Aquaculture Facility Certification

BAP Farm Standard

Best Aquaculture Practices Certification Standards, Implementation Guidelines

Best Aquaculture Practices

• Food Safety • Social Accountability • Environmental Responsibility

• Animal Health and Welfare • Traceability

Previous Issue Invalid 01-March-2022

Aquaculture Facility Certification

BAP Farm Standard

Issue 3.0 – 01-March-2021
Best Aquaculture Practices
Certification Standards, Guidelines

Best Aquaculture Practices Certification

The following Best Aquaculture Practices (BAP) standards apply to the farming of finfish, crustaceans, and other aquatic invertebrates. They cover all production methods, including flow-through, partial exchange, and closed or recirculating aquaculture systems operated in ponds, cages, net pens, tanks, raceways, or closed-containment vessels.

Not covered under these standards are:

- Salmonids reared in net pens in marine waters (refer to BAP Salmon Farm Standard),
- Bivalve Mollusks (refer to the BAP Mollusk Farm Standard),
- Aquaculture facilities that produce eggs and/or juvenile aquatic animals for live transfer to other aquaculture facilities (refer to BAP Hatchery and Nursery Standard).

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. BAP Standards lead to certification of compliance after verification of the applicant's facilities by BAP approved third-party certification bodies.

BAP Structure

The BAP program has four pillars and an overarching set of Traceability Requirements. The pillars comprise the first four sections of the standard:

1. Food Safety
2. Social Accountability
3. Environmental Responsibility
4. Animal Health and Welfare

The fifth section defines the Traceability Requirements that are essential to preserve product identity and to verify the validity of any BAP claims.

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 shall 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 or mandatory and "should" to mean compliance is recommended. Auditable points are "shall" statements listed at the beginning of each section.

The Certification Process

1. Program Management

Best Aquaculture Practices is a division of the Global Seafood Alliance (GSA), with offices headquartered in Portsmouth, New Hampshire, USA. Best Aquaculture Practices manages multiple GSA standards including the BAP Farm Standard on behalf of the GSA.

To obtain BAP certification, applicant farms shall be audited by an independent, BAP-approved certification body (CB). To apply for certification, please contact:

Best Aquaculture Practices
85 New Hampshire Avenue, Suite 200
Portsmouth, NH 03801 USA
Tel: +1-603-317-5000
Email: bapcert@bapcertification.org
BAP Website: www.bapcertification.org
GSA Website: www.globalseafood.org

2. Self-Assessment

New applicant farms are expected to carry out a self-assessment against the Standard to ascertain their preparedness for a third-party CB audit.

3. Third-party CB Assessments

Once a self-assessment has been carried out by the farm and it is satisfied that all deficiencies identified have been rectified, they can proceed to certification. To become certified, farms must be able to demonstrate compliance with this Standard, through an independent third-party on-site assessment by a GSA-approved CB.

The chosen CB will formulate an agreement between the farm and the CB detailing the requirements and commitments needed from the farm.

New farms must be in operation for at least three months from commencing production to ensure that they can demonstrate full compliance with the Standard during the assessment.

4. Assessment Frequency

Audits to the BAP Farm Standard are conducted at a frequency of once per year. However, additional audits, re-audits, short notice, or unannounced audits shall also be conducted at the discretion of GSA and Certification Bodies where facility compliance concerns arise.

5. Duration of Assessments

The duration of an assessment is dependent on factors such as size of the operation/farm and number of personnel. In most cases the actual on-site audit duration for an individual farm facility is one full day. CBs are required to inform GSA-BAP where a deviation in audit duration is foreseen. The assessment format includes systems review and physical inspection of the site and production process. Time allocation during the assessment shall be such to provide sufficient and proportionate time for each activity to be carried out in full and where appropriate, additional time may be given when the auditor is required to carry out further investigation.

6. Audit Process (Figure 1)

All requirements in the Standard shall be addressed. As with other BAP standards, the audit against the BAP Farm Standard will consist of elements listed in Figure 1 in accordance with ISO 19011.

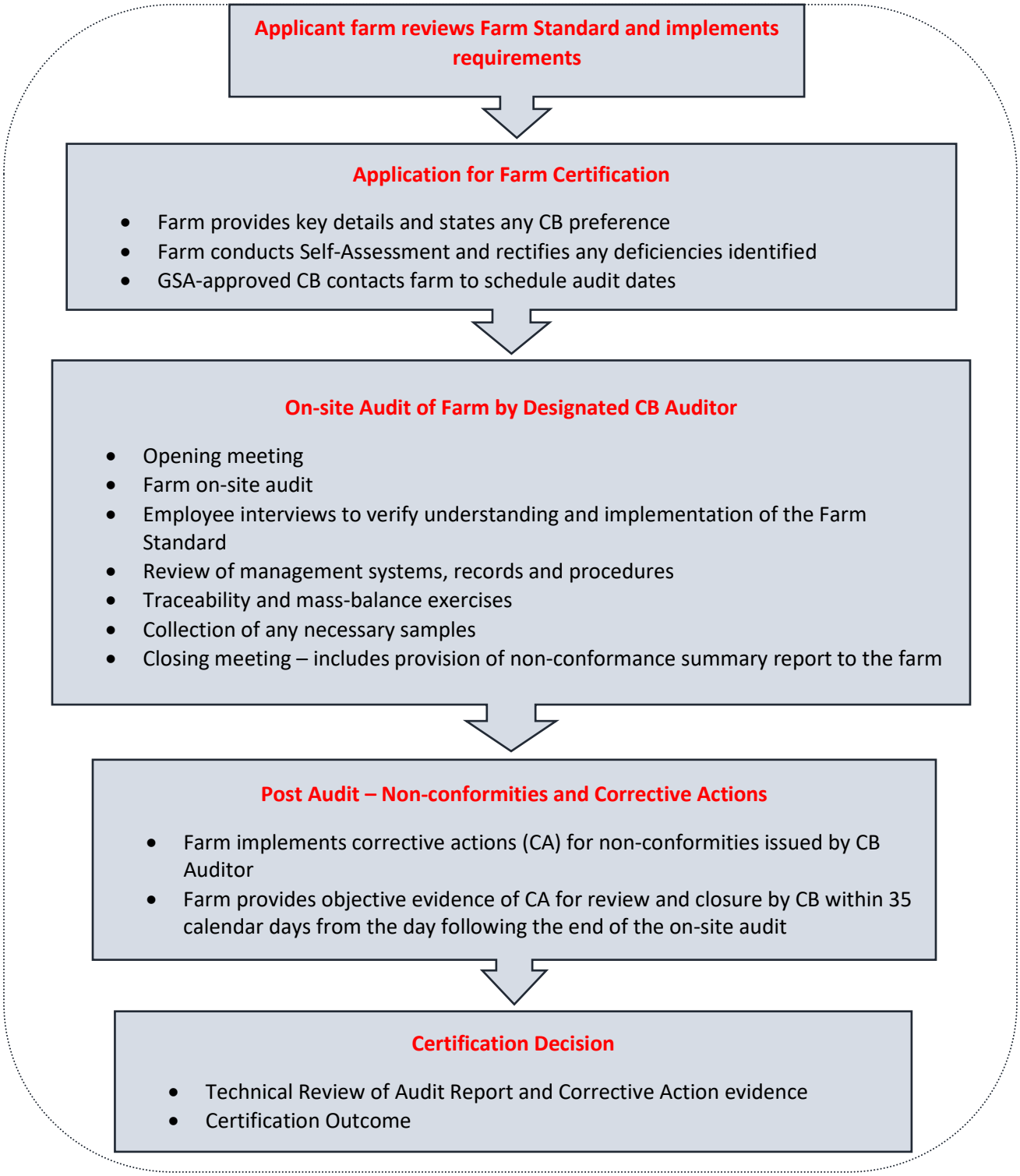

Figure 1. BAP Audit Process

7. Non-Conformities and Corrective Actions

Any non-conformity issued during the assessment will be recorded by the auditor as either:

NC Rating	Definition	Required Action
Minor	Where absolute compliance with requirements and/or the intent of any clause in the Standard has not been demonstrated. The matter does not rise to the level of Major or Critical and tends to be lower risk issues or isolated instances rather than patterns. Not indicative of an overall breakdown in compliance and systems.	Objective evidence verifying the proper implementation of corrective actions and closure of non-conformities must be submitted to the Certification Body in accordance with GSA/BAP certification management rules.
Major	Where there is a substantial failure to meet the requirements and/or intent of any clause in the Standard but there is no food safety risk and/or legal issue or immediate risk to the Integrity of the scheme. (Generally, policy)	Objective evidence verifying the proper implementation of corrective action and closing of non-conformities must be submitted to the Certification Body in accordance with GSA/BAP certification management rules.
Critical	Where there is a critical failure to comply with a food safety and/or legal issue or a risk to the integrity of the scheme.	The auditor will immediately inform the Certification Body, who will inform the GSA/BAP office. Immediate temporary suspension may ensue pending clarifications and a re-audit may be necessary.

At the closing meeting, the auditor shall present his/her findings and review all non-conformities that have been identified during the assessment but shall not make comment on the likely outcome of the assessment. A written summary of the non-conformities discussed at the closing meeting shall be agreed upon and signatures from the farm representative obtained. A copy of the non-conformity report must be left with the farm prior to the auditor departing the farm. The farm shall provide the CB, in accordance with GSA/BAP certification management rules, suitable and adequate objective evidence that corrective action has been implemented to rectify the non-conformity. This evidence shall also address root cause and future prevention. The evidence will be reviewed, and the CB will respond either confirming closure of the non-conformity or requesting further evidence. The farm must submit evidence to the CB to close out all non-conformities within 35 calendar days from the day following the end of the audit. Failure to close out non-conformities in the given timeframe will result in certification not being granted or continued, and facilities will be required to re-apply for a full assessment for certification.

8. Audit Reporting and the Certification Decision

The auditor will provide a full report of the assessment, including the details of any non-conformities issued. The auditor will submit the report to the CB. The report shall include brief statements of objective evidence of both conformity and non-conformity. The report shall follow the format specified by the GSA/BAP. The report shall be issued in accordance with the GSA/BAP Report Guidelines. Within the audit report there shall be a record of the duration of the assessment (expressed as hours) and any reason for the lengthening or shortening of the duration from that which is typical.

The audit report along with the corrective actions submitted by the farm will be evaluated by a Certification Committee of the CB, who will make the final certification decision post closure of all non-conformities. The timelines for audit, closure of non-conformities, technical review and certification decision are as specified in the GSA/BAP CB Requirements Document PI - Policy - BAP CB Requirements Document - Issue 14.8 - 18-September-2020.pdf (bapcertification.org) available on the BAP website. To achieve certification to the BAP Farm Standard, the applicant farm must meet all of the requirements of the Standard.

9. Standards Development

BAP standards are developed by committees of technical experts following a process aligned to the FAO Technical Guidelines on Aquaculture Certification.

References:

https://www.bapcertification.org/Standards
http://www.fao.org/3/a-i2296t.pdf

Acknowledgements

An expert group, the BAP Farm Standard Technical Committee, develops and endorses the Standard, with representatives throughout the supply chain and interested parties including industry associations, processors, producers, regulators, non-governmental organizations and conformity assessment and standards experts. The GSA is grateful to the members of the Farm Standard Technical Committee members who created the earlier versions of the Standard and to other specialists that offered valuable input during the review process. Special thanks are due to the Technical Committee that worked on this 2019-2020 update of the BAP Farm Standard:

BAP Farm Standard Technical Committee

John Hargreaves, **(Chair)**, independent consultant, TX, USA
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Michelle Walsh, Florida Keys Community College, Key West, FL, USA

Standard Version History

1999 – Codes of Practice for Responsible Shrimp Farming
2002 – Shrimp Farm Standards
2008 – Tilapia Farm Standards, Catfish Farm Standards
2009 – Shrimp Farm Standards, Revision 9-09
2010 – Pangasius Farm Standards
2012 – Shrimp Farm Standards, Revision 6-12
2013 – Finfish and Crustacean Farms Standards
2014 – Finfish and Crustacean Farms Standards, Revision 9-14
2016 – Finfish and Crustacean Farms Standards, Revision 4-16
2016 – Finfish and Crustacean Farms Standards, Revision 11-16
2017 – Finfish and Crustacean Farms Standards, Revision 5-17
2021 – Farm Standard

BAP Farm Standard – Contents

BAP Standards Compliance Requirements

Pillar 1: Food Safety

A. General Requirement - All Production Systems

Audit Clauses

1.1: Farms shall conduct an assessment that identifies potential contamination risks from the surrounding environment with potential to affect the food safety of products from an aquaculture farm, including monitoring any changes to watershed land use practices over time. The farm shall develop a management plan that describes procedures to monitor and control those risks and provide evidence that the plan is operational and effective.

Implementation

Contamination Risk Assessment

Aquaculture farms are embedded in a particular landscape and watershed or water body. Depending largely on the degree of openness of the culture system to the environment, the risk of product contamination by activities in surrounding areas will vary. Open systems are at much greater risk of potential product contamination from the watershed than more closed systems. Thus, each farm has its own particular set of risks of potential product contamination and these should be clearly identified and described in the Contamination Risk Assessment.

The risk assessment can use any approach that systematically evaluates risk sources and the severity and consequences of exposure to various environmental hazards present in the watershed. Elements of a qualitative Contamination Risk Assessment include:

- Identification of potential food safety hazards from the watershed
- Description of pathways for introduction of contaminants, with and estimation of the probability of occurrence. (In a HACCP plan, these are the critical control points.)
- Exposure assessment – pathways for exposure of potential contaminants to cultured aquatic animals, with estimation of probability of exposure and critical limits
- Direct consequence assessment – relationship between exposure and consequences of exposure, with estimation of probability of occurrence. Consequences of residue accumulation during the production cycle and short-term risks associated with exposure near harvest.
- Risk Assessment - integrating the results of the entry assessment, exposure assessment, and consequence assessment to produce overall measures of risks associated with the hazards identified (prioritization of contributions to overall risk)
- Risk Management – measures to address the risks identified in the risk assessment
    - Option identification
    - Implementation
    - Monitoring and review

Perhaps the best framework for the Contamination Risk Assessment is the Hazard Analysis and Critical Control Point (HACCP) system for management of food safety risks that is commonly used in aquatic animal processing plants. A farm-level HACCP plan would identify, evaluate and control the food safety risks that occur during production. Such a plan would meet the requirements of this audit clause. The plan should address hazard analysis, critical control point (CCP) identification, establishing critical limits, monitoring procedures, corrective actions, verification procedures, and record-keeping and documentation. The individual responsible for performing monitoring, corrective actions, verification procedures and record-keeping should be identified.

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

washing and loading sites for spray applicators and agricultural aircraft. 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 internally conducted and documented in a risk-based analysis. If contamination is suspected, laboratory analysis of the surrounding watershed may be required to verify safety of the water supply.

B. Chemical and Drug Management - All Production Systems

Audit Clauses

1.2: Use of any treatment with antimicrobial agents shall be based only on recommendations and authorizations overseen by a qualified aquatic animal health specialist or veterinarian and only to treat diagnosed diseases, supported by antimicrobial agent sensitivity testing conducted as soon as possible, in accordance with instructions on product labels and national regulations, as part of an Animal Health Management Plan.

1.3: For tilapia production, any usage of antimicrobial agents shall not exceed three treatments per on-growing cycle, where a treatment comprises a single course of antimicrobial agents given to treat a specific disease event over a defined period followed by the completion of an appropriate withdrawal period prior to harvest.

1.4: Records shall be maintained for every application of antimicrobial agents and other therapeutic chemicals that include the date, compound used, reason(s) for use, drug sensitivity test results, dose, required withdrawal period and harvest date for treated production lots. Antibiotic use shall be reported as kg API/MT of harvested aquatic animals.

1.5: Periodic verification testing of the effectiveness of the withdrawal period shall be conducted by measurements of antimicrobial agent residues in samples of harvested crops of aquatic animals.

1.6: Antimicrobial agents or chemicals that are prohibited in the producing or importing country shall not be used in feeds, pond additives or any other treatment.

1.7: Antimicrobial agents or hormones shall not be used for growth promotion or applied prophylactically to prevent disease outbreaks. However, metaphylactic treatments in response to diagnosed disease outbreaks are permitted.

1.8: For farms using seed (fry, fingerlings, post-larvae) provided by non-BAP certified sources, statements shall be provided by the hatcheries or nurseries that declare no proactively prohibited antimicrobial agents or other chemicals were applied to seed.

1.9: For farms using feed provided by non-BAP certified sources, statements shall be provided by the feed manufacturers that attest to production procedures that exclude prohibited antimicrobial agents, unsafe levels of additives or heavy metals and physical or other contaminants.

1.10: Farms shall present evidence, such as product testing and evaluation results, that any nutritional supplements, pond additives or farm-made feeds used, manufactured, or prepared on the farm do not contain unsafe levels of contaminants and contain only substances permitted by the appropriate regulatory authorities.

1.11: Any use of antifouling agents must be legally permitted and applied using protocols that prevent contamination of farmed aquatic animals.

1.12: If used at harvest of shrimp and other crustaceans, sulfites (e.g., sodium metabisulfite) shall be applied in a manner that will yield a tissue concentration of sulfite within regulatory limits of both producing and importing countries.

1.13: Any chemicals that are prohibited in the producing or importing country shall not be used during the transport of harvested aquatic animals to processing plants. Any chemicals used shall be listed and only applied according to a documented Standard Operating Procedure.

1.14: Antimicrobial agents designated as Critically Important for Human Medicine by the World Health Organization (WHO) shall not be used.

Implementation

The major chemical risks of concern to human food safety in aquaculture are residues of therapeutic drugs and chemicals applied directly through feeds or to water of production units. In open systems, farmed aquatic animals may be exposed to pesticide residues associated with agricultural land use. Substances known as persistent bioaccumulative and toxic substances (PBTs), also known as persistent organic pollutants, may also be of concern. Knowledge of historical and current land use changes in a watershed is needed, especially regarding activities that have resulted in discharges or spills of substances that can compromise the food safety of farmed aquatic animals.

Treatment with Antimicrobial Agents

Animal Health Management Plans shall explain the steps to be taken when a diagnosed disease will be treated with approved chemicals (see Pillar 4 – Animal Health and Welfare). Lists of approved chemicals can usually be obtained from government regulatory authorities, seafood processing plants, government health and agricultural agencies, or university aquaculture or fisheries research and extension programs.

Chapter 6.2 of the OIE Aquatic Animal Health Code (2019) describes the principles for responsible and prudent use of antimicrobial agents. Responsible and prudent use 1) maintains the efficacy of antimicrobial agents both for veterinary and human medicine and to ensure the rational use of antimicrobials in aquatic animals with the purpose of optimizing both their efficacy and safety; 2) complies with the ethical obligation and economic need to keep aquatic animals in good health; 3) prevents or reduces the transfer of both resistant microorganisms and resistance determinants from aquatic animals to humans and terrestrial animals; and 4) prevents antimicrobial residues that exceed the established maximum residue limit (MRL) occurring in the food.

Article 6.2.7 of the OIE Aquatic Animal Health Code (2019) describes the responsibilities of veterinarians and other aquatic animal health professionals. These include:

- Identification, prevention and treatment of aquatic animal diseases, as well as the promotion of sound animal husbandry methods, hygiene procedures, vaccination and other alternative strategies to minimize the need for antimicrobial use in aquatic animals.
- Prescription, dispensation or administration of a specific course of treatment with an antimicrobial agent for aquatic animals under their care.
- Carrying out a thorough clinical assessment of the aquatic animal(s), including as appropriate: clinical examination, post-mortem examination, bacteriology with culture and sensitivity, and other laboratory tests to arrive at the most definitive diagnosis possible before initiating a specific course of treatment with an antimicrobial agent.
- Evaluation of environmental factors and husbandry at the production site (e.g. water quality) should be considered as potential primary factors leading to infection and should be addressed prior to prescribing a course of antimicrobial agent treatment.

