



## FARM BIOSECURITY GUIDELINES FOR AQUACULTURE

### Purpose

The purpose of these guidelines for aquaculture farms is to assist the farms to monitor and implement biosecurity measures.

### Importance of farm biosecurity

Diseases affect the survival and growth rate of fish<sup>1</sup>, resulting in losses during outbreaks and lower harvests in the long-term.

They are a constant threat in fish farming that can come from various sources, including new fish introduced, feed, people, pests, equipment, the water, and wild fauna. To minimise fish losses through diseases and the need for drug treatments, it is important for each farm to take precautions against the introduction and spread of diseases within the farm, and to other farms. Each farm should appoint one or more of their staff to monitor farm site conditions, develop and manage farm biosecurity. Training is available at various institutions, please see examples listed in [Annex](#).

### Introduction to guidelines

Diseases in aquaculture are not caused by a single event but are the end result from the interactions between the host (the fish), the environment and the presence of a pathogen (organisms causing the disease in the fish). Under aquaculture conditions, three factors are particularly important affecting host's susceptibility: stocking density (number of fish kept in a unit area), innate susceptibility and immunity (natural/acquired). The environment includes not only the water and its components (such as oxygen, pH, temperature, toxins, wastes) but also the kind of management practices (e.g. handling, drug treatments, transport procedures, etc.). Pathogens may include viruses, bacteria, parasites and fungi; diseases may be caused by a single species or a mixture of different pathogens.

To prevent losses from disease, the first and most important defence is for the farm to monitor as regularly as possible and take appropriate action at the first sign(s) of suspicious behaviour, affected body part or mortalities in the fish.

To assist farms, SFA has drawn up the following guidelines which are organised as measures to i) prevent entry of diseases into farms, ii) prevent spread within farms and iii) prevent spread from farms.

SN	Guidelines for farm biosecurity	Details
I) Prevention of entry of diseases into farms		
1	Access to the production area should be restricted to farm workers and essential business visitors only e.g. contractors for repair and maintenance of farm equipment, visits by business partners/investors.	Set up a visitor's register, which should include names, contact information, date, vehicle/vessel registration numbers.

<sup>1</sup> In this document, fish refers to not just finfish for consumption but also other forms of seafood

2	<p>The farm should have in place a pest management programme to prevent the harbourage and breeding of pests on the grounds and within the farm facilities.</p>	<p>Effective means should be provided to exclude pests, e.g. rats, mice, cockroaches and birds from entry and harbouring in the premises.</p> <p>The services of a professional pest control company should be engaged if the pest control carried out by the farm is found not effective.</p> <p>For semi-closed or closed aquaculture production systems, measures should be implemented to prevent entry of wild aquatic animals.</p> <p>Examples of pest control measures:</p> <ul style="list-style-type: none"> <li>i) filtering or screening of water entering and exiting semi-closed and closed aquaculture production systems to prevent entry of wild aquatic animals;</li> <li>ii) surrounding floating aquaculture production systems by barriers on the establishment perimeter to prevent contact with or entry of wild aquatic animals and other animals; and</li> <li>iii) covering outdoor or unenclosed aquaculture production systems with nets to prevent access by birds.</li> </ul>
3	<p>There should be proper documentation of fish stocks in the various ponds/net cages/tanks which should be labelled. Fish movement between ponds/net cages/tanks from entry till exit should be tracked.</p>	<p>Accurate records should be maintained of the species farmed and, where relevant, any significant stock characteristics, such as whether they are non-native, specific pathogen-free, hybrid, triploid, sex-reversed.</p> <p>Sources and purchases of fish stocks, and the number stocked in each culture unit for each production cycle should be recorded.</p> <p>Incoming fish stocks should be of good health and known farm origin. i.e. not wild caught. Stocks should arrive on farm with no visible signs of illness or high mortality and are from a known good source. Where appropriate, quarantine incoming stock from other fish stocks within the farm. Quarantine means to maintain a group of fish in isolation with no direct or indirect contact with other fish, in order to observe them for a specified length of time, and if appropriate, with testing and treatment to mitigate disease risks e.g. treatment for external parasites, including proper treatment of the waste waters.</p> <p>Stocking densities should be based on culture techniques, fish species, size and age, carrying</p>

