Collection Frequency
Temperature Dissolved oxygen pH Chlorophyll a 5-day biochemical oxygen demand Secchi disk visibility Soluble phosphorus Total ammonia nitrogen Phytoplankton abundance and species	Vertical profile, 2-m intervals Vertical profile, 2-m intervals Equal to cage mid-depth Equal to cage mid-depth Equal to cage mid-depth Not applicable Equal to cage mid-depth Equal to cage mid-depth Equal to cage mid-depth	Monthly Monthly Quarterly Quarterly Quarterly Weekly Quarterly Quarterly Quarterly

Appendix E

Load Indices for Cages, Net Pens

Water use indices cannot be applied to cages and pens. The loads of nitrogen and phosphorus imposed by cages and net pens on receiving water bodies can be estimated as follows:

Equation 1

Nitrogen load (kg/yr) = [Total feed (kg) x
Nitrogen (% in feed) ÷ 100] –
[Harvested fish* (kg) x Nitrogen (% in fish) ÷ 100]

Equation 2

Phosphorus load (kg/yr) = [Total feed (kg) x
Nitrogen (% in feed) ÷ 100] –
[Harvested fish* (kg) x Nitrogen (% in fish) ÷ 100]

*In Equations 1 and 2, the mass of harvested fish can also include the mass of any dead fish removed from the cages before harvest.

Equation 3

Nitrogen load index (kg/MT fish) = Nitrogen load (kg/yr) ÷
Fish production (MT/yr)

Equation 4

Phosphorus load index (kg/MT fish) = Phosphorus load (kg/yr) ÷ Fish production (MT/yr)

The percentage nitrogen in feed is percentage crude protein divided by 6.25. The phosphorus content in tilapia feed is about 1%, but the exact value should be measured or obtained from the feed manufacturer. For example, live tilapia typically contain 2.2% nitrogen and 0.72% phosphorus.

Appendix F

Sample Product Traceability Form

Farm Name	Pond or Cage Number Pond Area (ha)
POSTLARVAE OR FINGERLINGS Stocking Date	**FEED** Feed Type
Stocking Quantity Species	Manufacturer
Any Species Specifications (e.g., triploid, G.M.)	Lot Number(s)
Hatchery BAP No.	
Confirmation: No Use of Proactively Prohibited Chemicals Yes No	Confirmation: No Use of Proactively Prohibited Chemicals Yes No
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)	

BAP FCFS Standard - Issue 2.4 Change-Log (23-May-2017)

Approved (SOC May 2017)

20.5 In watersheds where Tilapia species are not indigenous and not established, tilapia farms shall have at least two independent containment systems to prevent escapes. Additionally, they shall only stock monosex juveniles(minimum 99% phenotypically monosex).

Added social accountability to descriptions of Critical and major NC's.