If therapy with an antimicrobial agent is deemed necessary, it should be initiated as soon as possible. Selection of the agent should be based on the knowledge and experience of the veterinarian or other aquatic animal health professional authorized to prescribe veterinary medicines. Sensitivity testing of the target microorganism should be used to confirm the choice of treatment. The veterinarian or other aquatic animal health professional should indicate precisely to the aquatic animal producer the treatment regime: dosage, method of application, treatment intervals, duration of the treatment, the withdrawal period and the amount of antimicrobial agents to be delivered, depending on the dosage and the number of aquatic animals to be treated. Antimicrobial agents shall only be used on the prescription of a veterinarian or other authorized aquatic animal health professional. Aquatic animal producers shall ensure that antimicrobial agents are properly stored, handled, and disposed of. If treatments are required to maintain good welfare for farmed aquatic animals, these should be provided.

The Animal Health Management Plan, and specifically disease treatments with antimicrobial agents, shall be overseen by a veterinarian or other authorized aquatic animal health professional. Recognizing that such expertise is not always available in farming areas, farm owners should endeavor to secure the services of experts or consultants with training, experience and expertise in aquatic animal health. In any case, the aquatic animal health professional or consultant should be identified, with qualifications or certifications held on file for review.

Recordkeeping

Detailed records on the use of antimicrobial agents shall be kept. Records shall include date, compound used, reason(s) for use, drug sensitivity test results, dose, required withdrawal period and harvest date for treated production lots. 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. Farms shall report total quantity of each antibiotic used (kg of active pharmaceutical ingredient (API) per metric ton of harvested aquatic animals). Records shall be retained for a period that exceeds both 12 months from expected harvest date and the expected shelf life of the processed aquaculture products. Records for disease diagnosis should provide supporting evidence to justify cases where the decision is made to use therapeutants. Results of sensitivity tests should be made available to the Competent Authority on request. The supervising aquatic animal health expert should review farm records on the use of antimicrobial agents to ensure compliance with their directions and use these records to evaluate the efficacy of treatment regimens. See Traceability section for additional record-keeping requirements. All records related to use of antimicrobial agents shall be available for review during farm audits.

Residue Testing

When approved antimicrobial agents are used for therapeutic purposes, residue tests shall be carried out after the withdrawal period and before harvest to ensure that withdrawal periods are of sufficient duration to ensure that regulatory limits on antimicrobial agent residues are not exceeded. Testing should be done in accredited (ISO 17025) laboratories using standard analytical procedures at least twice annually. Where available, farms may use residue testing data from government surveillance or processing plant preharvest screening programs. Alternatively, where published information on acceptable withdrawal periods for a particular antimicrobial agent is available for a particular species of aquatic animal, producers can extend the withdrawal period to 1.5× the published withdrawal period and not be required to conduct residue testing.

Prohibited Antimicrobial Agents

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. Farms shall have lists of antimicrobial agents prohibited for use in the country where production occurs as well as in the country or countries representing the primary markets for farmed aquatic animals. The recordkeeping system and inspection of drug storage containers shall demonstrate that prohibited antimicrobial agents are not in use on the farm.

Prohibition on Use on Antimicrobial Agents or Hormones for Growth Promotion

Low, sub-therapeutic doses of antibiotics provided to healthy livestock like cattle, pigs or poultry in water or feed can improve growth rate. One of the major concerns associated with this practice is the selection of antimicrobial resistant bacteria during low-dose, long-term treatment of healthy animals. This practice was banned in the EU in 2006 and in the US in 2017 and is now banned in many other countries. The ban refers specifically to antibiotics important in human health, not all antibiotics, and other growth promoters remain legally permitted. For aquatic animal production under this BAP standard, the use of antimicrobial agents and hormones for growth promotion during grow-out is prohibited. (Hormone use for sex reversal at the fry or fingerling stage is permitted under the BAP Finfish, Crustacean and Mollusk Hatcheries and Nurseries standard.) The use of antimicrobial agents should be reserved to treat specific diseases in aquatic animals with those diseases.

Similarly, prophylactic use of antibiotics is prohibited. Prophylaxis is the treatment of healthy aquatic animals to prevent infection and disease. However, metaphylactic use of antibiotics is allowed. Metaphylaxis is the treatment of a group of aquatic animals, some of which are healthy and some of which are diseased, that are in close contact, with the goal of preventing disease spread from diseased to healthy aquatic animals, thereby protecting the overall health of the group. As is the case with conventional disease treatment, metaphylactic

treatment shall only be initiated following a diagnosis of infection or disease by a trained aquatic animal health specialist.

Statements from Seed and Feed Suppliers

Statements from non-BAP seed and feed suppliers that attest to production procedures that exclude prohibited antimicrobial agents, unsafe levels of additives or heavy metals and physical or other contaminants are required to be maintained on file in the record-keeping system. Statements shall be updated annually at a minimum and shall be available for all seed shipments and all feeds used. For farms using feed provided by non-BAP certified sources, statements shall be provided by feed manufacturers.

Feed Additives Applied on Farm

Nutritional supplements, pond additives or farm-made feeds used, manufactured, or prepared on the farm shall include product testing and evaluation procedures to ensure that these substances do not contain unsafe levels of contaminants and contain only substances permitted by the appropriate national authorities. 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. Farms shall maintain a list of all nutritional supplements or pond additives used and provide evidence of the implementation of product testing and evaluation procedures to ensure product safety.

Antifouling Agents

Antifouling agents are often used to prevent or minimize biofouling of mesh material used to construct cages and net pens that are typically placed in the marine environment. Residues of antifouling agents may accumulate in sediment beneath net pens or enter marine food webs. Any antifouling agents used must be legally permitted and applied using protocols that prevent contamination of farmed aquatic animals. Farms using authorized antifoulant treatments must retain a copy of permits and the relevant laws or regulations on file.

Metabisulfite Use

Metabisulfites are used as a post-harvest treatment for shrimp to prevent melanization that can affect product quality. Sulfites are not considered toxic but can cause health problems in some humans. Typically, shrimp are dipped in clean, chilled water and then in chilled metabisulfite solution. Farms using this practice shall develop a Standard Operating Procedure for metabisulfite treatment to ensure good treatment efficiency and that metabisulfite residues in treated shrimp do not exceed levels authorized by importing countries. For example, the maximum sodium metabisulfite residue in shrimp imported to the US and Japan may not exceed 100 ppm. The farm should have a plan or standard operating procedure to maintain sodium metabisulfite residues below action levels of the countries to which they export shrimp. Product labels must include a clear indication if sulfites are used in shrimp post-harvest treatment and processing.

Chemical Use in Transport

Aquatic animals may be transported at any life stage, typically from hatcheries or nurseries to grow-out facilities. This audit clause refers specifically to chemical use in transport of aquatic animals (live or dead) after harvest from farms to processing plants. Chemicals used in transport are sedatives/anesthetics/tranquilizers to reduce aquatic animal metabolic rate, salts for enhanced osmoregulation and handling stress reduction, oxygen-producing chemicals (e.g. hydrogen peroxide), pH buffering chemicals, ammonia control chemicals (e.g. zeolite), and antifoaming agents to improve visibility to allow better observation of aquatic animals. Antimicrobial agents shall not be used during transport from farm to processing plant. All chemicals used during transport shall be approved by government regulatory authorities for application to aquatic animals. A list of such approved chemicals shall be maintained on file at the farm. In addition, a Standard Operating Procedure for aquatic animal transport shall be prepared and available for review during the farm audit.

Antimicrobial Agents Designated as Critically Important for Human Medicine

Antimicrobial agents designated as Critically Important for Human Medicine by the World Health Organization (WHO) shall not be used. Antimicrobial agents designated as Critically Important for Human Medicine by the World Health Organization (WHO) are categorized by meeting two criteria: 1) the antimicrobial class is the sole, or one of limited available therapies, to treat serious bacterial infections in people, and 2) the antimicrobial class is used to treat infections in people caused by either: a) bacteria that may be transmitted to humans from non-human sources, or b) bacteria that may acquire resistance genes from non-human sources.

Critically important antimicrobials include Aminoglycosides (e.g. gentamicin), Ansamycins (e.g. rifampicin), Carbapenems and other penems (e.g. meropenem), Cephalosporins (3rd,4th and 5th generation; e.g. ceftriaxone, cefepime, ceftaroline, ceftobiprole), Glycopeptides (e.g. vancomycin), Glycylcyclines (e.g. tigecycline), Lipopeptides (e.g., daptomycin), Macrolides and ketolides (e.g. azithromycin, erythromycin, telithromycin), Monobactams (e.g., aztreonam), Oxazolidinones (e.g. linezolid), Penicillins (antipseudomonal; e.g. piperacillin), Penicillins (aminopenicillins; e.g. ampicillin), Penicillins (aminopenicillin with betalactamase inhibitors; e.g. amoxicillin-clavulanic-acid), Phosphonic acid derivatives (e.g. Fosfomycin), Polymyxins (e.g. colistin), Quinolones (e.g. ciprofloxacin), and drugs used solely to treat tuberculosis or other mycobacterial diseases (e.g. isoniazid).

Additional Information

US FDA (2017), HACCP Principles & Application Guidelines
https://www.fda.gov/food/hazard-analysis-critical-control-point-haccp/haccp-principles-application-guidelines

Bowker, J.D. and J.T. Trushenski, Editors. 2019. Guide to Using Drugs, Biologics, and Other Chemicals in Aquaculture. American Fisheries Society Fish Culture Section.
https://fishculture.fisheries.org/working-group-on-aquaculture-drugs-chemicals-biologics/wgadcb-resources-tools/guide-to-using-drugs-biologics-and-other-chemicals-in-aquaculture/

WHO (2018), Critically Important Antimicrobials for Human Medicine, 6th Revision, 45 pp.
https://www.who.int/foodsafety/publications/antimicrobials-sixth/en/

WHO (2019), Highest Priority Critically Important Antimicrobials
https://www.who.int/foodsafety/cia/en/

OIE Aquatic Animal Health Code (2019), Section 4 – Disease Prevention and Control
OIE Aquatic Animal Health Code (2019), Section 6 – Antimicrobial Use in Aquatic Animals
https://www.oie.int/international-standard-setting/aquatic-code

OIE (2019), Manual of Diagnostic Tests for Aquatic Animals
http://www.oie.int/en/international-standard-setting/aquatic-manual/access-online

Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (revised in 2017)
http://www.pic.int/

Stockholm Convention on Persistent Organic Pollutants (POPs) (revised in 2017)
http://chm.pops.int/

C. Microbial Sanitation, Hygiene, Harvest and Transport - All Production Systems

Audit Clauses

1.15: Human waste shall be properly collected, treated and disposed of to avoid contamination of farmed aquatic animals and surrounding areas.

1.16: Terrestrial livestock, guard dogs and domestic pets shall not be allowed to access production units/areas unless such animals are subject to veterinary oversight and control and are certified to be free of parasites and other diseases of concern to human or aquatic animal health.

1.17: Human wastes and unpasteurized animal manures shall not be used as fertilizers in and around production units.

1.18: Uncooked whole organisms and their uncooked by-products shall not be used as feed in any production system.

1.19: If chilled at harvest, fish and crustaceans shall be chilled rapidly to an internal product temperature of 4^{o}C or less.

1.20: Ice for chilling harvested products shall be made from water that complies with microbial and chemical limits for potable water or water certified as safe for use on aquatic animals intended for human consumption by government regulatory authorities.

1.21: Equipment and containers used to harvest and transport fish or crustaceans shall be cleaned, sanitized, and free of lubricants, fuel, metal fragments and other foreign material that presents a potential food safety hazard.

1.22: Workers with open wounds, sores or skin infections shall be prohibited from handling harvested products.

1.23: Workers shall be trained in good personal health and hygiene to ensure they are aware of their roles and responsibilities in protecting aquaculture products from food safety risks.

Implementation

The major biological risks of concern to human food safety are pathogenic bacteria and viruses, parasites and biological toxins. Human pathogens may contaminate harvested aquatic animals in farming systems that use inputs such as organic fertilizers or where standards of worker hygiene during production are poor.

Sanitation

Sanitary facilities shall be provided for farm workers, management staff and visitors. Housing for managers or workers sometimes is located near production ponds. Wastewater from bathrooms, kitchens and other facilities shall be collected and stored in septic tanks. Waste oxidation lagoons are also an acceptable treatment method on large farms. Farms with toilets located near canals or waste treatment systems shall not discharge or leak into ponds or farm canals and any deficiencies shall be corrected. At cage farms, workers often spend long hours on floating cage platforms. Portable toilets shall be provided, and sanitary procedures for disposal of wastes onshore shall be established. In all cases, untreated wastewater shall not be allowed to enter ponds or be discharged directly to natural water bodies. Human waste collected in septic tanks or portable toilets shall be removed periodically by trained individuals or specialized contract haulers.

Exclusion of Livestock

In general, terrestrial livestock, guard dogs and domestic pets shall not be allowed free access to production ponds. Fences should be installed to prevent these animals from drinking, wading or swimming in ponds. Farms should provide a water source outside the pond area to discourage livestock from seeking access to ponds for drinking water or heat relief. Runoff from livestock barns and other holding facilities shall not enter ponds.

Access by terrestrial livestock, guard dogs and domestic pets is allowed under specific conditions. All farms are required to conduct a comprehensive contamination risk assessment (see 1.1). With respect to these animals, the risk assessment should consider 1) risks related to livestock species, behavior and physiology, 2) disease risk

from the livestock and potential diseases in relation to aquatic animal or human health, 3) information on any drugs used on the livestock, 4) any actions that could trigger increased interactions between livestock and culture ponds, and 5) the potential risks of animal manure.

Livestock with access to production ponds shall be submitted to veterinary oversight and control and shall be certified to be free of parasites and other diseases. A certified veterinarian should be available to assess livestock health. Livestock that must be treated with veterinary medicines shall be placed in quarantine away from the pond area until the drug has cleared following treatment termination. Whole herd treatment with veterinary drugs is prohibited. Records must show drug treatments administered and quarantine dates associated with treatments

Pond Fertilizers

Some farmers of aquatic animals in earthen ponds will occasionally use organic fertilizers to stimulate a bloom of zooplankton. This practice is acceptable but human wastes and unpasteurized animal manures shall not be used.

Harvested Product Chilling

For aquatic animal products that are harvested and chilled at harvest, products shall be chilled rapidly to 4 ^{o}C or less to maintain product quality and avoid microbial spoilage. 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. Temperature logs during harvest and transport should be kept demonstrating compliance.

Unclean water can cause contamination of aquatic animals during transit from ponds to processing plants or markets. Water used to make ice used to chill aquatic animal products shall be made from water that complies with microbial and chemical limits for potable water (i.e. human drinking water quality) or is certified as safe for use on aquatic animals intended for human consumption by government regulatory authorities.

Harvest and Transport

Equipment and containers used to harvest and transport fish or crustaceans shall be cleaned, sanitized, and free of lubricants, fuel, metal fragments and other foreign material that represent an injury risk or a potential food safety hazard. This equipment should be maintained in good working order and cleaned after each use and inspected for potential food safety hazards prior to each use.

Worker Health and Training

Workers with open wounds, sores or skin infections shall be prohibited from handling harvested products. Workers shall be trained in good personal health and hygiene to ensure they are aware of their roles and responsibilities in protecting aquaculture products from food safety risks. Workers should be trained in the importance of their role in the production of safe aquatic animals, including control of all specific contamination hazards for each farm. Workers responsible for monitoring critical control points should be aware of the monitoring procedures and practices applied to maintain food safety. Training records shall be available for inspection.

Additional Information

WHO/FAO (2012), Code of Practice for Fish and Fishery Products, 2nd edition
http://www.fao.org/3/a-i2382e.pdf

Pillar 2: Social Accountability

A. Legal Rights and Regulatory Compliance - All Production Systems

Audit Clauses

2.1: The farm shall have current and valid documents to prove legal land and water use by the farm.

2.2: The farm shall have current and valid documents to prove all business and operating licenses have been acquired.

2.3: The farm shall have current and valid documents to prove compliance with applicable local and national environmental regulations for farm siting, construction, operation and liability for environmental damage.

Implementation

Laws, regulations, licenses and permits regarding the operation and resource use of farms vary significantly from place to place. Among other requirements, they can call for:

- business licenses
- aquaculture licenses
- land deeds, leases or concession agreements
- land use taxes
- construction or habitat modification permits
- water use permits
- protection of mangroves or other sensitive habitats
- effluent or waste discharge permits
- adherence to veterinary and aquatic animal health regulations
- use of therapeutics and antimicrobial agents
- permits related to non-native species
- introductions or movements of seed (fingerlings, juveniles, post-larvae)
- use of genetically modified or bioengineered organisms
- predator control permits
- well operation permits
- landfill operation permits
- disposal of mortalities
- adherence to environmental regulations (e.g., water quality monitoring)
- environmental impact assessments
- bonds for potential environmental damage.

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 should also become familiar with the legal requirements within the areas they service.

A farm representative, such as compliance officer, shall present all necessary documents to the auditor prior to or during the audit. 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.

B. Local Community Relations - All Production Systems

Audit Clauses

2.4: The farm shall accommodate local residents by not blocking traditional access routes to fishing grounds, wetland areas and other public resources.

2.5: The farm shall manage usage of open-access water resources to avoid restricting the amount of water available to other users.

2.6: The farm shall maintain a favorable general appearance and prevent unnecessary and excessive odors and noises that may be a nuisance to neighbors.

2.7: The farm shall demonstrate constructive interactions with the local community to avoid or resolve complaints or conflicts through meetings, committees, correspondence, service projects or other activities performed at least annually.

Implementation

Access to Public Resources

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. Aquaculture farms are often located in rural areas, where some individuals may rely on local 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. Farms shall not block traditional access corridors to public mangrove areas and fishing grounds. In some cases, it may be necessary to provide a designated access route across the farm. Farm management shall attempt to accommodate traditional uses of coastal resources through a cooperative attitude toward established local interests and environmental stewardship.

During farm visit, 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.

Farm Appearance

Farms shall maintain a neat and attractive appearance to avoid becoming an eyesore to local residents. It should be apparent that buildings and facilities are well-maintained and in keeping with local architecture and landscapes to minimize visual intrusion. Sanitary measures shall be employed to prevent odors from affecting nearby neighbors. No obvious objectionable or foul odors should be present. Machinery shall be maintained in good working order to avoid unnecessary noises that may disturb neighbors.

Community Engagement

Farms should make a good-faith effort to have at least one face-to-face meeting annually with community representatives or with the community at large in an open meeting. Evidence of the effort to hold community meetings can include posters advertising a meeting, email messages to community leaders or representatives, posts on social media platforms and meeting minutes. Other evidence of community engagement or in-kind contributions can include invoices, receipts, signed declarations of donations or contributions to community events, construction of facilities (e.g. a playground), timesheet records of staff volunteering time at community events (e.g. replanting of mangroves), records of the applicant's initiative towards engagement. Farms are encouraged to contribute to the provision of facilities such as access roads, schools, community centers and other tangible and intangible contributions to community cohesion and building social capital. Local community members should have the opportunity and a mechanism or procedure to register complaints.

C. Worker Rights and Employee Relations - All Production Systems

Audit Clauses

General Requirement

2.8: Farms shall operate in compliance with this standard and all local, national, and applicable, ratified international conventions, rules and regulations, whichever provides the highest protection to the worker. Farms shall have in place policies and non-discriminatory procedures pertaining to, but not limited to: worker health and safety and compliance with requirements regarding wages, benefits, hours, hiring practices, minimum age, status of workers, and good employee relations that provide the highest protection to the workers.

2.9: All records of recruitment, compensation, benefits, access to training, promotion and termination shall be separated by sex.

Wages and Benefits

2.10: The farm shall ensure that workers are paid at least the legal minimum wage, or the wage rate established by an employment contract or collective bargaining agreement, whichever is higher. Regular wages and compensation shall cover the workers' basic expenses and allow for some discretionary funds for use by workers and their families.

2.11: The farm shall provide benefits that, at a minimum, are required by local or national law (such as paid holidays, maternity leave, health insurance, paid sick time, etc. as applicable).

2.12: The farm shall not have inappropriate access to the worker's bank account. Payment of wages shall not be made to someone other than the worker or into an account not controlled by the worker, unless otherwise required by law.

2.13: The farm shall issue wages directly to workers and not withhold or delay or make irregular payments. All wage payments shall be documented. A record of wage payment (such as a pay slip) shall be provided to the worker and include itemized detail of all benefit provided and deductions made.

Working Hours

2.14: The farm shall abide by the mandatory national work week, and where that is absent, an average work week of no more than 48 hours. The specific timing and organization of the working day may be agreed in a voluntary agreement between farm owners/management and workers.