		<p>capacity of the fish farm, anticipated survival and desired size at harvesting.</p> <p>Use of species in polyculture or integrated multitrophic aquaculture should be carefully considered in order to reduce potential risk of disease transmission. Polyculture refers the production of two or more farmed species in the same physical space at the same time e.g. shrimp and fish in the same pond/tank whereas IMTA is a systematic practice of more intensive growing of farmed species (e.g. fish), fed side-by-side with extractive species (e.g. seaweed, shellfish, etc), connected by nutrient and energy transfers through water.</p> <p>Example of label/ document:</p> <table border="1" data-bbox="751 790 1385 907"> <tr> <td data-bbox="751 790 1385 831"><b>Tank/net cage no. (e.g. 12-25-11)</b></td> </tr> <tr> <td data-bbox="751 831 1385 871"><b>(species/size/quantity: tilapia/fry/3000)</b></td> </tr> <tr> <td data-bbox="751 871 1385 907"><b>Date of stocking:</b></td> </tr> </table>	<b>Tank/net cage no. (e.g. 12-25-11)</b>	<b>(species/size/quantity: tilapia/fry/3000)</b>	<b>Date of stocking:</b>
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4	<p>Fish stocks should be monitored daily on their health status, with abnormalities and deaths recorded.</p>	<p>Farm staff should regularly inspect the culture facility, water quality, and behaviour and condition of the fish.</p> <p>It is critical to establish, and record, normal behaviour and appearance to compare with observations made during disease events. Any change from normal behaviour should be a cause for concern and warrants investigation.</p> <p>Check water quality regularly and record parameters such as dissolved oxygen, ammonia, nitrite and pH as acceptable levels may vary depending on the species to be farmed and fluctuations can cause environmental stress affecting fish health.</p> <p>For hatcheries, critical information that should be recorded include:</p> <ul style="list-style-type: none"> <li>• feeding activity</li> <li>• growth</li> <li>• mortalities</li> </ul> <p>For pond or net/cage sites, observations which need to be recorded include:</p> <ul style="list-style-type: none"> <li>• growth</li> <li>• fouling</li> <li>• mortalities</li> </ul> <p>These should be recorded with date, site location and any relevant activities (e.g. sample collection for laboratory examination). As elsewhere, these records</p>			