2.15: Overtime shall not exceed 12 hours per week except as permitted by national law and agreed to between the facility and workers in a voluntary contractual agreement. The facility shall demonstrate any overtime that exceeded 12 hours per week only occurs under exceptional circumstances with due measures taken to ensure workers' health and safety during overtime work.

2.16: The farm shall not terminate a worker's contract for refusal to work overtime or deploy any other detriment for noncompliance.

2.17: Farms shall comply, at a minimum, with national laws regarding meal and rest breaks during work shifts. Farms shall respect the right to a rest day after six consecutive days worked.

2.18: Documentation of the time each worker starts and finishes each workday shall be accurately recorded and accessible to both farm managers and each worker.

Forced, Bonded, Indentured, Trafficked, and Prison Labor

2.19: All work, including overtime, shall be voluntary, and shall not be under threat of any penalty or sanctions.

2.20: The farm shall not engage in any form of forced or indentured labor. This includes human trafficking, use of prison labor, the confiscation or holding of original identity papers and other valuable possessions, prohibiting workers from leaving the premises after their shift or other means of 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 workers upon request and readily available to them at all times.

2.21: Bonded labor shall be prohibited. The farm shall not require the payment of deposits, bonds or other financial or collateral guarantees that may result in debt bondage. This includes recruitment fees, fines,

and deductions from wages, and withholding of pay that are not part of a written contractual agreement with the worker.

2.22: Workers shall have the right to leave the premises after their work shift. Workers shall also have the right to terminate their employment after reasonable notice. The farm shall not otherwise unreasonably restrict workers' freedom of movement including but not limited to surveillance during rest or non-work hours, during transportation, in dormitories provided by the farm.

Child Labor and Young Workers

2.23: The farm shall not engage in or support the use of child labor. The farm shall comply with local child labor laws regarding minimum working age, or the age of compulsory education, or the ILO Minimum Age Convention 138, whichever is higher. Although the ILO Minimum Age Convention 138 states that the minimum age shall be 15, local law of minimum age of 14 may apply if it is in accordance with developing nation's country exceptions under this convention. Records shall be collected, verified and retained to verify age requirements are met.

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

2.25: Young workers (above the minimum age but under 18 years old) shall not be subjected to conditions which compromise their health, safety, or moral integrity, or which harms their physical, mental, spiritual, moral or social development. This includes restrictions on working hours and prohibiting night work and hazardous work.

2.26: The farm shall have in place procedures for support to anyone identified as a child laborer on the farm. Depending on the age of the child, support must include at a minimum removal and reintegration into education (for children below the minimum age and/or children who have not completed basic education and/or changing job functions for young workers above the minimum age to non-hazardous tasks).

2.27: The farm may accept young people into trainee and apprenticeships programs in accordance with national regulations and provided the young person has completed compulsory education and that the young person receives adequate training and supervision at all times.

Hiring and Terms of Employment

2.28: The farm shall only employ workers with a legal right to work in the country, whether national citizens or migrants. Work performed and terms of employment shall be in compliance with local, national law or international labor standards, whichever is stricter. Records shall be collected, verified and retained to document right to work documents.

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

2.30: The farm shall not use contractors, subcontractors, temporary workers, homeworkers, apprentices or other non-full-time employment schemes to avoid the payment of social security and other benefits required by local or national law under a regular employment relationship.

2.31: All labor recruiting agencies or employment services used by the farm must be licensed to operate by the local or national government as a labor provider. Workers shall not be subject to recruitment practices that utilizes threats, penalties, coercions, physical force, or fraud.

2.32: The farm shall provide to all workers, prior to hire and during employment, with written and understandable information regarding the terms and conditions of employment, worker's rights, benefits, compensation, expected working hours, details of wages for each pay period each time they are paid; and farm policies regarding disciplinary actions, grievance procedures, any authorized deductions from pay, physical work requirements, environment and housing, and workplace safety. This information shall be provided in the appropriate language of the employees. This requirement shall apply to all workers

regardless of status, including but not limited to hourly, salary, piece rate, temporary and seasonal workers.

2.33: Where contracted/subcontracted or temporary workers are hired through a labor recruiting agency, the farm shall ensure that these services provide 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.

2.34: The farm shall document the agencies used to recruit, hire, and/or employ workers, in addition to any known fees paid by or debts accrued by workers in order to secure employment.

2.35: If provided or mandated by the farm or employment agency/labor agency, worker housing shall meet local and/or national standards. Such housing conditions shall include at minimum, ensuring that structures are safe and watertight, that space is adequate as per occupational load for the buildings, and that heating/ventilation/cooling, pest control, sink, shower and toilet facilities are provided.

Discrimination, Discipline, Abuse and Harassment

2.36: The farm shall provide for equal opportunity with respect to recruitment, hiring, terms of employment, compensation, access to training, promotion, termination and retirement.

2.37: The farm shall not engage in or permit discrimination in any aspects of employment, including but not limited to recruitment, hiring, compensation, terms of employment, discipline, access to training, promotion, termination, or retirement on the basis of race, color, gender, national origin/ heritage, religion, age, nationality, social or ethnic origin, maternity, sexual orientation, political opinion, disability or any other status. There shall be no discrepancy in wages and benefits between men, women, ethnic or religious groups for equal qualifications, experience and/or responsibilities. Terms and conditions of employment shall be based upon the ability to do the job, not on personal characteristics or beliefs.

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

2.39: The farm shall not terminate workers for pregnancy, subject workers to pregnancy or virginity testing, force the use of contraception, or reduce wages after maternity leave.

2.40: The farm shall have a written disciplinary procedure made available in appropriate language of the workers. Records shall be maintained of all disciplinary actions.

2.41: The farm shall have a written worker grievance process/procedure and make it available to all workers, that allows for the anonymous reporting of grievances to management without fear of retaliation.

2.42: The farm shall have in place an established complaints and remediation system to handle cases and allegations of sexual abuse/harassment, bullying, or discriminatory practices. This process shall, at a minimum, include a confidential reporting mechanism, information on any hotlines or other outside support services available and the possibility of calling in independent assessment/arbitration.

2.43: The farm shall have the information regarding hotlines, competent authorities, and other resources for victims of labor rights abuse displayed prominently for easy access to workers.

Freedom of Association and Collective Bargaining

2.44: Workers shall have the right to associate, organize, and bargain collectively (or refrain from doing so) without the need of prior authorization from management. Farms shall not interfere with, restrict, or prevent such activities and shall not discriminate against or retaliate against workers exercising their right to representation in accordance with international labor standards.

2.45: Where the right to freedom of association and collective bargaining is prohibited or restricted under local law, the farm shall not prevent alternative means to facilitate worker representation and negotiation (for example, the election of one or more workers by other workers to represent them to management).

Worker Health and Safety

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

2.47: The farm shall have a sufficient number of toilets for men and women in compliance with local and national laws. These shall be readily accessible to workers and kept in good repair.

2.48: The farm shall designate a management person responsible for managing worker health, safety and training.

2.49: The farm shall identify, prevent, eliminate or minimize any workplace health and safety hazards. This includes a requirement for documenting incidents, and investigations of accidents and their cause and correction.

2.50: An Emergency Response Plan shall be prepared for serious illnesses, accidents, natural disasters or other incidents.

2.51: Select workers shall be trained in the details of the Emergency Response Plan and in first aid to include electrical shock, profuse bleeding, drowning, boat accidents and other possible medical emergencies. A list of the trained workers shall be available.

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

2.53: Personal protective gear and equipment (e.g., eye protection for welding, gloves for shop work, boots for wet areas, life jackets on boats) in good working order and in alignment with local laws and work conditions shall be provided to and used by workers based on an assessment of workplace risks.

2.54: Electrical pumps and aerators shall be connected to power supplies according to standard safe procedures that include proper wiring, grounding of cables, and coverage of circuit boxes. Machinery shall have proper driveshaft and/or drivebelt safety guards.

2.55: The farm shall provide training in personal health and hygiene to promote worker health and safety at least annually.

2.56: The farm shall have a training program to ensure workers that handle or are exposed to antimicrobial agents, agricultural chemicals, fuels, or other toxic substances that represents a physical, human health, food safety or environmental hazard are properly trained in their safe use.

2.57: The farm shall have in place a policy that workers can refuse to work in an unsafe environment, without disciplinary action being taken against the worker.

2.58: If applicable, the farm shall comply with laws that govern diving on aquaculture facilities and develop a written Dive Safety Plan that documents procedures for safe diving, response to diver emergencies, and equipment maintenance. Limits for time under water shall be established and monitored through diver logs. Diver safety training is required.

2.59: If the farm requires boat usage, the farm shall provide written procedures and staff training for the safe operation of boats to avoid accidents and the risk of drowning.

Implementation

Worker Rights and Employee Relations

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.

Certified farms must comply with local and national labor laws, including those related to young workers, overtime pay and compensation, worker safety, and where applicable, on-site living conditions. Auditors shall take into account national and local regulations, however, if the law differs from a BAP requirement, the provision that provides the greatest protection to the worker applies. Recommendations of the International Labor Organization (ILO) should be used as a normative reference when local and national legislation regarding worker/employee safety, wellbeing and rights is not sufficiently comprehensive in comparison.

Certified farms must demonstrate compliance through worker contracts, documented method of payment, timesheets, disciplinary records, and piece rate records, among others. Farms must maintain policies related to working hours, benefits, anti-discrimination, and remediation for anyone identified as a child worker. In addition, farms should maintain thorough records regarding their labor supply chains including recruitment agency agreements, any fees paid by the worker, and the legal status of each worker. Age documentation for every worker should also be maintained and available at the time of the onsite audit. When hiring foreign workers, farms shall require documentation of legal status. Records shall be maintained of all disciplinary actions, worker grievances and mediation. Records of disciplinary actions should document the date, time, personnel involved, evidence reviewed, and disciplinary action taken, and corrective actions to address the issue. Workers should sign the record to indicate awareness. These records should be available to the auditor.

The principal of equal opportunity shall be adhered to throughout this section of the Standard. All records of recruitment, compensation, benefits, access to training, promotion and termination shall be disaggregated (separated) by sex. Men and women shall receive equal pay for similar tasks.

Living quarters shall be well ventilated and have adequate shower and toilet facilities. Meals, where provided for workers, shall be wholesome, with food storage and preparation done in a responsible manner. Trash and garbage shall not accumulate in living, food preparation or dining areas.

During farm inspection, the auditor will evaluate whether farms comply with labor laws. The auditor will select a random sample of workers to interview to obtain information about wages, safety and living conditions.

Worker Health and Safety

Workers should be provided with:

- Knowledge and skills needed to do their work safely and avoid creating hazards that could place themselves or others at risk.
- Awareness and understanding of workplace hazards and how to identify, report, and control them.
- Specialized training, when their work involves unique hazards.

Staff and workers shall be given initial orientation training as new workers as well as refresher training on safety in all areas of farm operations. Farms should take the approach that workers have a “right to know” about worker safety and hazardous conditions associated with employment. Training programs should be accurate, credible, clear and practical. Training materials should be prepared by qualified individuals and updated as needed. Trainers should have a general safety background or have practical experience in safety or be a subject matter expert. Training programs must be clear and presented in terms understandable by workers. Training programs should be useful to workers, with demonstrated application on the farm.

Workers shall 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. Training should be provided on response to natural disasters such as severe floods and tropical cyclones.

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. Use of personal protective gear and equipment should align with local conditions and local dress customs. However, these conditions and customs should not preclude use of personal protective gear when the job or task requires their use.

Farms that use divers to clear sludge from pond bottoms or perform other underwater tasks shall develop a written Dive Safety 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 sulfites are used during harvesting, procedures shall be adopted to minimize health risks to workers. Workers shall also be aware of their roles in producing safe food. Workers should be provided with information about controlling hazards that could compromise food safety during production of aquatic animals. Workers should

be aware of their roles and responsibilities in monitoring any critical control points to maintain food safety during production. Workers should be aware of the role of their personal health and hygiene in maintaining the food safety of aquatic animals produced on the farm.

Additional Information

ILO Conventions and Protocols (www.ilo.org)

- Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87)
- Right to Organise and Collective Bargaining Convention, 1949 (No. 98)
- Workers' Representatives Convention, 1971 (No. 135)
- Collective Bargaining Convention, 1981 (No. 154)
- Forced Labour Convention, 1930 (No. 29)
- Protocol of 2014 to the Forced Labour Convention, 1930 (No. P029)
- Minimum Age Convention, 1973 (No. 138)
- Equal Remuneration Convention, 1951 (No. 100)
- Discrimination (Employment and Occupation) Convention, 1958 (No. 111)
- Employment Policy Convention, 1964 (No. 122)
- Protection of Wages Convention, 1949 (No. 95)
- Occupational Safety and Health Convention, 1981 (No. 155)
- Safety and Health in Agriculture Convention, 2001 (No. 184)
- Migration for Employment Convention (Revised), 1949 (No. 97)
- Migrant Workers (Supplementary Provisions) Convention, 1975 (No. 143)
- ILO Declaration on Fundamental Principles and Rights at Work and its Follow-up (1998, rev. 2010)
- ILO Declaration on Social Justice for a Fair Globalization (2008)

Occupational Safety and Health Administration (OSHA, 2016). Recommended Practices for Safety and Health Programs https://www.osha.gov/shpguidelines/education-training.html

Pillar 3. Environmental Responsibility

A. General Implementation Guidance - All Production Systems

Environmental Impact Assessment and Management Plan

The BAP Environmental Responsibility pillar includes audit clauses that are specific to manage what are identified and considered to be the most important environmental impacts. However, every farm and the environment in which it is embedded is different. Environmental impacts and their management will vary with type of production system (e.g. ponds, net pens, flow-through systems, RAS), production system intensity and, to a lesser extent, species farmed. Thus, management plans should be flexible and responsive to address the impacts identified for a particular farm.

Some of the potential issues that may be considered in an Environmental Impact Assessment and Management Plan may include:

- Location of farm with respect to wetlands or sensitive habitats
- Quality of waters receiving farm wastes
- Salinization of local areas near farm
- Environmental capacity of water bodies receiving farm wastes
- Characteristics of sediments beneath net pens
- Use of chemicals and drugs
- Disease transmission between wild and farmed fish
- Disposal of mortalities
- Use of non-native species
- Escapes from culture systems
- Impacts on biodiversity, especially threatened and endangered species
- Conflicts with other resource users
- Impacts on cultural and recreational resources
- Resource use (i.e., water, land, energy, feed ingredients)

Every BAP-certified farm should conduct an assessment that identifies the impacts from construction and operation of the farm to the surrounding environment. The identification and assessment of the type, magnitude and extent of environmental impacts is the first step in developing options for impact management. The Environmental Impact Assessment need not be formal or conducted by an independent third party. Some farms may be required to conduct a formal Environmental Impact Assessment by government regulatory agencies as a condition of permitting.

Although aquaculture production has global-scale environmental impacts, the main focus of the Environmental Impact Assessment and Management Plan should be on local- to regional-scale impacts. The emphasis should be on impacts and management during farm operation, although impacts of farm construction should also be considered for new farms. Stakeholder consultation during and communication after the environmental impact assessment process is strongly encouraged.

The farm should develop an Environmental Management Plan that describes procedures to monitor and control farm impacts and provide evidence that the plan is operational and effective. The Environmental Management Plan should include the following elements:

- Description of an environmental quality baseline based upon available science that indicates the sensitivity of the environment to the impacts identified.
- Identification of significant but easily identifiable impacts and environmental issues of concern at the production site with an estimation or prediction of the magnitude, spatial extent, duration and frequency of occurrence of each impact.
- Impacts to any nearby ecologically sensitive areas (e.g., freshwater and marine wetlands, mangrove forests, seagrass beds, coral reefs, salt marshes, tidal flats) should also be identified. The significance of each impact

should be evaluated and assessed. For significant, high-risk, or irreversible impacts, a more comprehensive impact assessment should be conducted.

- Identification and quantification of inputs and outputs of production, emissions to water, and resource use (land, water, fishmeal, etc.). The contribution of inputs, outputs, emissions and resource use to eutrophication, water stress, and resource depletion should be estimated using appropriate methods.
- For each impact identified, a description of actions that will be taken to reduce, mitigate or manage the impact.
- Description of the environmental monitoring and reporting system that will be followed.
- Specification of the time interval between internal reviews of the risk assessment and management plan.

An environmental manual should be compiled that includes the documents and standard operating procedures used to address each environmental impact. Each section should describe the procedures for management of each impact. Include training materials for workers. A team to implement the management plan should be organized. An employee or worker responsible for implementation of the plan should be identified and other responsibilities assigned as appropriate. Regular internal meetings should be held to assess the current situation and such meetings should be documented, with document review by auditors.

Additional Information

FAO (2009). Environmental impact assessment and monitoring in aquaculture. Requirements, practices, effectiveness and improvements. FAO Fisheries and Aquaculture Technical Paper 527.
http://www.fao.org/3/i0970e/i0970e00.htm

B. General Requirements

Audit Clauses

3.1: Farms shall calculate environmental loading indices for total nitrogen and total phosphorus based on data collected on production system type, feed conversion ratio and water exchange.

3.2: The farm shall keep records of annual direct energy (fuel and electricity) consumption.

Implementation

Environmental Loading Indices

Environmental loading indices can be used to estimate the eutrophication (pollution) potential of aquaculture production and are more indicative of the pollution potential of farm effluents than separate measurements of concentrations of effluent water quality variables and effluent volume. Environmental loading varies widely, depending on type of production system, production system intensity and any waste treatment technology or approaches (e.g. sedimentation) deployed to reduce waste loading to the environment. Fundamentally, environmental loading is estimated by multiplying effluent volume by effluent nutrient concentration and then dividing by fish or shrimp production. Thus, regular measurements of each of these variables is required, as dictated by production system. Estimates of water use and effluent volume can be derived from water pump station logs, weir measurements and flow meters. Recordkeeping for estimation of effluent volume should be demonstrated. Similarly, a recordkeeping system for the concentration of total nitrogen and total phosphorus in effluent should be demonstrated. Examples of environmental loading calculations for different production systems are provided in Appendix A. Environmental loading indices should be calculated for each crop completed in a calendar year, expressed as an annual average and range (minimum, maximum).

Direct Energy Consumption

Direct consumption of energy on farms is used primarily for water pumping and mechanical aeration but is also used to operate other farm equipment (e.g. tractors and vehicles) and farm support activities (e.g. electricity for office equipment, lighting, etc.). Farms are required to keep records of their direct annual energy use, based on

fuel (L/yr) and electricity consumption (kWh/yr). These data will be anonymized and compiled by BAP to gauge industry performance and enable the setting of future standards for energy efficiency. Improvements in energy efficiency will contribute to reducing CO_2 emissions per ton of fish or shrimp produced.

C. Effluent Management - Ponds, Non-Coastal Flow-through Systems and Recirculating Aquaculture Systems

This section applies to effluents from 1) earthen or lined ponds, irrespective of production intensity or salinity, 2) freshwater flow-through systems (e.g., trout raceways), and 3) recirculating aquaculture systems (RAS). It does not apply to 1) cage culture in freshwater or brackishwater water bodies (see Section E), 2) net pen culture in marine or estuarine environments (see Section F) or 3) coastal flow-through facilities (see Section F).

Audit Clauses

3.3 Effluent Compliance Options

3.3.1: Effluent water quality from ponds, flow-through and recirculating aquaculture systems shall comply with BAP Effluent Water Quality Criteria (Appendix B) or applicable regulations if they are equivalent or more rigorous.

3.3.2: Farms that can demonstrate that water quality at the edge of the mixing zone (samples taken nearby and down-current of discharge) and outside the mixing zone (samples taken nearby and up-current of discharge) does not deteriorate.

3.3.3: Farms that use source water with individual water quality variables that exceed limits established as BAP Effluent Water Quality Criteria. In this case, concentrations of those variables shall reflect no deterioration between intake and discharge of the relevant variable. For variables of source water that do not exceed BAP Effluent Water Quality Criteria, compliance with these effluent criteria is required. Values of influent water quality variables shall be recorded.

3.3.4: Farms that demonstrate water reuse, only occasional water exchange and no intentional discharge of effluents into natural water bodies during grow-out, such that less than 1% of the culture water volume is exchanged daily on an annual basis and discharged to a receiving watershed.

3.3.5: Farms that undertake a formal Environmental Impact Assessment, conducted by a qualified third-party, that includes a favorable assessment of assimilative capacity of the receiving water body and an Environmental Management Plan.

3.3.6: Farms that operate within a freshwater irrigation system such that effluent water is exclusively destined to irrigate agricultural crops.

3.4: Records and summaries of the volume of farm intake water use shall be maintained and available.

3.5: The farm shall take effective measures to control erosion and other impacts caused by culture unit outfalls.

3.6: 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.

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

3.8: If a farm produces more than 20 mt of aquatic animals per hectare per crop, the farm shall maintain sufficient sedimentation basin capacity or implement other technical or engineering solutions to capture at least 50% of the biosolids produced from feeding.

3.9: Any accumulated sludge removed from ponds, reservoirs or sedimentation basins shall be confined within the farm property, consolidated and used locally for landfill or agriculture, or some other technical or engineering solution applied to reduce sludge volume (e.g. biogas digestor). Collected sludge/sediment shall not be placed in sensitive wetland or mangrove areas, or in public water bodies.

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

3.11: If sulfite is used during shrimp harvest, solutions shall be deactivated or neutralized, for example by 48-hour retention, prior to release into natural water bodies.

Implementation

Best Management Practices for Pond Effluents

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.

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

If best management practices to improve water quality or reduce effluent volume are not sufficient to meet the BAP Effluent Water Quality Criteria, a settling basin should 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 Monitoring and Management

The intention of this standard is that all pond- and other land-based farms, irrespective of salinity, demonstrate that effluent of good quality, as defined by the BAP Effluent Water Quality Criteria, is discharged to receiving waters. The water quality criteria also assure that the effluents from aquaculture facilities have no greater concentrations of pollutants than typically allowed for effluents from other point sources. To confirm compliance with BAP water quality criteria at farms, the auditor will review the written effluent sampling and analysis protocols used by the farm. These protocols should conform to the guidelines outlined in Appendix B. Analysis should be done by an independent laboratory that uses standard methods as published by the American Public Health Association, American Water Works Association and Water Environment Federation – http://www.standardmethods.org. Any on-farm water quality laboratories will be inspected during an audit. If effluents are released regularly (more frequently than weekly), farms shall maintain records for effluent data. (See sample form in Appendix C).

At least 3 months of effluent data are required for initial farm certification, including those variables that are to be recorded quarterly. for each variable measured monthly, at least 10 of the values obtained during a 12-month period shall comply with the criteria, provided the 12-month average of the monthly data remains below the BAP limit for each variable. For variables measured quarterly, only one non-compliance is permitted for each

variable during a 12-month/4 quarter period, provided the average of the quarterly data remains below the BAP limit for each variable. When non-compliances occur, farms should make every effort to correct the problems within 90 days.

In recognition of the diversity of production system types and intensities, this standard provides several options and exemptions to achieve conformity. These options should demonstrate that application of good management practices is effective in reducing the volume and improving the quality of farm effluents.

Mixing zone

When effluents are discharged, the effluent plume interacts with the receiving waters, which vary widely in quality and movement patterns. Exchange of the receiving waters with adjacent larger water bodies also varies widely. In high water exchange environments, mixing and dilution may be rapid. In more static receiving waters, a distinct zone of influence of farm effluents can be easily identified. The mixing zone option allows farms to achieve conformity with 3.3 by demonstrating that water quality inside and outside the mixing zone does not differ, even though the effluent water quality exceeds BAP Effluent Water Quality Criteria for some variables. This requires identification of sampling locations upcurrent and downcurrent of discharge and regular monitoring of effluent water quality. A review of the sampling program and effluent and mixing zone water quality records and inspection of sampling sites will be conducted during the farm audit.

Source water quality

Some farms may use surface waters from streams, rivers, lakes or estuaries as source water for fish or shrimp production. On occasion, the concentration of some of the water quality variables in the source water exceeds the limits for effluents as defined in the BAP Effluent Water Quality Criteria. For those variables, farms shall demonstrate that there is no deterioration in water quality between intake and discharge points. Specifically, farms shall demonstrate that there is no increase in concentrations of total suspended solids, soluble phosphorus, total ammonia-nitrogen, 5-d biochemical oxygen demand and no decreases in dissolved oxygen concentration. This option does not apply to pH and chloride concentration. For those variables that do not exceed BAP Effluent Water Quality Criteria, compliance with these criteria is expected and required. To demonstrate no deterioration in water quality between and intake and discharge, water quality variables at both points shall be measured and records available for inspection. Samples must be collected according to the frequencies stated in Appendix B.

Low water exchange rate systems

The mass discharge of nutrients and organic matter from ponds and other land-based production systems is the product of concentration multiplied by effluent volume. As a practical matter, it is much easier to reduce mass discharge by reducing effluent volume. In recognition of this, an exemption to meeting BAP Effluent Water Quality Criteria is established for farms that limit the volume of effluent discharged. Farms that qualify for this exemption shall demonstrate water reuse, only occasional water exchange and no intentional discharge of effluents into natural water bodies during grow-out, such that less than 1% of the culture water volume is exchanged daily on an annual basis and effluent is discharged to a receiving watershed. An estimate of the total water volume used in production of aquatic animals shall be reported. Records indicating the volume of effluent discharged shall be available for review during the farm audit. Farms qualifying for this exemption are required to report an annual effluent discharge volume. An estimation of annual effluent volume, water use and nutrient load indices shall be determined as described in Appendix A. Farm intake water volume shall be recorded monthly.

Environmental Impact Assessment

Some farms may be required to undertake a formal Environmental Impact Assessment (EIA) as a condition of operational permitting by government regulatory agencies. Farms may also choose to undertake a formal EIA voluntarily. Such an assessment must be conducted by a qualified professional individual or organization with no affiliation with the farm. Suitable qualifications of the technical expert that conducts the EIA include 1) holding environmental assessment certificate or license, 2) registration as an environmental assessor, 3) having three years

of experience and a portfolio of EIAs, or 4) being an employee of an environmental consulting firm with capacity to undertake EIAs. Formal EIAs will address a range of environmental impacts, including the discharge of effluents. Management of impacts will be described in an Environmental Management Plan, which is part of the EIA. The EIA must also include an assessment of the capacity of the receiving water body to assimilate farm effluent and justify a determination that farm effluent discharges will not result in exceeding the assimilative capacity of receiving waters.

Crop Irrigation

Farm effluents are typically released to public waters. However, some farms may draw from and discharge water to irrigation canals. Nutrients contained in these aquaculture farm effluents may be beneficial if applied to irrigate crops. Farms that operate within a freshwater irrigation system such that effluent water is exclusively destined to irrigate agricultural crops are exempt from monitoring effluent water quality. Use of water from irrigation systems shall be in accordance with regulations and effluents shall be returned to the irrigation system. Farms claiming this exemption shall provide maps and measurements of effluent volumes that verifies that all effluent water is being used for crop irrigation.

Erosion Control

When effluent is released from ponds, the energy from the flowing water can impact adjacent embankments and cause scouring of drainage canals or ditches. Effluent should be released from ponds in a controlled manner to limit the water velocity to a level that will not cause scouring and erosion. Drainage pipes should extend at least 1 m beyond the base of pond embankments. Drainage pipes should release water at an elevation near the bottom of the drainage canal. The drainage outlet area should be protected with a splash shield or a layer of stones (riprap) or concrete armor 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. A sample of drainage structure outlets will be inspected during the farm audit.

Seepage Control

Construction of ponds in areas with permeable soils, typically containing a high proportion of sand, is undesirable because more water is required to maintain operational water levels. Furthermore, seepage water will contain nutrients and salts that may contaminate groundwater aquifers or adjacent surface waters. Fundamentally, seepage control is a site selection issue and thus the best approach is to prevent seepage by avoiding construction of ponds in areas with permeable soils. There are a number of options to control seepage, including installation of plastic liners or mixing native soils with clay, followed by compaction. Evidence must be provided to demonstrate that the soil type is suitable for pond aquaculture. Examples include soil maps or results of soil permeability testing. For permeable soils, the presence of a liner will indicate conformity with this standard.

Salinization

Some inland shrimp farms use brackish groundwater as a water source or may import concentrated brine from coastal salt ponds. Discharge of this water into low salinity receiving waters can cause salinization of those waters or the soils and wells of nearby agricultural crop farms that draw from those surface waters. Several practices can be adopted to reduce 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. Saline water should not be discharged into freshwater areas. Excessive pumping of groundwater from freshwater aquifers should be avoided and freshwater from wells should not be used to dilute salinity in grow-out ponds. 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.

For farms supplied by naturally saline groundwater with over 550 mg/L of chloride, pond effluent should be captured in a reservoir and reused. If brackishwater ponds are drained into a freshwater stream, the water

should be discharged when stream flow is high. The water should be discharged slowly to avoid increases in chloride concentration greater than 250 mg/L in the receiving water body. To determine if salinization is occurring, monitoring of chloride concentration in nearby (within 1 km) groundwater wells and surface waters must demonstrate that chloride concentrations are not increasing as a result of discharges of brackishwater effluent.

On inland shrimp farms, runoff from spoil piles of saline sediment onto non-saline soil or into freshwater can cause salinization. Saline sediment should be confined to prevent overflow after rainfall events. The confinement structures should be large enough to hold the largest amount of rainfall expected within any 24-hour period over 25 years. If the soil is highly pervious, downward seepage can result in salinization of freshwater aquifers. In this case, the confinement area must be lined to prevent seepage. When sediment is disposed of outside the immediate farm area, it should 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 area must not cause harm in adjacent areas. Once sediment is leached of salt by rainfall, it can be disposed of by using as construction fill or for other purposes.

Sediment and Sludge Management

Most aquaculture ponds have long hydraulic retention times and solids generated during production from feeding will settle and to some extent be treated on the pond bottom. However, 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, uneaten feed, and dead algae and mineral particles from source water, if rivers and streams are used, and scoured from embankments or resuspended from the pond bottom.

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 water supply canals and production ponds.

Sediment accumulation in ponds and canals can be reduced by:

- implementing proper earthen infrastructure design and construction to reduce erosion by rainfall and water currents,
- placing aerators to avoid impingement of water currents on embankments that cause scouring,
- placing a layer of large stones (riprap) or other lining materials in erosion-prone areas, and
- covering bare areas of embankments with gravel or grass.

Discharge of sludge may not be an issue for ponds with production of less than 20 mt/ha per crop, but above this threshold, sedimentation basins for sludge storage are needed. 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 this equation, fish production is the total quantity of fish produced in all ponds that discharge into a sedimentation basin, and sludge transfers are the mean frequency at which sludge is moved from ponds to a 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.

If sludge is removed more frequently from ponds, the required size of the sedimentation basin can be reduced.

For farms producing more than 20 mt/ha per crop, 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 surface at one end of the basin and the resulting effluent exits at the surface at the other end of the basin. Five or six calibrated poles should be installed in basins to allow the accumulation of settled solids to be monitored and ensure the available capacity can always support a minimum six-hour hydraulic retention time.

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.

Any accumulated sludge removed from ponds, reservoirs or sedimentation basins shall be confined within the farm property or consolidated and used locally as fill material or for agriculture. Pond sediment from bank erosion can usually be reused to restore the slope of eroded pond embankments. Sludge or sediment shall not be applied to sensitive natural wetlands or wetland buffers. 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. When sediment is stored, it shall be confined within a diked area so that solids resuspended by rainfall can be retained. The sediment can also be spread in a thin layer over the land and vegetative cover established. If dredged accumulated sediment is disposed of outside water-holding structures, care shall be exercised to prevent the formation of spoil piles that can cause ecological disruption through erosion and transport to surrounding areas.

Sulfite Treatment

Immediately after harvest, shrimp are often treated with sodium sulfite or sodium metabisulfite to preserve product quality by preventing spotting (melanosis). Typically, shrimp are dipped into a bath of ice water and then another bath of chilled metabisulfite. The concentration of metabisulfite ranges from 6 to 15 percent, depending on shrimp size. If shrimp are treated on farm at harvest with sulfites, the protocol for this practice shall be provided during the audit. The protocol should include the specifics of sulfite use to preserve shrimp product quality and disposal of used solutions. Sulfite should be used according to specifications provided in the product's Material Safety Data Sheet that should be maintained on file.

Used sulfite solutions can cause localized dissolved oxygen depletion in the water bodies into which it is discharged. Solutions should be held in a tank or small pond until the sulfites have oxidized completely, typically for at least 48 hours. Sulfite oxidation can be accelerated by providing mechanical aeration. When the dissolved oxygen concentration of the solution reaches 4 or 5 mg/L, the sulfite has been completely converted to sulfate. To neutralize acidity, sulfite solution can then be treated with 0.4 kg lime/L before final release into natural waters.

D. Habitat Protection and Site Selection - Ponds and All Other Land-based Systems

Audit Clauses

3.12: New farms shall not be located in mangrove forests, sensitive wetlands or any other critical or vulnerable habitats.

3.13: New farms shall not result in the loss of critical habitat for endangered or critically endangered species.

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

3.15: If net loss of wetland habitat occurred on farm property since 1999, the loss shall have been mitigated by restoring an area three times as large with the equivalent diversity of native species or by an equivalent donation to measurably successful restoration projects.

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

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

3.18: Dredged material shall be properly contained and not placed in mangrove areas, natural water bodies, or other sensitive habitats.

3.19: Farm operations shall not cause vegetation at the farm perimeter to die off.

3.20: Farm operations shall not permanently impede the flow of fresh water in watersheds, and the normal flow of brackish water to mangroves or fresh water to wetlands, unless specific permits apply.

3.21: If a farm extracts groundwater, water levels in nearby wells shall be monitored at least annually during the dry season to establish that aquaculture does not result in reducing the water table below historical levels of normal seasonal variation.

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

Implementation

Sensitive or Critical Habitats

For the purposes of this standard, wetlands are defined as areas that are inundated or saturated by surface or groundwater 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 applies to new farms and does not apply to farms that were constructed in former wetland habitats that were converted or lost prior to the publication of the Global Seafood Alliance's Codes of Practice for Responsible Shrimp Farming in 1999. New farms may not be constructed in sites designated in the Ramsar Convention on Wetlands of International Importance.

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. 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. Dredge and fill operations shall be restricted to areas within the farm boundaries.

Construction and operation of new farms shall not result in the loss of critical habitat. Critical habitat, as defined by the International Finance Corporation (2012), is "any area of the planet with high biodiversity conservation significance based on the existence of habitat of significant importance to critically endangered or endangered species, restricted range or endemic species, globally significant concentrations of migratory and/or congregatory species, highly threatened and/or unique ecosystems and key evolutionary processes." Critical habitat for species classified as Endangered or Critically Endangered according to the IUCN Red List of Threatened Species

or any species on the list by the Convention on International Trade in Endangered Species (CITES) of Wild Fauna and Flora shall not be lost by construction and operation of new farms. New farms shall not be constructed in legally protected areas, particularly IUCN Protected Area Categories I through IV.

Allowable Wetland Transformation and Restoration

For farms constructed before 1999, some loss of wetland habitat after that year is allowed, but only for specific purposes. If a farm operation requires access to water resources, wetland habitat transformation and removal of wetland vegetation shall only be allowed for the installation of inlet and outlet canals, pump stations and docks. Wetlands removed for such purposes shall be mitigated by restoring a wetland area that is three times the size of the area removed using a wetland plant community that is representative of the area. Wetland restoration is allowable only if permitted by local or national regulatory authorities.

Farms constructed in former mangrove or wetland areas are encouraged to demonstrate environmental stewardship by re-establishing mangrove or wetland vegetation. However, many farms may not own or have access to suitable habitat and to the expertise needed to develop wetland restoration projects. Thus, the most reliable mitigation approach is to contribute to mangrove or wetland rehabilitation projects. 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, with an appropriately diverse wetland plant community, and continues to be healthy at subsequent audits. In cases where the auditor is not 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 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 that die-off is the result of farm operations. If it is, a warning will be issued and the deficiency shall be corrected as a condition of continued certification. Wetland removal for purposes other than those identified previously (for inlet and outlet canals, pump stations and docks) or failure to mitigate allowable removal will result in loss of certification.

Hydrological Alteration

Water is an obvious input for aquaculture farms. In general, farms should operate in a way that normal surface water flows and groundwater aquifer levels are maintained within the range of natural variation. Hydrological conditions shall not be altered in a way that deprives water that leads to the loss of wetland vegetation or causes erosion and sedimentation where farm drainage canals meet natural water bodies (i.e. streams, rivers, estuaries). To demonstrate compliance, farms shall provide maps indicating natural water flows and how these flows are affected by farm construction and operations.

In freshwater floodplains, excessive pond construction 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 floodplain. The problem usually can be avoided if no more than 40% of the floodplain is blocked by pond embankments. Maps should be provided to demonstrate the proportion of a floodplain developed into the aquaculture farm. When farms constructed in former mangrove or wetland areas are closed, pond embankments shall be breached to restore natural water flow so that wetland vegetation can reestablish.

Excessive pumping of groundwater can lead to aquifer depletion and affect the availability of water to other users in the area. Farms using groundwater shall provide the results of a groundwater level monitoring program, including wells within 1 km of the farm perimeter, taking into consideration natural variation in aquifer level and withdrawals by other users of groundwater resources.

Additional Information

IUCN Red List of Threatened Species
https://www.iucnredlist.org/

Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1975 (Appendix I)
https://www.cites.org/eng/app/appendices.php

IUCN Protected Area Categories
https://www.iucn.org/theme/protected-areas/about/protected-area-categories

Convention on Biological Diversity, 1992
https://www.cbd.int/

Convention on Wetlands of International Importance, 1971 (Ramsar Convention)
https://www.ramsar.org/

E. Water Quality and Sediment Monitoring - Cages or Net Pens in Fresh or Brackish Water

Audit Clauses

3.23: Water quality in the surface mixed layer of water bodies used for cage culture shall conform to at least two out of three of the following: not more than 40 µg/L for total phosphorus, not more than 15 µg/L for chlorophyll a, not less than 3 m for Secchi disk visibility as an average of sample collections encompassing four consecutive months. In addition, average daily dissolved oxygen concentration at 50 cm depth shall not be less than 4 mg/L for more than four consecutive months.

3.24: From a baseline established by an independent (third-party) during the first year following initial certification, any increase in annual average total phosphorus, or chlorophyll *a* concentrations, or any decrease in annual average Secchi disk visibility shall not exceed 25%. In addition, any decrease in annual average dissolved oxygen concentration shall not exceed 25%.

3.25: In water bodies with a Secchi disk visibility less than 5 m, scum-forming or potentially toxic blue-green algae or other potentially harmful algae shall not comprise more than 60% of the phytoplankton biomass over consecutive sampling periods encompassing four months.

3.26: For cages in lakes or reservoirs, cages shall be placed in locations with an average water depth of greater than 10 m or at least twice the depth of the cage, whichever is greater.

3.27: For cages in water less than 30 m deep, and where sediments are usually aerobic in the absence of cages, divers or cameras shall be used periodically, at least once per production cycle, to inspect the bottom for accumulation of feces and uneaten feed. When such conditions are identified, aerobic benthic conditions shall be restored by fallowing or other means.

Implementation

Production Practices for Cages and Net Pens in Freshwater

The best way to reduce nutrient outputs from cage and net pen culture is to increase the efficiency of feed use (i.e. reduce FCR). Feed should be manufactured by a reputable feed mill and meet the nutritional needs and presented in a form (i.e. pellet size) that is suitable for each particular life stage of the fish. The feed should contain ingredients of high digestibility and contain no more nitrogen and phosphorus than necessary.

Feed should be provided at a frequency and duration to maximize efficiency. Farm personnel responsible for feeding should assure that fish consume all feed offered. Fish should have access to the feed for sufficient time so that it is consumed before feed is lost through the cage or pen mesh. Feeding rings that retain floating feed

should be used in low-volume (<25 m^3) cages. Feeding rates should be monitored to avoid overfeeding. Observations of fish feeding activity are facilitated by using floating feed for certain species.

It is currently not practical to collect and treat wastes from cages and net pens. The main precaution against pollution is to locate culture units in open-water areas where water currents are sufficiently high to transport wastes away from cages and rapidly mix and dilute wastes.