		<p>should be checked regularly by the staff responsible for farm biosecurity.</p> <p>Examples of abnormalities observed in fish are:</p> <table border="1"> <tr> <td>Behaviour</td> <td> <p>Fish swimming near the surface, sinking to the bottom, loss of balance, flashing, cork-screwing or air gulping (non air-breathers) or any sign which deviates from normal behaviour.</p> <p>Bursts of abnormal activity are often associated with a generalised lethargy.</p> </td> </tr> <tr> <td>Skin/fins</td> <td> <ul style="list-style-type: none"> <li>• Red spots, which can be pin-point size or larger patches</li> <li>• White or black spots</li> <li>• Bleeding/haemorrhage</li> <li>• Erosions/ulcers</li> <li>• Mucus build up</li> <li>• Scale loss</li> <li>• Abnormal growth/ tumour</li> </ul> </td> </tr> <tr> <td>Eyes</td> <td> <ul style="list-style-type: none"> <li>• Shape/size e.g. enlarged and swollen eye “popeye”</li> <li>• Cloudiness</li> <li>• Gas bubbles</li> <li>• Haemorrhagic</li> </ul> </td> </tr> <tr> <td>Gills</td> <td> <ul style="list-style-type: none"> <li>• Paleness</li> <li>• Erosion</li> </ul> </td> </tr> </table>	Behaviour	<p>Fish swimming near the surface, sinking to the bottom, loss of balance, flashing, cork-screwing or air gulping (non air-breathers) or any sign which deviates from normal behaviour.</p> <p>Bursts of abnormal activity are often associated with a generalised lethargy.</p>	Skin/fins	<ul style="list-style-type: none"> <li>• Red spots, which can be pin-point size or larger patches</li> <li>• White or black spots</li> <li>• Bleeding/haemorrhage</li> <li>• Erosions/ulcers</li> <li>• Mucus build up</li> <li>• Scale loss</li> <li>• Abnormal growth/ tumour</li> </ul>	Eyes	<ul style="list-style-type: none"> <li>• Shape/size e.g. enlarged and swollen eye “popeye”</li> <li>• Cloudiness</li> <li>• Gas bubbles</li> <li>• Haemorrhagic</li> </ul>	Gills	<ul style="list-style-type: none"> <li>• Paleness</li> <li>• Erosion</li> </ul>
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5	For land farms, all production areas in the farm should be completely fenced to prevent unauthorised entry.	Land-based aquaculture production systems can create a better-defined border of the farm and hence improve access control by using a fence or a wall to prevent entry of animals and people, with a gate for controlled access for authorized personnel and visitors.								
<b>II) Prevention of spread of diseases within farms</b>										
6	Feeds should be properly stored to prevent contamination, spoilage/ decomposition.	Storage is according to manufacturer’s instructions, in a clean, dedicated area under suitable temperature controls. Feed should be raised above ground or in container and to prevent cross contamination such as chemicals or non agri-substances. Usage should be on a first-in-first-out basis. Feed should be in dried form and any mouldy or rancid feed should be disposed.								
7	Raw or unprocessed animal materials or products (e.g. animal carcass or any part thereof, animal fat, meat, bone, manure, etc) should not be fed to the aquatic animals.	These increase the risk of transmitting diseases to farmed fish, and can be managed by using feed and feed ingredients that: <ul style="list-style-type: none"> <li>a) have undergone sufficient processing to inactivate pathogenic agents of concern;</li> </ul>								

	Diseased/moribund fish should not be used as feed.	<p>b) are from sources that are declared free from the pathogenic agents of concern or have been confirmed (e.g. by testing) that pathogenic agents are not present in the feed or feed ingredients; and</p> <p>c) have been processed, manufactured, stored, transported and delivered in a manner to prevent contamination by pathogenic agents.</p>
8	Sick or dead fish should be removed from the production units/net cages as soon as possible and disposed in labelled and sealed double-lined bags.	<p>Affected fish should be quarantined as far away as possible from unaffected fish until the cause of the mortalities can be established and the situation is resolved.</p> <p>If possible, the farm should completely remove fish from all or parts of the farm at intervals, for instance between fish generations or production cycles, followed by cleaning, disinfection and drying of production installations. Sites should be fallowed for a period sufficient to interrupt infection cycles and reduce or eliminate pathogen challenge to restocked fish. Fallowing should be coordinated for farms in the same shared water bodies.</p>
9	Only trained personnel are allowed to carry out and supervise usage of antibiotics, drugs, vaccines and chemicals in the farm.	<p>Healthy stock may be given treatments to prevent diseases, such as vaccinations and chemical baths to eliminate external parasites.</p> <p>Sick fish should be quarantined from unaffected fish. They may be given antibiotics, drugs and chemical baths, depending on the cause of illness. Chemicals for cleaning and disinfection have to be prepared in the right concentrations and applied under the right conditions to be effective.</p> <p>Staff can apply measures to reduce stress in both healthy and sick fish such as reducing stocking density, reduced handling and strict maintenance of staff hygiene and other practices to prevent contamination on farm.</p> <p>These processes require understanding and correct application by staff, through training and following documented procedures.</p>
10	Should the farm intend to treat the fish with any drug, it should be ensured that:	Antibiotics, drugs, vaccines and chemicals used should be those allowed for use in Singapore and following the recommendations on the manufacturer's label or as directed according to a veterinarian.