High fish biomass in a particular location can increase the likelihood of pollution. In bodies of water that stratify thermally, a high fish biomass can result in severe organic enrichment and dissolved oxygen depletion in the bottom water layer (hypolimnion). Subsequent sudden thermal destratification, a naturally occurring process, can result in dissolved oxygen depletion throughout the water column. This phenomenon has been responsible for serious fish mortality of caged fish as well as wild fish populations outside cages. Although 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 and anticipate the need to take action in the event of sudden destratification.

Water Quality Limits

Cages and net pens may be installed in lakes, reservoirs, rivers, streams, irrigation systems, ponds, estuaries and embayments. Uneaten feed, fish feces and metabolic excretions of fish enter directly the water bodies that contain the cages or net pens. The release of these wastes, derived from feeding, can cause enrichment (eutrophication) of the water bodies used for cage farming. The potential of cage and net pen culture to cause eutrophication of lakes and reservoirs depends primarily on the total amount of feed added, location of production facilities relative to the water body outlet, the area and depth of the water body and the hydraulic retention time (HRT) or flushing rate of the water body. 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. Collectively these factors affect the capacity of the water body to assimilate the wastes from feeding, often called the carrying capacity. Assimilation capacity is impractical to measure for purposes of aquaculture certification.

The approach used to demonstrate environmental responsibility with respect to the effects of feed-derived wastes released during cage and net-pen fish farming is water quality monitoring. Specifically, this standard sets limits for certain water quality variables that are indicative of a mesotrophic or intermediate state of eutrophication. In mesotrophic conditions, an extreme level of environmental enrichment is avoided. In mesotrophic waters, the risk of dissolved oxygen depletion is less than in eutrophic or hypereutrophic waters. Thus, a mesotrophic condition simultaneously limits the extent of environmental enrichment and protects fish welfare to enable conditions suitable for good fish and growth and efficient feed conversion. The water quality limits provide some flexibility because each water body responds uniquely. Furthermore, water quality in many water bodies varies seasonally (cold, warm / dry, rainy) and these water quality limits account for that variation. 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.

Water samples shall be collected once every two months for analysis of total phosphorus and chlorophyll *a* concentration by standard laboratory methods. Samples shall be collected within the lease or concession at a depth of 50 cm. Secchi disk visibility shall be measured once every two weeks during clear weather and around mid-day. Dissolved oxygen concentration shall be measured once monthly in the morning, between 0600 and 0900 h, at 50 cm depth. Appendix D has additional information on water sampling and analysis.

One of the typical consequences of eutrophication in water bodies used for cage or net-pen culture is a shift in the composition of phytoplankton communities towards species that are tolerant of low light intensities. Often these species can be broadly categorized as blue-green algae (cyanobacteria), which are undesirable because they are potentially toxic to fish or livestock, produce unsightly surface scums, and may cause off-flavor in farmed and wild fish. These algae typically appear in water of low transparency.

Once every two months, in water bodies with a Secchi disk visibility less than 5 m, a water sample shall be collected at 50 cm depth and the percentage of blue-green or other potentially harmful algae assessed. There are numerous examples of suitable methodological approaches for sampling and enumeration of phytoplankton. One

example is "A Phytoplankton Methods Manual for Australian Freshwaters" (http://phytobioimaging.unisalento.it/Portals/7/Documents/General_Documentation/A%20Phytoplankton%20Manual%20methods%20Australia.pdf). Blue-green algae have a wide size variation but the focus of sampling should be directed towards the relatively large-sized, scum-forming blue-green algae, including but not limited to representatives of the following genera: *Anabaena*, *Aphanizomenon*, *Microcystis* and *Planktothrix/Oscillatoria*. Blue-green and other algae should be enumerated to estimate relative community composition. Sub-samples can be used periodically to estimate algal biovolume by multiplying cell or colony counts by estimates of cell volume for the main species identified.

Allowable Water Quality Changes

To assure that environmental quality is maintained at a level to support good fish welfare and mesotrophic conditions, farms shall evaluate changes in water quality that may anticipate reaching the water quality limits established in 3.23. During the first year after initial certification, an independent laboratory shall be contracted to establish a baseline of environmental quality. Specifically, the laboratory shall measure concentrations of total phosphorus and chlorophyll a concentration in samples collected from 50 cm depth within the lease or concession every two months. Farms shall measure baselines for Secchi disk visibility and minimum dissolved oxygen concentration. Measurements of Secchi disk visibility shall be done every two weeks and dissolved oxygen concentration monthly. In subsequent years, the monitoring program shall proceed as outlined in 3.23. Changes in any water quality variable greater than 25% of the value of the baseline will be considered a non-conformity and require corrective action, typically a reduction in fish biomass.

Sediment Monitoring

Wastes can accumulate beneath cages and cause deterioration of sediment quality. This is environmentally undesirable and can have negative impacts on the welfare of fish in cages as well. Sediment quality in areas with fish cages can be protected by fallowing – periodically moving cages to new sites in a concession and allowing the sediment beneath the original sites to recover. Observations on sediment quality shall be used to determine if and when to move cages. For cages located in rivers or in reservoirs with extremely short HRT's (<5 days), the restriction concerning location of cages where depths are >10 m or where the reservoir depth is at least twice the depth of the cage, is not applicable.

Some freshwater lakes and reservoirs are normally stratified throughout the year, with a bottom layer of water with little or no oxygen. In such conditions, restoration of bottom condition is not possible or practical because the processes leading to anaerobic bottom waters are naturally occurring. In this case, farms are not required to inspect sediment. However, farms shall demonstrate that bottom waters are anaerobic with monthly sampling of dissolved oxygen concentration in the hypolimnion (bottom layer), with specification of the depth sampled. Farms placed in locations with water depths greater than 30 m are exempt from sediment monitoring.

F. Sediment Monitoring - Marine Net Pens and Coastal Flow-through Farms

This section applies to net pens in marine and brackishwater environments. It also applies to coastal flow-through facilities that operate with a high rate of water exchange, greater than one system volume exchange per hour.

Audit Clauses

3.28: Monitoring of sediment conditions shall be undertaken within 30 days of the peak sustained feeding period during the production cycle and shall be conducted according to the requirements of the farm's operating permits or its own Sediment Monitoring Plan in countries or regions where sediment monitoring is not required, and as specified in the implementation guidance.

3.29: 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.

3.30: For newly established farms (first production cycle) or farms that have expanded and do not yet have enough monitoring data, the farm 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.

3.31: For established farms (after first production cycle), the farm shall provide sediment monitoring data for the most recent production cycle to show that the farm meets or exceeds the sediment quality criteria specified in its operating permits and/or its own Sediment Monitoring Plan at current operating levels.

3.32: The farm shall provide documents that describe local standards for benthic impacts under net pen farms or at water discharge sites from coastal flow-through facilities. These standards shall include benthic indicator "trigger levels" above which the farm would not be in compliance with local standards. In the absence of benthic trigger levels set by regulatory bodies, the farm shall define these trigger levels based on the benthic characteristics study as per 3.30.

3.33: 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.

3.34: For farms located in areas with other neighboring BAP-certified farms, or with members of an established Area Management Agreement, production cycles and fallowing shall be coordinated.

3.35: For farms located in areas with neighboring farms that are not BAP certified, or where an Area Management Agreement has not been established, the farm shall demonstrate that a good-faith effort has been made to cooperate with neighboring farms on matters of stocking, fallowing, animal health and biosecurity within an area twice the regulatory minimum separation distance to an upper limit of a 5-km radius from the farm.

3.36: Where sediment monitoring is not required as described above and/or where an allowed sediment impact zone is not defined, the farm shall document and implement a Sediment Monitoring Plan. The Plan shall incorporate:

- Securing the services of 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.
- Establishing and mapping 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 current patterns as long as the total area remains the same.
- Monitoring organic matter accumulation 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.
- Conducting sediment sampling to coincide with the period of peak sustained feeding during each crop cycle.

Implementation

Local Standards

In some countries and regions, cage farms are subject to specific regulations about 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.

Farms shall provide documents that describe local standards for benthic impacts under cage farms. 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 evaluate this area. Because biological sampling of sediments (i.e. benthic invertebrate community composition) 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 a chemical indicator trigger point is exceeded.

Production cycles and fallowing should be coordinated with neighboring farms, whether or not they are BAP-certified, or with members of an established Area Management Agreement. Whole leases, not only bays with

cages, should be fallowed for at least six months. BAP-certified farms are encouraged to make a good-faith effort to participate in the creation and implementation of Area Management Agreements to address cumulative benthic impacts associated with multiple farms. BAP-certified operations that operate in isolation should have a statement of intent to enter an AMA, if another operation moves into the area.

Hydrographic and Benthic Characterization

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 that are based on prior knowledge of local sediment biology or analysis of sediment reference samples collected from the farm location.

Sediment Monitoring Plan

Chemical indicators used for sediment monitoring include sediment oxidation-reduction potential; concentrations of dissolved oxygen, sulfide, total organic carbon or total volatile solids; or visual inspection with documentation by video. Certain variables 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 concentration 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.

An existing farm shall provide at least one production cycle of monitoring data to show that the farm meets or exceeds benthic standards required by operating permits at current production levels. Newly established farms (first production cycle) 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 subsequent audit.

Sediment Sampling and Analysis

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. 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.

Farms shall provide documents to show that sediment quality was determined using generally accepted sample collection and analytical methods. As 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.

Farms shall demonstrate by statistical analysis of the results that there is no organic matter accumulation from farming activities at the boundary of the allowable sediment impact zone in comparison to the reference station, as determined by the monitoring method chosen.

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

G. Efficient Use of Fishmeal and Fish Oil - All Production Systems

Audit Clauses

3.37: The farm shall use feed for which the manufacturer has provided data on the inclusion rate (%) in feeds of total fishmeal, fishmeal from byproducts, fish oil, and fish oil from byproducts.

3.38: The farm shall record the inclusion rates, as indicated in 3.37, and protein levels of all feeds used, the total amounts of each feed used each year and the total annual aquatic animal production.

3.39: The farm shall calculate and record an average feed conversion ratio for completed crops in a calendar year.

3.40: The farm shall calculate and record a final Fish-in Fish-out (FIFO) ratio and Forage Fish Dependency Ratio (FFDR) value for all completed crops in a calendar year.

3.41: Depending on the species farmed, the FIFO shall not exceed the following values:

- Whiteleg shrimp (*Litopenaeus vannamei*) – 1.0
- Black tiger shrimp (*Penaeus monodon*) – 1.2
- Tilapia – 0.5
- Pangasius catfish – 0.3
- Channel catfish – 0.3
- Rainbow trout – 1.2 (note: does not include steelhead salmon raised in sea cages).
- Atlantic salmon – 1.4 (note: in recirculating systems only).

3.42: For species not named in 3.41, the FIFO shall not exceed 4, or 5 if fish processing byproducts are included in the feed.

3.43: The farm shall obtain feed either from a BAP-certified feed mill or from a feed mill that provides declarations that it complies with BAP Feed Mill standards regarding:

- The recording of species and fishery origins of each batch of fishmeal and fish oil, and;
- Having a written Plan of Action defining policies for responsibly sourcing fishmeal and fish oil from reduction fisheries and setting clear goals for responsibly sourcing soy ingredients.

Implementation

Average FCR Calculation

Feed conversion ratio (FCR) is the fundamental measure of feed efficiency in aquaculture and is calculated as the amount of feed needed to produce a unit weight of aquatic animals. Farms shall calculate and record FCR yearly as follows: Feed conversion ratio = Annual feed use ÷ Net biomass (live weight) of aquatic animals produced. The amount of feed used and net biomass of aquatic animals produced can be reported in metric tons or kilograms, but the same units shall be used for both in the calculation. The net biomass of fish or shrimp produced is calculated by subtracting the total weight of stocked juveniles from the total live weight of the harvested aquatic animals. The FCR shall be reported on an annual basis for all crop cycles completed within a calendar year.

FCR as calculated for the purpose of BAP certification is also known as economic FCR (eFCR). Economic FCR is very sensitive to survival rate, rising sharply if the survival rate drops significantly.

Although BAP for FCR have not been established, producers should always strive to reduce FCR because it is among the best indicators of potential profitability and is direct evidence of efficient use of marine feed ingredients. Farms should always attempt to demonstrate continuous improvement after initial certification by progressive reductions in FCR. Proposed FCR targets, which may become limits in future versions of this standard, are: *L. vannamei*, 1.2; *P. monodon,* 1.5; tilapia, 1.5; *Pangasius* catfish, 1.5; channel catfish, 2.0; rainbow trout, 1.2; Atlantic salmon, 1.1.

FIFO and FFDR Calculation

Aquaculture producers should strive to use marine feed ingredients efficiently, relative to current industry standards, as well as in the global context of livestock feeds and the different species and system intensity combinations. The fish-in fish-out (FIFO) ratio and forage fish dependency ratio (FFDR) are two related indices of the ecological efficiency of fishmeal and fish oil use in an aquaculture system. In short, FIFO considers fishmeal and fish oil together and FFDR considers fishmeal and fish oil separately. Many aquaculture feeds incorporate only small amounts of fishmeal and fish oil and farms that use these feeds can have FIFO and FFDR values less than 1, indicating that they make a net contribution to global fish supplies.

Farms shall obtain the percent fishmeal and fish oil in feeds from feed manufacturers or suppliers. The inclusion levels in feeds shall include any meal or oil derived from whole, wild-caught fish, squid, krill, mollusks or any other wild aquatic animals. However, they shall exclude meal or oil derived from by-products such as trimmings, offal and their derivatives such as squid liver powder, aquaculture by-products such as shrimp head meal and ingredients derived from invasive aquatic species. The quantity of each feed type used, along with the fishmeal and fish oil content of each feed shall be recorded in the audit report.

For calculation of FIFO and FFDR, in the absence of better, specific data from feed suppliers, the industrial processing yields from the reduction of wet, whole, forage fish to fishmeal is assumed to be 22.5% and for forage fish to fish oil is assumed to be 4.8%. However, feed mills should supply farmers with more precise estimates if the default values are not valid in specific cases, with appropriate documentation from suppliers of fishmeal and fish oil.

The feed fish inclusion factor (FFIF) estimates the combined fishmeal and fish oil concentration of the feed on a dry weight basis, relative to the wild fish, and is calculated as follows:

Feed fish inclusion factor = (Percent fishmeal in feed + Percent fish oil in feed) / (22.5 + 4.8)

Using the resulting value for FFIF, farms shall calculate and record a final yearly FIFO ratio as follows:

Fish-in fish-out ratio = Feed fish inclusion factor x Feed Conversion Ratio

Calculation of the FFDR separately compares the amount of fishmeal and fish oil provided in feed to the production system with the wet weight amount of fish produced and then uses the greater of these two values as the total FFDR for the system. In cases where aquatic animals are provided with feed of relatively high protein and

lipid to meet requirements, fish oil derived from forage fish is more limiting than fishmeal. In that case, the FFDR for fish oil is reported. Farms shall calculate and record a final production cycle FFDR as follows:

$FFDR_{fishmeal}$ = (Percent fishmeal in feed x Feed Conversion Ratio)/22.5
$FFDR_{fish\ oil}$ = (Percent fish oil in feed x Feed Conversion Ratio)/4.8
FFDR = The greater of $FFDR_{fishmeal}$ or $FFDR_{fish\ oil}$

Metric standards for FIFO for production of some key aquaculture species have been set based on available industry data and used to reward efficient operations within those sectors with certification. For farms producing novel or uncommon species (particularly higher trophic level marine fish species), insufficient or unreliable data limits the potential to set a species-specific standard at this time. However, given the limited availability of marine ingredient resources for aquafeeds, there is a need to set a global maximum limit for "responsible" products in the market. For this reason, an absolute maximum FIFO for BAP certification has been set at four where byproducts are excluded and five if byproducts are included in the FIFO calculation. Auditors must collect data during audits that shall be used in the future to establish metric standards for other species.

Compliance with BAP Feedmill Standards

To promote responsible sourcing of marine ingredients, the farm shall obtain feed from a BAP-certified feed mill or a feed mill that declares and documents compliance with BAP Feed Mill Standards - Issue 3.0 clauses 4.1 and 4.4. BAP Feed Mill Standard 4.1 requires declarations from suppliers on the species and fishery origins of each batch of fishmeal and fish oil. BAP Feed Mill Standard 4.4 requires a clear, written Plan of Action defining policies for responsibly sourcing fishmeal and fish oil from reduction fisheries and setting clear goals for responsibly sourcing soy ingredients. Additional implementation guidance regarding options for the Plan of Action can be found in the BAP Feed Mill Standard – Issue 3.0.

Additional Information

MarinTrust Standard (formerly IFFO RS Version 2.0 Standard) – Global Standard for Responsible Supply of Marine Ingredients
https://www.marin-trust.com/sites/marintrust/files/2017-07/FINAL%20V2.0%20Standard%20for%20publication.pdf

Fish In:Fish Out (FIFO) Ratios
https://www.iffo.net/fish-fish-out-fifo-ratios-conversion-wild-feed

H. Stocking Sources and GMOs - All Production System

Audit Clauses

3.44: The farm shall keep complete and accurate records of the sources, purchases of stocking material and numbers of seed (e.g. post-larvae, juveniles, fingerlings) stocked in each culture unit for each crop, stocking dates, species stocked and, if applicable, species characteristic specifications such as non-native, specific pathogen-free, specific pathogen-resistant, hybrid, triploid, sex-reversed, genetically modified (GM) or bioengineered (BE).

3.45: 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.

3.46: Wild juveniles shall not be stocked, other than as incidental introductions in extensive ponds that rely on tides for pond filling and water exchange.

3.47: Where the species farmed is not native, not escaped and subsequently established in the wild, 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.

3.48: Farms that produce genetically modified or bioengineered aquatic animals shall comply with all regulations in producing and consuming countries.

Implementation

Recordkeeping

From the standpoint of product traceability, at the farm level, records of stocking and sources of seed are the fundamental first step. For each production unit (pond, tank, cage) and each production cycle, comprehensive records about the source, seed attributes and characteristics, and number stocked and number surviving shall be maintained. The list of examples of species characteristics given in the audit clause is not exclusive; there may be other relevant characteristics that should be noted. For example, some aquatic animal seed batches may have been vaccinated or treated with chemicals as disease prophylaxis prior to stocking. The flow of aquatic animal seed through the farm as the animals grow, including transfers among production units, shall be tracked with the recordkeeping system. Farms shall demonstrate that groups of aquatic animals in a production unit can be traced back to the source hatchery at any time while the group is being grown. A sample Traceability Form that records these data is provided in Appendix E.

Importation Permits

During an audit, documentation of compliance with government regulations (i.e. permits) relating to the importation of aquatic animal seed (fry, fingerlings or postlarvae) and any associated health certificates shall be available for review. The farm should demonstrate awareness of the relevant national and local laws and regulations regarding introductions and transfers of live aquatic animals. The farm should establish a link to the domestic competent authority (veterinary health authority or other government regulatory body) to verify international importation requirements and follow the International Health Certificate protocol defined by the OIE. Government regulations differ by country and the certification body is not expected to maintain complete records of the requirements in every country. However, auditors should become familiar with relevant regulations and importation procedures in countries where they regularly perform audits. Farms importing a new species for the first time should be scrutinized with extra vigilance to demonstrate that legal channels were followed.

Wild Juveniles

The BAP Farms standard requires that only aquatic animals produced in hatcheries can be used to stock production units on farms. Wild juveniles shall not be stocked, other than as incidental introductions in extensive ponds that rely on tides for pond filling and water exchange. Collection of wild seed with fixed or mobile fishing gear, explosives or toxins is not allowed.

Non-native Species

Many non-native species are a major segment of productive aquaculture sectors in many countries. Tilapia have been spread to many countries outside native ranges in Africa and the Middle East. White shrimp have been introduced from the Americas to many countries in Asia. For intentional introductions of non-native species, farms shall demonstrate regulatory approval that is based on the 2005 ICES Code of Practice on Introductions of Marine Organisms or the Codes of Practice and Manual of Procedures for Consideration of Introduction and Transfers of Marine and Freshwater Organisms (FAO 1988). A non-native 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. To reduce the potential deleterious impact of escapes, technologies such as sterility, ploidy and monosex production are encouraged.