	<ul style="list-style-type: none"> <li>i. veterinary advice has been sought before treatment,</li> <li>ii. the manufacturer's instructions have been followed, and</li> <li>iii. the withdrawal period has been observed.</li> </ul>	<p><u>Requirements under the farm directive issued by SFA for drug use (this is for compliance by all farms issued with the directive):</u></p> <p>Prophylactic use of antibiotics in a healthy animal population is not allowed unless there is a disease threat as assessed by a veterinarian. The use of antibiotics as growth promoters is also prohibited. During the period of treatment and withdrawal, the farm must not sell any of the fish for human consumption. The following drugs are not allowed for use in food-producing animals on the farm:</p> <ul style="list-style-type: none"> <li>a. Carbapenems</li> <li>b. Chloramphenicol</li> <li>c. Chloroform</li> <li>d. Chlorpromazine</li> <li>e. Natural toxins (e.g. Colchicine)</li> <li>f. Dapsone</li> <li>g. Nitroimidazoles (includes Metronidazole, Iprnidazole, Ronidazole, Dimetrazole)</li> <li>h. Glycopeptides (includes Avoparcin, Vancomycin, Orienticin)</li> <li>i. Polymyxin (e.g. Colistin)</li> <li>j. Sulfanitran</li> <li>k. Streptomycin</li> <li>l. Thiouracil analogues</li> <li>m. Tapazol</li> <li>n. Quinoxalines (includes Olaquinox and Carbadox)</li> <li>o. Triphenylmethane dyes (includes Gentan violet, Malachite green and its metabolites)</li> <li>p. Nitrofurans group &amp; the metabolites</li> <li>q. Any beta-agonist drugs</li> <li>r. Any synthetic hormones e.g. anabolic steroids (with exception of use for spawning aids, if applicable, subject to approval by SFA)</li> <li>s. Any materials/mixtures which the Licensee does not have knowledge of the composition and content of such material/mixtures or are known to contain prohibited substances.</li> </ul>
11	Antibiotics, drugs, vaccines and chemicals should be clearly labelled and stored securely. The storage area should be isolated from packing areas and feeds to prevent contamination.	Antibiotics, drugs, vaccines and chemicals should be clearly labelled and stored in their original containers, securely. They should be stored at the appropriate temperature. Storage area should be isolated from packing areas and fish feeds to prevent contamination. Good chemical storage practice should be adhered to, including ensuring that the store has facilities to clean up spills and put out flames.

		All containers and unused portions of antibiotics, drugs, vaccines and chemicals should be safely and properly disposed. Do not recycle empty containers for other uses.
III) Prevention of spread of diseases from farms		
12	Farms should notify SFA if they encounter abnormal mortality patterns.	<p>The farm should report to SFA any unexplained or unusual mortalities, or suspicion of a notifiable disease or an emerging disease in the fish. Investigation and diagnosis of the cause of mortality should be undertaken by aquatic animal health professionals or veterinarians.</p> <p>Patterns of mortalities should be closely monitored, as well as levels of mortality. If losses persist or increase, samples should be sent for laboratory analysis. Mortalities that seem to have a uniform or random distribution should be examined immediately and environmental factors during, pre- and post-mortality recorded. Mortalities that spread from one area to another may suggest the presence of an infectious disease agent and the fish and water should be sampled immediately.</p>
13	Carcasses/diseased stock and other farm waste should be properly disposed in land-based waste disposal facilities.	<p>Farm waste should be removed promptly and properly to avoid accumulation. It should be disposed of in compliance with NEA and PUB's regulations and avoid environmental contamination and odour problems (e.g. recycling, burning, composting or placing in a legal landfill).</p> <p>Garbage and food waste should be retained in water-tight receptacles with covers to protect contents from insects, rodents and other animals.</p> <p>Waste from fuel, lubricants, feed and agricultural chemicals should be disposed of in a safe and responsible manner.</p>
14	Farm equipment, including cages, cage nets, containers, cleaning tools, diving equipment, and vehicles/ vessels/ transport containers, should be cleaned and disinfected regularly with planned cleaning schedules and procedures.	<p>These can mechanically transfer pathogenic agents into, within and from the farm, and are known as fomites. They should be operated and maintained in ways that prevent contamination from workers, sewage/toilets, domestic animals, machinery oil/fuel and other possible sources in order to maintain cleanliness.</p> <p>Cleaning and washing of surfaces and equipment is necessary to remove solid waste, organic matter and chemical residues as these may reduce the efficacy of disinfectants. The use of detergent is also important</p>

		<p>to break down biofilms. The detergent used should be compatible with the disinfectant and the surface being treated.</p> <p>After cleaning, any excess water should be drained and before the application of disinfectants all surfaces and equipment should be inspected to ensure there is no remaining organic material. The disinfectant to be used and contact time will depend on the pathogenic agent of concern.</p> <p>Examples of good practices include:</p> <ol style="list-style-type: none"> <li>i. Assess the disease risk associated with any fomites moved into, within or from the farm</li> <li>ii. Ensure procedures and infrastructure are in place to clean and disinfect fomites, including at designated delivery and loading areas, prior to entry into the farm</li> <li>iii. Dedicate items that are difficult to disinfect, or those with a high likelihood of contamination, to a specific area instead of moving them after disinfection</li> <li>iv. Apply the cleaning and/or disinfection measures described in i) to iii) above, to the movement of fomites between production units within the farm</li> <li>v. Avoid sharing equipment between farms, different production units within the farm, or between farming and processing areas</li> </ol>
15	Standard Operating Procedures (SOPs) should be established to describe the management processes carried out for biosecurity.	Farms should specify the types of fish produced in their farms, identify the potential critical hazards and establish and monitor appropriate measures during all phases of farm production. Corrective actions should be established, implemented and documented at the time of hazard occurrence.
16	<p>Records should be maintained to show evidence of biosecurity measures put in place, which include:</p> <ul style="list-style-type: none"> <li>• Fish health monitoring</li> <li>• Veterinary visits and findings</li> <li>• Inventory of drug/chemical purchase and usage</li> <li>• Stock movement</li> <li>• Cleaning and disinfection</li> <li>• Visitor access</li> <li>• Staff biosecurity training</li> </ul>	<p>Establishment of verification procedures and proper documentation (i.e. log records, standard operating procedures, instruction manual, etc) of such practices is essential for effective disease management. These should be complemented with proper communication and training of staff in good farm practices and management.</p> <p>SOPs describe routine management processes that should be performed to support the effectiveness of the farm's plan. Each SOP should clearly describe its objectives, personnel responsibilities, the procedure (including record keeping), precautions and a review date.</p>



		<p>Examples of documentation required include: aquaculture establishment layout, movements of fish, origin and destination and health status of the fish introduced to the aquaculture establishment, quarantine measures, records of visitors to the establishment, escapees, stocking densities, feeding and growth rates, records of personnel training, treatments/ vaccination, water quality, cleaning and disinfection events, morbidity and mortality (including removal and disposal of mortalities), surveillance and laboratory records.</p> <p>To highlight, health monitoring should be performed at a production unit and farm level. Activities may include disease surveillance, routine monitoring of stock for important health and production parameters (e.g. by personnel, an aquatic animal health professional or a veterinarian), recording of clinical signs of disease, morbidity and mortality, laboratory test results and analysis of these data (e.g. calculation of rates of morbidity and mortality).</p> <p>Emergency procedures should be established to manage a disease outbreak, including emergency harvest, decontamination, destruction and disposal of large quantities of diseased/dead stock.</p>
17	<p>A training programme should be maintained to ensure that all farm staff involved in applying biosecurity measures are capable in their roles.</p>	<p>Training enables farm staff to inculcate and be updated on good practices and operations, be aware of their roles and responsibilities to maintain biosecurity. It should include the following topics:</p> <ul style="list-style-type: none"> <li>• Aquaculture production systems</li> <li>• Stock management</li> <li>• Feed and feeding management</li> <li>• Quarantine of new or sick fish</li> <li>• Fish handling</li> <li>• Fish health monitoring</li> <li>• Disease identification, treatment and control</li> <li>• Use of veterinary products</li> <li>• Waste management and disposal</li> <li>• Risk assessment and management to aquaculture-related hazards</li> <li>• Emergency procedures</li> <li>• National regulations, standards and guidelines</li> </ul> <p>Records of the training should be kept.</p>