Genetically Modified or Bioengineered Organisms

Bioengineered (BE) organisms, otherwise also referred to in some jurisdictions as 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. Consumers should be provided with reliable information regarding the BE/GMO status of farmed aquatic animals to enable informed food choices. Traceability standard T12 specifies that information regarding the BE status of harvested aquatic animals be transferred from the farm to processing plants that receive those animals.

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 (2019), Section 5 – Trade Measures, Importation/Exportation Procedures and Health Certification
https://www.oie.int/standard-setting/aquatic-code/access-online/

BAP Interpretation Guidelines – Supplementary Interpretation of Requirements for “BE” (Bioengineered) Products Labeling – Issue 1.0 – 12 December 2019
https://www.bapcertification.org/Downloadables/pdf/standards/PI%20-%20Interpretation%20Guidelines%20-%20Supplementary%20Interpretation%20of%20Reqs%20for%20BE%20(Bioengineered)%20Products%20Labeling%20-%20Issue%201.0%20-%2012-December-2019.pdf

I. Control of Escapes - All Production Systems

Audit Clauses

All Production Systems

3.49: All holding, transport and culture systems shall be designed, operated and maintained to minimize the release of aquatic animals at any life stage.

3.50: Screens and nets of a size to retain the smallest farmed animals present at the farm shall be installed as a barrier between the culture unit and the environment.

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

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

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

Net Pens

3.54: The farm shall have a written Containment Plan that includes procedures to prevent, detect and respond to incidences of escapes of aquatic animals from culture units.

3.55: The farm shall provide documents to show that all staff members have received training in the Containment Plan, which shall be verifiable by training certificates in workers' files and verified during the audit by interviews with a subset of workers.

3.56: Cages, nets and pens shall be labeled and maintained in good condition, and records of repairs shall be kept.

3.57: Regular inspections by divers or underwater cameras of mooring lines and cage mesh condition shall be documented.

3.58: Jump nets that extend above the water line shall surround the perimeter or cover the entire surface of net pens and shall have appropriate mesh sizes to contain the aquatic animals.

Ponds - Shrimp

3.59: The mean water exchange rate of shrimp ponds shall not exceed 10% per day (i.e., on an annual basis, 36.5 x total pond volume) unless necessary to maintain salinity within physiological limits to support shrimp welfare.

Implementation

Containment System Integrity

Avoiding breaches in containment leading to escapes of aquatic animals is in the economic interest of producers. It is also in the interest of minimizing environmental interactions between farmed and wild organisms, such as disease transfer and changes in gene frequency in wild populations. Thus, containment systems for any life stage shall be designed, constructed and operated to minimize the escape of culture animals. These containment systems can be used to grow, hold temporarily or transport cultured aquatic animals.

Containment systems should be designed and constructed using applicable standards or best practices. For example, earthen pond embankments should be designed with proper slopes, using soils that are suitable for holding water, and construction techniques that provide sufficient compaction to avoid embankment failure.

The infrastructure and equipment used to contain aquatic animals shall be inspected according to a regular schedule. A program should be in place for regular preventative maintenance and repair of containment infrastructure and equipment. A reporting system shall be in place to indicate inspection results and preventative maintenance undertaken.

Screening

Screens and nets of a size to retain the smallest aquatic animals present shall be installed as a barrier between the culture unit and the environment. This applies to cages or net pens and outlets (pipes, gates, etc.) from land-based pond, tank or flow-through systems. Examples of 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.

Escape Detection and Incidence Response

All incidents involving animal escapes shall be accurately documented, including the reason for the escape, the number of organisms that escaped, the health status of the escapes, and any recovery plans/effectiveness statistics. Farms 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 root cause shall be investigated immediately, the steps shall be taken to correct it, and plans and actions proposed to address future escape risks. These actions shall be documented in farm records. If, after investigation, there are grounds for believing an escape occurred, the remaining aquatic animals in the culture system shall be counted, if and/or when

water and welfare indicators indicate this can be done without causing excessive distress to the aquatic animals, and any loss of inventory shall be recorded.

Net Pens

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 in the cage mesh 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. Brightly colored buoys or navigation lights should be placed to mark location of cage arrays. 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.

Containment Plan

Farms using cages or net pens shall have a written Containment Plan that covers escape prevention and deals with known or suspected escapes. The Containment Plan shall include the following elements:

- Integrity of Infrastructure and Equipment – design and construction standards for an effective containment system, equipment testing
- Inspections – inspection program for infrastructure and equipment, including preventative maintenance program and repair
- Inventory Control Procedures – counting methodology and verification, aquatic animal inventory reconciliation
- Aquatic Animal Handling Practices – precautions during transfers, counting, grading, disease treatment, harvesting, transport and other farm operations
- Predator Deterrence and Control Plan – predator control structures (as appropriate), control of predator access, control methods
- Response Procedures and Escape Mitigation – recapture and recovery of stock, escape incident reporting requirements, root cause analysis of escapes or containment failure
- Recordkeeping – equipment testing results, aquatic animal inventory reconciliation or escape detection, escape event log, training activities.
- Training – definition of employee responsibilities, oversight.

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" during transfers.

Ponds

To minimize escapes from shrimp ponds, the mean water exchange rate of shrimp ponds shall not exceed 10% per day (i.e., on an annual basis, 36.5 x total pond volume), unless necessary to maintain salinity within physiological limits to support shrimp welfare. Pump station records shall be maintained and annual summaries of water use provided to verify the 10% limit. The 10% limit on water exchange rate for shrimp farms does not apply if farms use oceanic water to adjust pond salinity and compensate for evaporative water loss. However, this exemption is only allowed if the pond salinity is kept at 40 ppt or more. In arid zones, pumping oceanic water to maintain a salinity below 40 ppt would not be efficient.

For freshwater ponds, the elevation of pond embankments should be sufficient to avoid flooding (i.e. overtopping) by a 100-year precipitation event. Pond production facilities should 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 rainfall from raising water levels and overtopping embankments.

J. Biodiversity and Wildlife Protection - All Production Systems

Audit Clauses

3.60: The farm shall have a written Wildlife Interaction Plan (WIP) and demonstrate compliance with the procedural, performance and reporting requirements of the plan.

3.61: Farm managers and workers shall be familiar with the provisions of the Wildlife Interaction Plan (WIP) and be trained in its implementation.

3.62: Where applicable, government permits for predator control shall be made available for review.

3.63: The farm shall use humane methods of predator exclusion and deterrence, actively favor non-lethal methods and avoid lethal methods.

3.64: No predator controls other than non-lethal exclusion and deterrence shall be applied to species that are listed as endangered or critically endangered on the IUCN Red List or that are protected by local or national laws.

3.65: The farm shall maintain a recordkeeping system that records the species and numbers of all avian, mammalian (except rodent pests) and reptilian mortalities associated with predator control efforts.

Implementation

Wildlife Interaction Plan

Farms 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 stipulated in local laws. Farms that fully enclose culture units within a building or greenhouse that effectively exclude wildlife are exempt from the requirements of a WIP, other than meeting the required legal compliance. The farm should designate an individual in the farm management team to be responsible for implementation of the WIP. The WIP shall include but not be limited to the following elements:

- A list of relevant local laws and specific conditions of the farm's operating permits that apply to wildlife management and protection and allowed wildlife deterrent measures.
- 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.
- A map that identifies officially designated "critical" and/or "sensitive" protected areas in the region and the location of any wildlife colonies or migratory corridors.
- If the farm is in or near an area designated as critical or sensitive habitat, a list of endangered non-migratory species within a 2-km radius of the farm and of migratory species within the region, updated when necessary as new habitat is designated.
- A recordkeeping system for reporting observations of endangered, threatened and protected species.
- Designation of workers or management staff responsible for implementing lethal control measures, if needed.
- Description of the farm's passive measures (barriers) to deter the entry of predatory birds, mammals or reptiles into production units (ponds, tanks, cages, etc.).
- Procedures for regular inspections to evaluate and report on the integrity of culture units and the effectiveness of wildlife barriers.
- At marine net pen sites with carnivorous marine mammals (seals, otters, sea lions, orcas) and predatory sharks, a description of the farm's passive measures (primary or secondary barriers) to protect net pens from underwater attack.
- At marine net pen sites, the WIP shall include documentation to show that any acoustic harassment devices 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 indicates they can adversely affect these species.
- At marine net pen sites, the farm may only use acoustic harassment devices to control predators if independent expert opinion verifies that their use will not harm endangered, protected or threatened species or any cetaceans, and if they are legally approved and/or permitted for use.
- Documentation that any active, non-lethal wildlife deterrent measures used by the farm are approved by government regulators.
- Reporting procedures in the event that control measures cause the accidental death of wildlife and proposed actions to prevent reoccurrence.
- Procedures that state that legally approved lethal methods shall only be used after all non-lethal methods are attempted.
- Prohibition of deliberate lethal controls on species classified as endangered or critically endangered, 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.

Worker Training

The management staff member responsible for implementation of the WIP should be responsible for training workers and other management staff on elements of the plan. Workers should be trained in aspects of wildlife predator deterrence and control that they may be called upon to implement. Farm workers and management staff should be trained to recognize and report endangered, threatened and protected species observed on the farm. The individual designated to carry out lethal control measures should be adequately trained to implement humane and effective lethal control methods.

Predator Exclusion and Deterrence

Humane, non-lethal methods for exclusion and deterrence of wildlife predators is required. Farms shall keep records to demonstrate that, if used, a wildlife predator exclusion and deterrence program is operational and

effective. A farm inspection during the audit will assess ongoing wildlife predator exclusion and deterrence activities. As site characteristics and conditions vary widely, the use and effectiveness of various predator control methods will vary and no single approach is likely to be effective. A combination of approaches is encouraged and an empirical approach should be taken to evaluate effectiveness. Compliance with laws and regulations that apply to wildlife (especially threatened and endangered species) and permitted predator deterrence methods is expected.

Creating a barrier between wildlife predators and farmed aquatic animals is often the most effective approach to control the impacts of predation. Ponds can be partially covered with line, wire, netting or screens. Marine net pens can use top nets to control bird or marine mammal predators. Marine net pens can also use secondary perimeter nets or shark guards. Although the primary purpose of partial barriers is exclusion and physical protection, they can also serve as a visual deterrent.

Deterrent methods are active and non-lethal approaches to discourage or deter potential predators from approaching or entering culture units. Typically these can be classified as acoustic or auditory, visual or physical. The number and types of devices should be sufficient to be effective. Often, the effectiveness of devices is short-term because wildlife predators will habituate to the method. Thus, several approaches are needed in combination, in sequence or in rotation and with shifting locations, to be effective.

Various acoustic deterrents are used to control birds, seals and other potentially predatory wildlife. Noise generators include pyrotechnic devices, electronic noisemakers and recordings of distress calls, as examples. Visual deterrence devices include various types of lights, predator models (“scarecrows”) and mirrors or reflectors. Other examples of non-lethal control methods include water spray devices, aerial drones or underwater submersibles, vehicle patrols and deployment of guard dogs.

If humane, non-lethal methods for exclusion and deterrence of wildlife predators fails after every effort is made, then attempts should be made to capture, remove and relocate the potential predator from the farm. In extreme cases, after all non-lethal methods are attempted, and especially when worker safety is at risk, lethal methods can be considered. Lethal control methods must only be those allowed by applicable national laws and regulations. Lethal methods must be rapid, safe and done as humanely as possible. If firearms are used, they must be within the scope of government permits, weapons appropriate for the predator should be used, , only properly trained workers licensed to use firearms should kill the predator, and any attack and predator kill should be documented and reported properly. Only predators actively engaged in an attack that endangers worker safety should be shot without a permit. No lethal predator controls can be used with species that are listed as endangered or critically endangered on the IUCN Red List or that are protected by local or national laws.

Managing Entanglement Risk

Aquaculture gear in marine environments can represent an entanglement risk to wildlife. Farms sited in marine waters where endangered and critically endangered species exist and have the potential to become entangled in lines used on the farm should apply effective gear modifications and best practices to address these risks, including using “whale release” lines, reducing line length, and reducing vertical lines in the water to the greatest extent possible.

Recordkeeping

The Wildlife Interaction Plan has a recordkeeping requirement for reporting observations of endangered, threatened and protected species on the farm. Farms are encouraged to be transparent with stakeholders in providing public access to these records. Farms shall maintain a recordkeeping system that records the species and numbers of all avian, mammalian (except rodent pests) and reptilian mortalities associated with predator control efforts. It is not necessary to record mortalities of these species that are not caused by predator control efforts.

Additional Information

IUCN Red List of Threatened Species
https://www.iucnredlist.org/

IUCN Protected Area Categories
https://www.iucn.org/theme/protected-areas/about/protected-area-categories

K. Storage and Management of Farm Supplies and Solid Wastes - All Production Systems

Audit Clauses

3.66: Fuel, lubricants, feed and agricultural chemicals shall be labelled, stored, used and disposed of in a safe and responsible manner.

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

3.68: Fuel, lubricant and chemical storage areas shall be marked with warning signs and risk indicators.

3.69: Secondary fuel containment volume shall be at minimum equivalent to the total fuel container capacity plus 10%.

3.70: 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.

3.71: Decomposable wastes from housing and food preparation shall be retained in water-tight receptacles with covers to protect contents from insects, rodents and other animals.

3.72: Solid wastes generated on farms shall be collected promptly and stored appropriately before disposal and shall not be dumped in mangrove areas, adjacent wetlands or vacant land.

3.73: Solid wastes shall be disposed of in ways that avoid environmental contamination and odor problems and comply with local regulations.

3.74: Damaged, discarded, decommissioned or derelict net pen facilities or other floating gear shall be collected and removed promptly from oceans, lakes, rivers, shorelines or other water bodies to avoid accumulation or loss.

3.75: Measures shall be taken to prevent infestation of feed storage areas by animal and insect vectors and pests.

3.76: Mortalities from acute die-offs or euthanized diseased animals shall be removed from culture units promptly and disposed of responsibly by rendering, incineration, sterilization, composting, biogas production or ensiling. Disposal by burial is also permitted, with the assistance of a competent contractor if needed and in accordance with applicable regulations.

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

Implementation

The range of chemicals and supplies used and solid wastes generated on aquaculture farms is diverse, depending on type of culture system, production intensity and species grown. Release of those materials can compromise the food safety of farmed aquatic animals, environmental pollution or the spread of disease pathogens. Farms are encouraged to develop a systematic approach to the management of chemical and solid wastes in their particular production context. The goal of such a system should be to track the flow, generation and disposal of materials that result in waste and to reduce their volume.

Safe Storage

Some materials used in the operation and maintenance of aquaculture farms represent an environmental risk if released intentionally or inadvertently to the environment. Safe storage of these materials is the initial barrier between the material and the environment.

Labels, risk indicators and warning signs should align with the Globally Harmonized System of Classification and Labelling of Chemicals (GHS). All physical, human health and environmental hazards should be identified and

labeled as such. Material Safety Data Sheets (MSDS) should be available for all chemicals used on the farm. A chemical inventory should be maintained. Chemicals should be labeled with the date received and date opened.

Storage and containment facilities that are safe, secure, and properly designed, well ventilated and properly managed must be provided for all fuel, lubricants and agricultural chemicals used. Chemicals shall be stored in secure area with access only to authorized personnel. Chemicals shall never be stored on the floor. Materials should be segregated by hazard class and according to compatibility to prevent undesirable chemical reactions should two or more chemicals accidently mix. Material used in shelving should be compatible with the chemical being stored. Chemicals must not be stored in direct sunlight or near any heat source. Cylinders of compressed gases should be secured properly such as by using chains and not using breakable materials such as rope or raffia string. Highly toxic or controlled substances and veterinary medicines should be stored in a locked cabinet. 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%.

Chemicals such as insecticides, herbicides, algicides, and sodium metabisulfite used for shrimp should be stored in locked, well-ventilated water-tight buildings. The buildings' concrete floors should slope to a center basin for containing spills. Risk indicators and warning signs for these materials should be posted.

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.

Oil leaks from tractors, trucks and other equipment should be prevented through regular scheduled maintenance. Spills should be avoided during oil changes and refueling of vehicles, generators and pump motors. Used oil should be sent to a recycling or aggregation center. Used chemicals and leaking or deteriorating containers shall be disposed of responsibly.

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. First aid supplies, emergency phone numbers, eyewash and emergency shower equipment, fire extinguishers, spill cleanup supplies and personal protective equipment should be readily available and workers trained in their use.

Feed Storage

Feed represents the largest variable cost item in fed aquaculture. Thus, care must be taken to guard the quality of feeds during on-farm storage. During storage, lipids (fats) in the feed break down, causing rancidity that reduces the palatability of feed. Mold can create mycotoxins that affect fish kidney and liver function. The potency of vitamins, especially vitamin C and thiamine, also decreases during storage. Spoilage of feed can be caused by excessive moisture from rain, condensation and high humidity; high temperatures; scavenger pests such as rodents and birds; insect infestations by weevils, beetles and moths; and spoilage by fungi, which can cause mold. Moldy feed should never be fed to aquatic animals. Spoiled feed represents a resource efficiency and financial loss.

A covered, well-ventilated and secure building should be constructed for the specific purpose of feed storage. The roof should protect the feed from rainfall and direct sunlight. All ventilation openings and junctions between the roof and walls should be sealed with mesh coverings to prevent entry by scavenging rodents and birds. The air in the building should be as dry and cool as possible.

The feed storage building should be kept clean. Any spilled feed should be collected and removed to avoid attracting rodents. The storage building should be cleaned before new feed enters storage. When the storage building is empty, the walls, floors and storage pallets can be sprayed with insecticide. The outside area around the feed storage building should not have tall weeds or other overgrown plants that provide cover for rodents or other pests. There should not be any stagnant water near the feed storage building.

Feed bags should be arranged in stacks on pallets or above-ground racks. Feed should not be stored on the floor because spoilage may occur from condensation. There should be a 1-m gap between and around stacks and between stacks and storage building walls and at least 1.5 m between the top of a stack and the roof. Stacks that are more than 4 m high can cause damage of feed pellets in bags at the stack bottom, creating fine feed particles

that are usually not consumed by fish and can contribute to environmental waste loading. Bagged feed should be handled carefully because rough handling can damage pellets and create fines. Excessive handling of feed bags should be avoided. Walking or sleeping on feed bags should be discouraged.

The farm should keep an accurate and current inventory of all feed types used. The oldest feeds should be used first (first in, first out). Feeds should not be stored past the manufacturer's recommended use date, usually 90 days, especially in the tropics. Feed purchases should be managed to keep feed fresh.

Measures shall be taken to prevent infestation of feed storage buildings by animal and insect vectors and pests. Farms should have a Pest Management Plan for the control of key pests. The farm shall designate an individual responsible for pest management in the feed storage building, for documenting regular inspections of the feed storage building to monitor for pest activity or infestation, and for training workers on proper feed handling and storage. Traps should be placed in the feed storage building for control of rodents. Pesticide applications may be necessary and these should be documented and done using only legally approved chemicals and safe application methods by trained workers.

Spoiled or expired feed can be disposed of in a landfill and handled similarly to other solid wastes generated by the farm. Given that feed is decomposable, spoiled feed can be composted or used as an agricultural fertilizer for plant or tree crops. Spoiled feed should never be dumped directly into aquatic ecosystems.

Solid Waste Disposal

Solid wastes generated on farms include decomposable wastes such as kitchen and housing wastes (garbage) and expired or moldy feed, dry materials such as paper and glass, various bulky items, discarded farm supplies and equipment (tires, pallets, bags used for feed, fertilizer, liming agents and other chemicals, chemical barrels, aerators and aerator paddles and motors, and vehicle parts), construction debris, and electronic wastes (computers, mobile phones). Solid wastes may also include biofouling organisms removed during onshore net-cleaning operations. If these wastes are not disposed of properly, there is a risk of environmental pollution and unsanitary farm conditions. Farms should take a systematic approach to managing solid wastes by developing a plan that specifies procedures for the collection, storage and disposal of solid wastes. In general, the approach should be to reduce, reuse, or recycle potential wastes of any kind. Paper and plastic should be recycled if possible. Waste collection for recycling requires readily accessible waste containers that are serviced at regular intervals.