## References:

- 1) OIE Aquatic Code (2021) Chapter 4.1 Biosecurity for aquaculture establishments. Accessible at: <https://www.oie.int/en/what-we-do/standards/codes-and-manuals/aquatic-code-online-access/>
- 2) OIE Aquatic Code (2021) Chapter 4.4 Disinfection of aquaculture establishments and equipment
- 3) Asia Diagnostic Guide to Aquatic Animal Diseases. FAO Fisheries Technical Paper No. 402, Supplement 2. Rome, FAO. 2001. 240 p. Accessible at: <https://www.fao.org/inland-fisheries/tools/detail/en/c/1142712/>
- 4) FAO and EUROFISH International Organisation (2015) - A Guide to Recirculation Aquaculture. Accessible at: <https://www.fao.org/3/i4626e/i4626e.pdf>
- 5) D. Soto (ed.). Integrated mariculture: a global review. *FAO Fisheries and Aquaculture Technical Paper*. No. 529. Rome, FAO. 2009. Accessible at: <https://www.fao.org/3/i1092e/i1092e00.htm>
- 6) BAP Finfish/Crustacean Farm Standards – Issue 2.4 – 23-May-2017. Accessible at: <https://www.globalseafood.org/wp-content/uploads/2019/08/PI-Standard-Finfish-and-Crustacean-Farms—Issue-2.4—23-May-2017.pdf>
- 7) Guidelines on ASEAN Good Aquaculture Practices (ASEAN GAqP) for Food Fish (2015). Accessible at: <http://aadcp2.org/guidelines-on-asean-good-aquaculture-practices-asean-gaqp-for-food-fish-2014/>
- 8) Guidelines of the Good Aquaculture Practice for Fish Farming (GAP-FF) Certification Scheme (Agri-Food & Veterinary Authority) (2014)
- 9) SFA licensing conditions for farms and directive on drug usage

## Annex: Examples of local training providers on aquaculture-related courses

### Temasek Polytechnic

- <https://www.tp.edu.sg/schools-and-courses/adult-learners/all-courses/short-courses/certificate-in-ss-good-aquaculture-practices.html>
- <https://www.tp.edu.sg/schools-and-courses/adult-learners/all-courses/industry-specific-courses/skillsfuture-work-study-programme/certificate/work-study-certificate-leading-to-diploma-in-applied-science-aquaculture.html>
- <https://www.tp.edu.sg/schools-and-courses/adult-learners/all-courses/part-time-diploma-post-diploma-courses/applied-science-aquaculture.html>
- <https://www.tp.edu.sg/schools-and-courses/adult-learners/all-courses/part-time-diploma-post-diploma-courses/diploma-in-applied-science-veterinary-technology.html>

### Republic Polytechnic

- <https://www.rp.edu.sg/sas/full-time-diplomas>

### James Cook University Singapore

- <https://www.jcu.edu.sg/courses-and-study/courses/course/bachelor-of-science-majoring-in-aquaculture-science-and-technology>
- <https://www.jcu.edu.sg/courses-and-study/courses/course/bachelor-of-business-And-environmental-science-aquaculture>