Solid wastes should not be allowed to accumulate on farm property. Such wastes shall be collected promptly as it is generated and placed in temporary solid waste storage areas (dumpsters, bins) prior to final disposal. Solid wastes should be disposed of responsibly in a well-designed and legally-operated sanitary landfill. Solid wastes shall not be dumped in open areas of mangroves or other wetlands or vacant land. Farm solid wastes should not be incinerated, unless part of a waste-to-energy production facility. If wastes are composted, the process should not create an odor problem or attract wild animals. Biofouling organisms on net cages shall not be cleaned at the production site. Nets should be transported to a shore-based facility for cleaning in facilities designed to capture solid wastes from net cleaning. Biofouling solid wastes should be diverted into a sedimentation pond, sanitary sewer or other treatment system.

Managing Derelict Gear, Marine Litter and Plastic Waste

Some aquaculture production systems require deployment of cages or net pens, rafts, racks, moorings, marker buoys, floating docks or other gear that floats or is submerged near the water surface. All deployed gear should be clearly marked or identified as property of the farm. During extreme weather events with high wind, waves and flooding, gear may become detached or damaged. Once safe to do so, every effort shall be made to retrieve this gear from the bottom, adjacent shorelines or water surfaces. Damaged gear that is retrieved can be repaired or disposed of like other solid wastes in a sanitary landfill. A procedure should be in place for the management and recording of lost, "end of life" or recovered aquaculture gear to control any risks of entanglement with wildlife.

Aquaculture uses many plastic items, including synthetic ropes, netting, floats and buoys, drums, buckets, trays, feed bags, plastic bags for transport of fry or post-larvae, Styrofoam cooler boxes, various packaging

materials, boats, pipes, tanks and pond liners, among many other items. Farms are encouraged to conduct a plastics inventory to track the procurement, use and disposal of all plastic items in an effort to avoid release to the environment. All plastics should be disposed of in a manner that will not generate marine litter or have other detrimental impacts on the environment. Records of how this waste material is disposed of should be retained.

Mortality Disposal

Occasionally large numbers of aquatic animals will die as a result of natural causes or human error. Dead aquatic animals, whether arising from an acute mortality episode or chronic daily mortality, shall be removed promptly and placed in dedicated containers. Containers of stored aquatic animal waste should be leak-proof and secured to prevent contact with aquatic animals, other animals or birds and unauthorized personnel. Aquatic animal waste containers should be labeled with regarding content. Dead aquatic animals should be stored for the minimum time that is practical before disposal and storage containers should be cleaned to prevent insect infestation. The storage area should be separated from farm production sites and bodies of water to minimize the risk of spread of pathogenic agents. Transport should be accompanied by appropriate documentation detailing origin, content and destination to allow tracing if required.

Aquatic animal waste infected by an agent causing a disease referred to as "listed" in the OIE Aquatic Animal Health Code, or suspected of being so, may not be transported without permission from the Competent Authority. The Competent Authority may assess the requirement for this condition based on the disease situation in the Member Country (e.g. where a disease referred to in the Aquatic Animal Health Code is enzootic in the Member Country).

Mortalities shall be disposed of on land by responsible procedures, including rendering, incineration, sterilization, composting, biogas production, ensiling or burial after removal by a competent contractor and in accordance with all applicable regulations. Carcasses should never be discarded in water bodies. Equipment used for transportation of aquatic animal waste should be cleaned and disinfected before being returned to the farm.

On-farm Processing Waste Disposal

To preserve or improve product quality, some fish are slaughtered directly upon harvest or are partially processed on farm before transport to processing plants. Fish should be rendered unconscious by stunning with electricity, percussion stunning or other means that protects the welfare of the animal prior to exsanguination. After stunning, fish can be bled to death quickly by cutting major blood vessels in the throat, thereby removing blood from fish muscle. Blood should be stored in sealed containers for transport to an acceptable treatment facility.

Blood water waste must be treated before being discharged. Under no circumstances is untreated blood water waste to be released directly to surface fresh waters or the sea. Treatment of blood water waste requires reduction of total suspended solids, biochemical oxygen demand and disinfection of pathogens. Treatment options include dissolved air flotation, aeration contact chambers and sedimentation ponds. Ultraviolet light can be used to disinfect blood water prior to discharge.

On-farm processing plants must be compliant with all local laws, regulations and permits required for operation. Such facilities should also meet the requirements of the US FDA Hazard Analysis and Critical Control Point (HACCP) program. Fish solid waste (offal) shall be stored in sealed containers. This material can be disposed of as described in the previous section on Mortality Disposal.

Additional Information

Marine Litter Inventory
https://aqua-lit.eu/assets/content/MARINE%20LITTER%20INVENTORY.pdf

OIE Aquatic Animal Health Code (2019), Chapter 4.7 – Handling, disposal and treatment of aquatic animal waste
https://www.oie.int/standard-setting/aquatic-code/access-online/

United Nations (2011), Globally Harmonized System of Classification and Labelling of Chemicals (GHS) https://www.unece.org/fileadmin/DAM/trans/danger/publi/ghs/ghs_rev04/English/ST-SG-AC10-30-Rev4e.pdf

Pillar 4. Animal Health and Welfare

A. Health and Biosecurity - All Production Systems

Audit Clauses

4.1: The farm shall have in place an operational Animal Health Management Plan or manual, reviewed and approved by an aquatic animal health specialist, that includes the listed elements in the Implementation Guidelines.

4.2: The farm shall have in place biosecurity controls that seek to prevent the introduction and spread of disease agents and disease on the farm or to neighboring farms and these controls shall be detailed in an operational Biosecurity Plan that includes the listed elements in the Implementation Guidelines.

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

4.4: The farm shall obtain written assurance from the feed manufacturer that the feed does not contain aquatic feed protein from the same genus as the species being farmed. However, protein hydrolysates verified to <10,000 daltons are permissible.

4.5: Farms located in an area with more than three aquaculture facilities (hatcheries, farms, processing plants) per 10 km^2 sharing the same surface water body shall initiate or participate in an Area Management Plan to coordinate biosecurity measures with neighboring sites, irrespective of BAP certification status, unless a documented disease risk assessment determines that there is a low risk of disease transmission among facilities.

Implementation

Prevention and protection are the two general approaches to control disease pathogens and their spread. The goal of prevention is to manage the rearing environment, primarily through husbandry Best Management Practices, to minimize stress on farmed aquatic animals, thereby reducing susceptibility to disease. Maintaining water quality within the tolerance limits of the aquatic animals, using high-quality feeds that meet nutritional needs, and stocking at a density that will not cause stress are the key approaches. The goal of protection (biosecurity) is to limit the pathogen from entering the farm. Using disease-free juveniles or post-larvae for stocking, disease monitoring, using water that is free of pathogens, hygienic practices (e.g. disinfection), all-in, all-out stocking and harvesting, and control of vectors are some options to prevent pathogen entry.

Animal Health Management Plan

The Animal Health Management Plan is the practical guide to the activities and practices that are implemented to maintain aquatic animals in good health and thus realize their productive potential. The Animal Health Management Plan should link to the biosecurity and welfare plans. A farm-specific written Animal Health Management Plan shall include, at minimum, the following elements:

- Protocols for water quality management to maintain water quality within the tolerance limits of aquatic animals – aeration, water exchange, liming, fertilization, etc.
- Protocols for feeding. How the farm will meet the nutritional requirements of aquatic animals for each life stage.
- Routine disease surveillance and characterization of the health status of the farm. Regular health monitoring is a fundamental part of the health and welfare management of aquatic animals. It provides an early warning detection system that allows rapid response to disease outbreaks. Protocols for regular observation of the behavior and welfare of aquatic animals should be described. Operational disease surveillance shall be demonstrated by a health-monitoring record-keeping program. The plan should

describe the diagnostic capacity (on-farm and contracted labs) available to support infectious disease surveillance.

- Disease diagnosis techniques that will be used to evaluate prevalence of expected diseases.
- Disease control procedures that will be followed in the event of disease outbreaks. The procedures should consider a broad range of options, including vaccination, quarantine, therapeutic treatments and treatment types (e.g. medicated feed, baths or dips, etc.) and humane slaughter (euthanasia). The steps followed shall include reporting to the Competent Authority if the disease is listed by the OIE or is required by local regulations. Procedures should also consider responses in the event of a disease emergency with potential to cause mass mortality.

To demonstrate that the Animal Health Management Plan is operational and fit-for-purpose, the farm shall maintain or have access to regularly updated records of water quality monitoring, feeding, aquatic animal health and behavior, water quality monitoring, daily mortalities, disease outbreaks, and use of veterinary drugs, therapeutic chemicals or disinfectants.

The Animal Health Management Plan should be evaluated once per year to assess compliance with the plan, effectiveness in meeting goals of improved health and greater survival, and whether documentation and record-keeping have been sufficient.

The Animal Health Management Plan should designate a member of the farm staff as health plan manager that will be responsible for implementing health plan elements, maintaining the recordkeeping system and training staff. The health plan manager should be a professional aquatic animal veterinarian or other trained specialist. The veterinary professional should guide the health monitoring program, conduct health checks and prescribe treatments.

Biosecurity Plan

Biosecurity in aquaculture consists of all practices, activities and policies that minimize the risks from the introduction and spread of aquatic animal diseases. Biosecurity in aquaculture spans multiple levels of governance from international (e.g. OIE guidelines on introductions and transfers), to national (legislative controls) and down to the farm level. Each farm is responsible for biosecurity within the farm.

Proper biosecurity controls will minimize the risk associated with the introduction or spread of disease agents within a farm. The Biosecurity Plan should link to the overall farm aquatic animal health and welfare plan. A farm-specific written Biosecurity Plan shall include, at minimum, the following elements.

- Identification of the likely infectious disease risks for the culture species within the region around the farm.
- Identification of entry and exit points and establishment of critical control points such as movement of aquatic animals and equipment, and farm access by visitors.
- Active control measures to prevent disease introduction in spread by movement of aquatic animals. This includes new introductions, regular stockings and internal movements of aquatic animals. Stock health inspections and certificates should be used to demonstrate the disease freedom of batches of introduced aquatic animals.
- Active control measures to prevent disease introduction and spread by movement of people and equipment. The plan should establish protocols that allow tracing of equipment and people movements, such as through visitor and delivery logs.
- Hygiene and sanitization protocols and standards for equipment and personnel.
- If slaughtering is conducted at the farm, procedures that will be followed to contain or treat blood water and other effluents generated through processing so they do not contaminate the environment or present a biosecurity risk.

To demonstrate that the Biosecurity Plan is operational and fit-for-purpose, the farm shall maintain regularly updated records that trace aquatic animal movements from hatchery to processing plant (see Traceability

section). Stock health inspections and certificates should be retained and compiled. Personnel, equipment and vehicle movement logs shall be maintained. Logs of sanitization and disinfection events should be maintained.

The Biosecurity Plan should be evaluated once per year to assess compliance with the plan, effectiveness in meeting goals of improved biosecurity, and whether documentation and record-keeping have been sufficient.

The Biosecurity Plan should designate a member of the farm staff as biosecurity plan manager that will be responsible for implementing biosecurity measures, maintaining the recordkeeping system and training staff and making visitors aware of their roles and responsibilities in implementing biosecurity measures.

Training

The biosecurity plan manager will be responsible for training farm workers in 1) aquatic animal husbandry practices that provide a low-stress environment conducive to good growth and survival, 2) identification of abnormal behavior and external clinical signs of diseases likely to be encountered on the farm, 3) disease reporting and notification procedures, 4) worker responsibilities in the event of disease outbreaks, and 5) role of worker movements in transmitting diseases. Training logs should be maintained by the biosecurity plan manager and will be reviewed during the audit.

Area Management

Although most BAP standards address farm-level impacts, they do not often address the cumulative impact of multiple farms. Cumulative impacts are especially critical with respect to disease transmission among neighboring farms, irrespective of certification status. Aquaculture zones or areas should be disease-free. To achieve area management of disease risks, qualifying farms are required to make a good-faith effort to initiate or participate in an Area Management Plan to coordinate disease surveillance and control and other biosecurity activities within one year of an audit. An exception is provided where farms can demonstrate, through a formal disease risk assessment by qualified and independent experts in aquatic animal diseases, that concludes that there is a low risk of disease transmission among farms.

Additional Information

SRAC 4707: Biosecurity in Aquaculture, Part 1: An Overview (Roy P. E. Yanong and Claire Erlacher-Reid)
https://srac.tamu.edu/fact-sheets

Finfish Biosecurity Measures Plan, Centre for Environment, Fisheries & Aquaculture Science (Cefas)
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/278581/Finfish_biosecurity_measures_plan.pdf

B. Welfare - All Production Systems

Audit Clauses

4.6: Mortalities; body condition factor; lesions, abrasions or fin damage; and gill damage or condition shall be measured in each production unit as individual-based welfare indicators of physical health.

4.7: Water quality shall be measured in each production unit as group-based welfare indicators of environmental quality and maintained within the tolerance limits established for the species and life-stage farmed.

4.8: Feeding response and swimming behavior shall be measured in each production unit as group-based welfare indicators of behavior.

4.9: The farm shall have Standard Operating Procedures for aquatic animal handling operations, including crowding, transfer among production units, grading, vaccination and chemical treatment, that limit the stress experienced by farmed aquatic animals during these operations.

4.10: Farm workers shall be trained in their roles and responsibilities in maintaining the welfare of farmed aquatic animals.

4.11: The welfare of harvested animals that are transported live to processing facilities shall be assessed by documentation of mortality rates during transport.

4.12: If aquatic animals are slaughtered on-farm, the farm shall identify the humane slaughter method used, appropriate for the species.

Implementation

For aquatic animals in aquaculture, welfare can be defined simply as an animal that is healthy and whose needs are met by the farmer. Fundamentally, good welfare will lead to good health, i.e. freedom from disease. Selecting sites and managing facilities to maximize fish welfare can improve production potential by providing conditions conducive to good growth and high survival. Attention to aquatic animal welfare is a characteristic of responsible aquaculture.

Aquatic animals experience numerous stressors that can affect welfare. These include handling, transport, crowding, grading, vaccination, chemical or therapeutic treatments, stocking density (space), water quality, water velocity, light, feed (access, distribution, quality), social interactions, predator control, and parasites and diseases, among others. The welfare requirements of different species and different life stages vary and so practices and considerations to provide good welfare also vary. Each farm should develop its own program to ensure good welfare of their aquatic animals. In general, culture conditions should be managed to avoid situations that could lead to stress, injury or disease. Farms should apply a maximum biomass limit based on standard best management practices and operational welfare indicators. Feeding should be managed to avoid stress caused by under- or over-feeding. For intensive production systems where there is a high risk to animal welfare in the event of a power failure, farms should have in place back-up or fail-safe systems (e.g. standby power generators, pure oxygen systems, tractor-powered paddlewheel aerators, emergency alert systems) to ensure maintenance of good water quality to support aquatic animal welfare.

<u>Welfare Indicators</u>

Best management practices to maintain good culture conditions and routine surveillance as part of health and welfare monitoring program are the keys to promoting good fish welfare. Operational welfare indicators can be measured by farm workers trained to recognize normal and abnormal physical health, water quality and behavior. Regular inspections of the culture facility, water quality analysis, and assessment of the behavior and condition of crustaceans or fish should be conducted regularly.

Individual – Physical Health

The farm shall maintain a recordkeeping system for individual-based welfare indicators of physical health. Mortality is one of the most basic indicators of aquatic animal welfare. Ideally floating dead fish would be removed and recorded as they appear at the water surface, but regular daily removal is best practice. Mortality is much easier to perceive and measure with finfish than with crustaceans. Finfish body condition factor (L/W) shall be measured regularly, preferably weekly. Various physical abnormalities associated with external physical health shall be recorded, including lesions, abrasions or fin damage and gill damage or condition. Crustaceans will have a different set of indicators of physical health. A scoring system can be used to assess all indicators of physical health. Sub-sampling for physical abnormalities can be done during normal biometric sampling, preferably weekly.

Group – Water Quality

The farm shall maintain a recordkeeping system for group-based welfare indicators of environmental quality. Although farms are required to measure the water quality of effluents, regular measurement of water quality to demonstrate that conditions are suitable for good production performance is also required. These are the same water quality variables that are normally measured as part of good husbandry practices. In each production unit, temperature, salinity, dissolved oxygen concentration, pH, ammonia and nitrite concentrations, and some index of solids concentration – transparency, turbidity or total suspended solids concentration – shall be measured regularly, as determined by culture system type and production system intensity (i.e. stocking density).

For finfish and crustacean species grown in flowing, tidal or turbulent water, current speed should be measured and not exceed limits defined by species and life stage. Fish should never be forced to the downstream end of the culture unit by water flow during the grow-out period. Farms should have contingency plans and/or alarms in place in the event of system failure, including having staff on-call to respond to water quality emergencies.

Group – Behavior

The farm shall maintain a recordkeeping system for group-based welfare indicators of behavior. Trained farm workers shall regularly inspect each production unit, noting the behavior of aquatic animals in each unit. Through training and experience, farm workers learn and can assess normal behavior. Often, a loss of appetite is the first sign of disease. Thus, regular assessment of feeding response is a component of health management that can permit rapid response, if necessary. Assessing feeding response can also indicate if fish are being underfed. Swimming behavior is a good indicator of group welfare in a production unit. Abnormal swimming behavior such as vertical orientation, lethargy, whirling, flashing, rubbing and piping are indicators of disease. For both behavior measures, farms may develop custom indices that may be qualitative or semi-quantitative (e.g. percentage range of group exhibiting a certain behavior).

Handling Operations

Aquatic animals that are concentrated during handling operations experience stress. Thus, handling operations should be conducted to minimize stress, including limiting crowding time and time out of water. Procedures for routine handling operations (crowding, transfer, grading, vaccination, chemical treatment, etc.) used on the farm should be described in a Standard Operating Procedure document. Equipment used for handling operations should be maintained in good working order and should be maintained and used in ways that minimize the potential for animal injuries.

Training

Farm workers shall be trained in their roles and responsibilities in maintaining the welfare of farmed aquatic animals. Farm managers are responsible for providing training to workers about 1) evaluation of welfare indicators, including normal and abnormal behavior, signs of poor welfare and expected diseases, 2) water quality management and aquatic animal husbandry, 3) aquatic animal handling procedures (crowding, disease treatment, transfers, loading for transport), and 4) humane euthanasia methods. Training logs should be maintained by the farm to indicate worker training activities.

Live Transport

Chapter 7.2 of the OIE Aquatic Animal Health Code provides detailed guidance on welfare of aquatic animals (especially finfish) during transport, including planning for transport, vehicles and transport containers, procedures for maintaining water quality, preparation for transport, loading, transport and unloading. All transport operations should be done with due consideration to aquatic animal welfare, biosecurity and potential disease transmission, and minimizing physical injuries to preserve product quality. Transport containers and vehicles should be washed and disinfected before and after use. Aquatic animals should be loaded at densities suitable for the species and for distance travelled to other production units or processing facilities. If aquatic animals are transported from one production unit to another, animals should be acclimated to new conditions prior to unloading. A transport logbook shall be maintained that includes information about the group of aquatic animals loaded to allow traceability to farm and production unit, and mortalities that occur during transport.

On-farm Processing

Chapter 7.3 of the OIE Aquatic Animal Health Code provides detailed guidance on welfare aspects of stunning and killing of farmed fish for human consumption. If aquatic animals are processed on-farm, the choice of stunning and killing method should be appropriate for the species and life stage. Stunning should be sufficient to render fish unconscious rapidly, as indicated by lack of opercular movement or other indicators. The following

methods are considered humane: percussive or mechanical stunning, including spiking or pithing, and electrical stunning and killing in water. The following methods are not allowed for killing fish: carbon dioxide (CO_2) in holding water, chilling with ice and CO_2 in holding water, salt or ammonia baths, asphyxiation by removal from water (anoxia) and exsanguination without stunning. Rapid chilling in an ice bath, i.e. thermal shock, is considered sub-optimal but is permissible for on-farm chill-kill of crustaceans and tropical fish species. Technology for the stunning of certain fish types, such as flat fish, is not widely available, so the use of thermal shock is still permissible in specific cases. Note however that the BAP requirements limiting the use of thermal shock will be revised within the three years following the release of this issue (3.0).

Additional Information

OIE Aquatic Animal Health Code (2019), Section 7 – Welfare of Farmed Fish
https://www.oie.int/international-standard-setting/aquatic-code

Noble, C., Gismervik, K., Iversen, M.H., Kolarevic, J., Nilsson, J., Stien, L.H. & Turnbull, J.F. (eds.) (2018)
Welfare Indicators for farmed Atlantic salmon: tools for assessing fish welfare
https://nofima.no/wp-content/uploads/2018/11/FISHWELL-Welfare-indicators-for-farmed-Atlantic-salmon-November-2018.pdf

AVMA Guidelines for the Euthanasia of Animals: 2020 Edition
https://www.avma.org/resources-tools/avma-policies/avma-guidelines-euthanasia-animals

Traceability - All Production Systems

Audit Clauses

T1: The farm 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.

T2: The farm shall have an online traceability system or an in-house database consisting of paper records, documents, forms, notebooks, files, or any combination thereof, and all records shall be available for verification during an audit.

T3: The farm shall keep complete and accurate records for each culture unit and production cycle, including the culture unit identification number, unit area and volume.

T4: As per Clause 3.44, the farm shall keep complete and accurate records of the sources (including BAP certification status of hatchery) and numbers of seed (e.g. post-larvae, juveniles, fingerlings) stocked, stocking dates, species stocked and, if applicable, species characteristic specifications such as non-native, specific pathogen-free, specific pathogen-resistant, hybrid, triploid, sex-reversed, genetically modified (GM) or bioengineered (BE).

T5: Farms that purchase stocking materials from both BAP and non-BAP certified hatcheries shall identify and record all sources and have adequate systems in place to prevent mixing/comingling of stocking materials. All product harvested from use of stocking material from non-BAP certified hatcheries shall not claim the hatchery-associated BAP star status.

T6: Farms that purchase stocking materials from non-BAP certified nurseries and/or other intermediaries shall identify and record all sources and have adequate systems in place to prevent mixing/comingling of the stocking materials. All product harvested from use of such stocking materials shall not claim the hatchery-associated BAP star status. (Note: This does not apply to nurseries within the farm and/or in close proximity to the farm that are part of the certification and that undergo audits during the farm annual audit).

T7: The farm shall keep complete and accurate records regarding feed manufacturer (including BAP certification status of feed manufacturer), lot numbers and quantities of each feed used in each production unit in each production/crop cycle.

T8: The farm shall keep complete and accurate records concerning any antibiotic or other therapeutic drug use at both the hatchery and the farm, including dosage and dates of treatment initiation and completion.

T9: The farm shall keep complete and accurate records concerning any therapeutic chemical or water quality amendment (fungicides, parasiticides, herbicides, algicides, pesticides, oxidants, probiotics) at the farm, including dosage and dates of treatment.

T10: For production of shrimp and other crustaceans, the farm shall keep complete and accurate records on the use of sulfites (e.g. sodium metabisulfite) or other approved food-processing aids/additives used to control melanosis at harvest.

T11: The farm shall keep complete and accurate records regarding the harvest date, harvest quantity, movement document number (if applicable) and processing plant(s) or purchaser(s). If product lots are destined for more than one processing plant or purchaser, each sub-lot shall be separately identified.

T12: The farm shall provide to all processing plants or purchasers the following information, as applicable, concerning the harvested products:

- Farm name
- Farm government registration number(s)
- BAP farm certification number
- Production method (pond, cages, reservoir, etc.)
- Production unit identification number (i.e., individual pond/cage ID number)
- Sources of post larvae/stocking material, including relevant stock characteristics such as BAP Star status, native/non-native, specific pathogen-free, specific pathogen-resistant, hybrid, triploid, all-male or all-female, sex reversed, genetically modified (GM) or bioengineered (BE)]
- Date of deliveries and lot numbers (defined as deliveries from a single pond or culture unit harvested on a single day)
- Estimated average size and number of harvested animals, total net weight and unit of measure (e.g. kg, mt) for mass balance
- Movement document number (if relevant)
- Feed use (BAP Star Status, commercial brand names, type and lot numbers)
- Reports of chemical treatments
- Testing data for the presence of microbes, antibiotics and chemicals in product (if any such testing was done by the farm itself)

T13: The farm shall keep records of any buyer complaints related to its products' compliance with the BAP standards and records of investigations of such complaints and actions taken to address/correct them.

T14: Farms shall record and provide documentation that demonstrates the farm's relationship with any BAP-certified facilities to which the farm is linked for purposes of star status claims, including:

- The names of all supplying facilities (feed mills and hatcheries/nurseries)
- The names of all product receiving facilities (processing plants), and
- The corresponding annual volume of BAP-certified product exchanged between the named BAP-certified facilities in metric tons/year in the case of feed and harvested products, and the number of live aquatic animals in the case of hatcheries/nurseries.

Note: Auditors must verify this volume/mass balance data and include summary data in the audit report.

T15: The farm, regardless of the star status claims being made for harvested products, shall provide data for the auditor to perform at a minimum two trace-back exercises, one to feed and one to stocking materials, and one trace-forward exercise to a processing plant. Results of these exercises shall be in line with expectations. Note: at the discretion of the auditor, more trace exercises may be conducted.

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. Farms are encouraged to consider implementation of an electronic supply chain traceability system such as blockchain. Where paper records, documents or notebooks are used, if possible, the information should also be transferred to computer database files to allow preparation of data summaries and facilitate electronic transmission. Transition to internal and/or third-party electronic traceability systems is encouraged, e.g. using GDST data recommendations for interoperability. Original files or paper records shall be kept for five years to allow verification of the electronic data.

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 review the effort at intervals to verify that it satisfies BAP requirements.

The farm shall keep complete and accurate records of the following:

- Sources of seed (eggs, post-larvae and fingerlings)
- Feed sources, types and quantities, feed mill owner/business identification, location
- Therapeutic treatments, with dose, treatment duration, and treatment completion date
- Chemicals (disinfectants, fungicides, parasiticides, herbicides, algicides and other pesticides/chemicals).

Records must be kept in relation to each production unit for each production cycle. Production unit-related records can be captured on the sample Product Traceability Form (Appendix E). Each form corresponds to the harvest on a particular day from a particular culture unit.

Product Identity Preservation

To ensure 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 ensure 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 farm shall have adequate systems in place to prevent unintended mixing/co-mingling of stocks and feeds from BAP-certified and non-BAP-certified sources. The BAP hatchery-related star cannot be claimed for harvested products from culture units in which more than 20% of the total number of animals were sourced from non-BAP certified hatcheries. The BAP feed-related star cannot be claimed for harvested products from culture units in which more than 20% by weight of the feed volume used was sourced from non-BAP certified feed mills.

The results of trace-forward and trace-back exercises and their mass balance shall be recorded for each eligible star designation. The auditor shall record the traceability and mass balance data in the audit report.

BAP Logo Use

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

Customer Complaints

The farm 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.

Appendix A – All Production Systems

This section describes procedures to estimate effluent volume that will be used to calculate a water use index (volume of water used divided by annual fish or shrimp production). Estimations of water use and effluent volume, along with information about effluent water quality and production system time, will be used to calculate nitrogen and phosphorus loads to the environment, expressed as mass per year and mass per fish or shrimp production. This information shall be collected and reported by farms to auditors. The production system scenarios identified below are not intended to be comprehensive, but rather cover the majority of production systems used by BAP-certified farms. Other methods of calculating effluent volume and nutrient mass loading may be suitable for systems not identified below. Those methods can be presented to the BAP Program Integrity team for review and approval. Through analysis of effluent water quality data submitted in BAP audit reports, provisional targets for load indices have been set at: 15kg/mt for total ammonia nitrogen; 1kg/mt for soluble phosphorus; 200 kg/mt for BOD_5.

Calculation of Annual Effluent Volume

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

Embankment Ponds – 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

Embankment Ponds – Water Exchange Method

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

Watershed Ponds – Filled Only by Overland Flow (Runoff)

Effluent volume (m^3/yr) = Annual rainfall (m) x (Watershed area (m^2) x 0.2)

Watershed Ponds – Filled by Inflow from a First-Order (Small) Stream

Effluent volume (m^3/yr) = Annual rainfall (m) x (Watershed area (m^2) x 0.4)

Raceways

Effluent volume (m^3/yr) = Velocity of flow in raceway (m/sec) x Raceway width (m) x Raceway depth (m) x Annual time of operation (days/yr) x 86,400 sec/day

Tanks

Effluent volume (m^3/yr) = Tank volume (m^3) x Number of tank water exchanges per day x Annual time of operation (days/yr)

Recirculating Aquaculture Systems

Effluent volume (m^3/yr) = System volume (m^3) x Fraction (0-1) of system volume replaced with new water per day x Annual time of operation (days/yr)

Other appropriate methods can be used.

Water Use Index

Although not recommended, 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. A water use index shall be estimated using the following equation.

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

Calculation of 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. Annual loads for total phosphorus and total nitrogen shall be calculated as indicated for each production system type.

Information indicated by a line must be provided by the applicant and recorded on audit reports.

Fish or shrimp produced per year (kg) _____
Feed used per year (kg) _____
Feed protein in grow-out feed (%) _____
Feed N content (%) = Feed protein (%) x 0.16 = _____
Feed P content (%) = _____ (1% is the default P content, unless value is provided by feed supplier)
Harvested fish or shrimp N content (%) = 2.5 (fish) or 3.0 (shrimp)
Harvested fish or shrimp P content (%) = 0.7 (fish) or 0.3 (shrimp)

Nutrient load indices shall be estimated using the following equations, depending on production system.

Cages/net pens and flow-through systems (e.g. raceways, circular tanks) with no solids capture, irrespective of salinity

Nitrogen load (kg/yr) = [Total feed (kg) x Nitrogen (% in feed) ÷ 100] – [Harvested aquatic animals (kg) x Nitrogen (% in fish) ÷ 100]
Nitrogen load index (kg/mt) = Nitrogen load (kg/yr) ÷ Annual production (mt/yr)

Phosphorus load (kg/crop) = [Total feed (kg) x Phosphorus (% in feed) ÷ 100] – [Harvested aquatic animals (kg) x Phosphorus (% in fish) ÷ 100]
Phosphorus load index (kg/mt) = Phosphorus load (kg/yr) x Crops/yr ÷ Annual production (mt/yr)

Flow-through systems with solids capture in quiescent zones or settling basins

Nitrogen load (kg/yr) = [Total feed (kg) x Nitrogen (% in feed) ÷ 100] – [Harvested aquatic animals (kg) x Nitrogen (% in fish) ÷ 100] x 0.80
Nitrogen load index (kg/mt) = Nitrogen load (kg/yr) ÷ Annual production (mt/yr)

Phosphorus load (kg/yr) = [Total feed (kg) x Phosphorus (% in feed) ÷ 100] – [Harvested aquatic animals (kg) x Phosphorus (% in fish) ÷ 100] x 0.50
Phosphorus load index (kg/mt) = Phosphorus load (kg/yr) ÷ Annual production (mt/yr)

Ponds

For ponds with no intentional discharge over multiple production cycles:
Nitrogen load (kg/crop) = [Total feed (kg) x Nitrogen (% in feed) ÷ 100] – [Harvested aquatic animals (kg) x Nitrogen (% in fish) ÷ 100] x 0.30
Nitrogen load index (kg/mt) = Nitrogen load (kg) ÷ Annual production (mt/yr)

Phosphorus load (kg/yr) = [Total feed (kg) x Phosphorus (% in feed) ÷ 100] – [Harvested aquatic animals (kg) x Phosphorus (% in fish) ÷ 100] x 0.15
Phosphorus load index (kg/mt) = Phosphorus load (kg/yr) ÷ Annual production (mt/yr)

For ponds managed with water exchange:
Load of total nitrogen or total phosphorous (kg/yr) = Effluent volume (m^3/yr) x [Mean total nitrogen or total phosphorus concentration in effluent – mean total nitrogen or total phosphorus concentration in source water (mg/L, same as g/m^3)] ÷ 1000 g/kg

Alternatively, in the absence of measurements of variable concentration in source water or where groundwater is used as a water source, the calculation shall be:
Nitrogen load (kg/yr) = Effluent volume (m^3/yr) x 5 mg/L (same as g/m^3)] ÷ 1000 g/kg
Nitrogen load index (kg/mt) = Nitrogen load (kg/yr) ÷ Annual production (mt/yr)

Phosphorus load (kg/yr) = Effluent volume (m^3/yr) x 0.3 mg/L (same as g/m^3)] ÷ 1000 g/kg
Phosphorus load index (kg/mt) = Phosphorus load (kg/yr) ÷ Annual production (mt/yr)

For intensive ponds (>20 t/ha per yr) with water exchange and with solids capture/sedimentation:
Nitrogen load (kg/yr) = [Total feed (kg) x Nitrogen (% in feed) ÷ 100] – [Harvested aquatic animals (kg) x Nitrogen (% in fish) ÷ 100] x 0.25
Nitrogen load index (kg/mt) = Nitrogen load (kg/yr) ÷ Annual production (mt/yr)

Phosphorus load (kg/yr) = [Total feed (kg) x Phosphorus (% in feed) ÷ 100] – [Harvested aquatic animals (kg) x Phosphorus (% in fish) ÷ 100] x 0.50
Phosphorus load index (kg/mt) = Phosphorus load (kg/yr) ÷ Annual production (mt/yr)

Recirculating Aquaculture Systems
Nitrogen load (kg/yr) = Effluent volume (m^3/yr) x NO_3-N concentration (mg/L) ÷ 1000 g/kg
Nitrogen load index (kg/mt) = Nitrogen load (kg/yr) ÷ Annual production (mt/yr)

Phosphorus load (kg/yr) = Effluent volume (m^3/yr) x Total P concentration (mg/L) ÷ 1000 g/kg
Phosphorus load index (kg/mt) = Phosphorus load (kg/yr) ÷ Annual production (mt/yr)

Calculation Examples

Example 1: 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, 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 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

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

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

S.P. index = (1,472 kg/yr) / (230 mt shrimp or fish) = 6.4 kg S.P./mt shrimp or fish
TAN index = (6,624 kg/yr) / (230 mt shrimp or fish) = 28.8 kg TAN/mt shrimp or fish
BOD index = (74,520 kg/yr) / (230 mt shrimp or fish)= 324 kg BOD/mt shrimp or fish

Example 2: 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 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
Water use index = (23,827.200 m^3/yr) / (378,000 kg shrimp or fish/yr) = 63.0 m^3/kg shrimp or fish

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

S.P. index = (4,765 kg/yr) / (378 mt shrimp or fish) = 12.6 kg S.P./mt shrimp or fish
TAN index = (25,018 kg/yr) / (378 mt shrimp or fish) = 66.2 kg TAN/mt shrimp or fish
BOD index = (266,865 kg/yr) / (378 mt shrimp or fish) = 706 kg BOD/mt shrimp or fish

Appendix B – Ponds, Non-Coastal Flow-through Systems and Recirculating Aquaculture Systems

BAP Effluent Water Quality Criteria

Variable (units)	Ponds and Raceways	RAS*	Minimum Collection Frequency
pH (standard pH units)	6.0-9.5	6.0-9.5	Monthly
Total suspended solids (mg/L)	Less than 50	Less than 25	Quarterly
Soluble phosphorus (mg/L)	Less than 0.5	---	Monthly
Total phosphorus (mg/L)	---	Less than 10	Quarterly
Total ammonia nitrogen (mg/L)	Less than 5	Less than 5	Monthly
Nitrate-N (mg/L)	---	Less than 50	Quarterly
5-day biochemical oxygen demand (mg/L)	Less than 50	Less than 25	Quarterly
Dissolved oxygen (mg/L)	More than 5	More than 5	Monthly
Chloride (mg/L)	No discharge above 800 mg/L chloride into freshwater**	No discharge above 800 mg/L chloride into freshwater**	Monthly

*Here RAS are defined as systems 1) with a recirculating flow that is >90% of total water flow and 2) with greater than 1% new water per day of total system volume. Recirculating systems with less than 1% new water per day of total system volume are exempt from effluent monitoring.

** Water with less than 1 ppt salinity, specific conductance below 1,500 mmhos/cm or chloride less than 550 mg/L is considered fresh.

Sampling

- Samples shall be collected just prior to locations where effluents enter natural water bodies or exit the farm property. Samples should be collected so that mixing of effluent and water from the receiving body is prevented.
- 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 container to prevent exposure to sunlight.
- 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 of 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 grow-out units being drained for harvest at the time of sampling shall be recorded.
- Samples of source water shall be collected quarterly directly in front of the pump station or from the pump discharge outlet but before pumped water mixes with water in the internal supply canal. Comparing water quality between source and effluent can be used to calculate annual loads and justify an exemption for water quality monitoring of variables that demonstrate no deterioration between source and effluent (3.2.2).

Analysis

- Water samples should be processed and measurements made promptly. Test kits for field or on-farm laboratory can be used for analysis of total ammonia nitrogen, soluble phosphorus, nitrate and chloride. Samples should be diluted with deionized or distilled water to bring test samples into the test kit concentration range for individual variables as needed. Total suspended solids, total phosphorus and 5-d biochemical oxygen demand should be measured by laboratories with technical capacity to conduct those tests.
- Measurements for dissolved oxygen and pH shall be taken in situ with portable meters. pH of water samples collected for dissolved nutrients can also be measured in on-farm water quality laboratories. Auditors shall verify the correct application of dissolved oxygen and pH meter calibration procedures.

Auditing

- A map of the farm layout indicating pumping stations, effluent outfalls and receiving water monitoring points shall be provided to auditors. These areas should be visited and viewed for obvious signs of impaired water quality near outfalls.
- Auditors will inspect and evaluate operation of the on-farm water quality laboratory, the water sampling program and the effluent monitoring recordkeeping system. Auditors can reject analytical results if sampling, in situ measurements or water quality laboratory protocols and analytical procedures are deficient.

Appendix C – Ponds, Non-Coastal Flow-through Systems and Recirculating Aquaculture Systems

Sample Effluent Monitoring Form – pH and Dissolved Oxygen

Date (day/month/ year)	pH (standard units) Morning	Evening	Average	Dissolved Oxygen (mg/L) Morning	Evening	Average	No. Units Harvested
____/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 D – Cages and Net Pens in Lakes and Reservoirs

BAP Water Quality Monitoring

Variable (units)	Sample Depth	Collection Frequency (minimum)
Secchi disk visibility (cm)	---	Every two weeks
Dissolved oxygen (mg/L)	At 50 cm depth	Every month
Chlorophyll a (µg/L)	At 50 cm depth	Every two months
Total phosphorus (µg/L)	At 50 cm depth	Every two months
Phytoplankton abundance and species (% blue-green algae)	At 50 cm depth	Every two months

Sampling

- A minimum of two sampling stations shall be established. One shall be at the approximate center of the cage farm or net pen area. The other station must be from 50 to 100 m away from the cages, in the prevailing downcurrent direction. It is recommended that these sampling stations be geolocated with fixed buoys or geographic positioning systems (GPS).
- The auditor must approve 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.
- Secchi disk visibility shall be measured on a clear day, around midday, with the sun behind the viewer but not in shadow. The recorded value should be the average of the depth of disappearance and the depth of reappearance of the disk.
- Direct measurements of dissolved oxygen concentration a shall be made between 0600 and 0900 hours.
- Water for measurement of total phosphorus and chlorophyll *a* concentration should be collected at each sampling station with a Kemmerer or van Dorn water sampler, or by use of a weighted bottle from which the stopper can be removed by yanking on a calibrated line. Samples should be transferred to clean plastic bottles and placed in ice in a closed, insulated container to avoid exposure to sunlight.
- Water samples from the two sampling stations shall be blended (1:1) to create a composite sample for analysis of total phosphorus and chlorophyll *a* concentration.

Analysis

- Water samples shall be processed, delivered to a water quality laboratory and measurements made promptly. 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.
- Measurements for dissolved oxygen concentration shall be taken *in situ* with a portable meter. Auditors shall verify the correct application of dissolved oxygen meter calibration procedures.

Auditing

- A map of the water body with the farm layout indicating location of cages or net pens, water body inlets and outlets, and water quality monitoring sampling stations shall be provided to auditors. Water quality should be visually assessed by auditors for obvious qualitative signs of impairment.
- Auditors will evaluate the qualifications of the selected water quality laboratory and the sufficiency of the water sampling program and the water body monitoring recordkeeping system. Auditors can reject analytical results if sampling, in situ measurements or water quality laboratory protocols and analytical procedures are deficient.

Appendix E - All Production Systems

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)	