

Best management practices in special reference to biosecurity and quarantine in Aquaculture: A Review

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Abstract

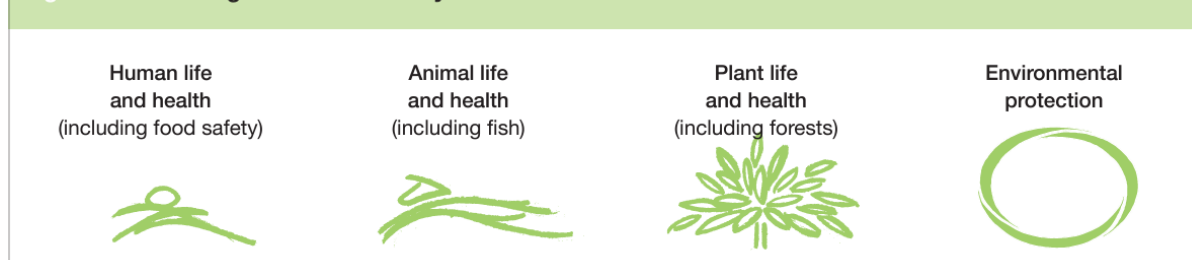
Biosecurity and quarantine are essential for keeping aquatic animals healthy and sustaining the aquaculture industry. These measures prevent and control diseases ensuring stable production and economic security. Biosecurity takes a proactive approach managing risks that affect aquatic life, human health and the environment. Its goal is simple; reduce disease, improve aquatic health and create a sustainable industry. The Progressive Management Pathway provides a structured framework moving through four stages from risk identification to long-term disease prevention. Disinfection methods include physical (heat, sunlight, drying) and chemical (iodophors, formalin) treatments. Quarantine serves as another critical defense, isolating new or relocated stocks for disease screening and acclimatization. However, enforcement faces challenges like diagnostic limitations and trade pressures. Stronger legislation, health certifications and international cooperation can enhance these efforts. Ultimately biosecurity and quarantine are investments in aquaculture's future ensuring food security and global trade resilience.

Keywords: Quarantine, Biosecurity, Sustainability, Aquaculture and BMP.

Basic of Biosecurity

- Biosecurity is a strategic and integrated approach that encompasses both policy and regulatory frameworks, aimed at analysing and managing risks relevant to human, animal and plant life and health, including associated environmental risks (FAO, 2007a).
- These practices also reduce stress to the animals, thus making them less susceptible to disease.

Figure 1.1. Sector goals of biosecurity



Aim of Biosecurity

A core concept of biosecurity is to prevent and control the occurrence and spread of infectious diseases, and needs to be incorporated into governmental regulations as well as farm operational plans. The sustainability of the aquaculture sector will be determined by effective biosecurity governance that can be put in place at all levels (e.g. policy and farm levels) (Yanong and Erlacher-Reid, 2012).

Objectives of Biosecurity

- Reduction of burden of diseases
- Improvement of aquatic health and welfare at farm, national and regional levels
- Minimization of global spread of diseases
- Optimization of socioeconomic benefits from aquaculture
- Attraction of investment opportunities into aquaculture

Progressive Management Pathway for Aquaculture Biosecurity

Stage 1: Biosecurity risks defined

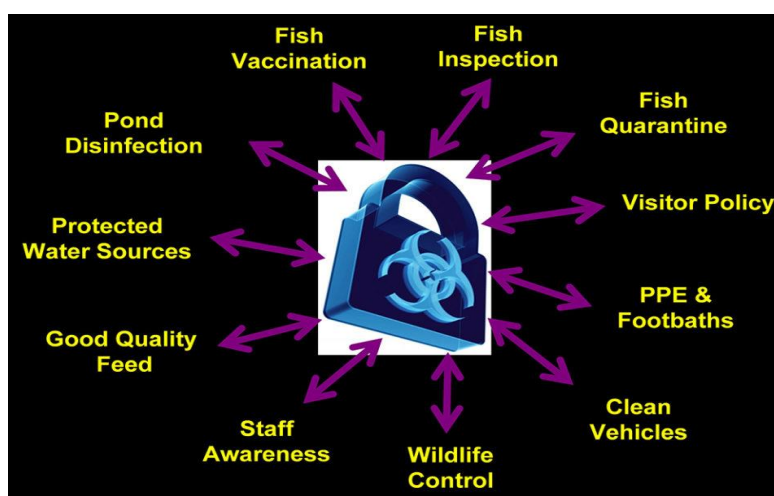
Key stakeholders in all aquaculture sectors are identified and the different aquaculture production systems in the country are described. Key vulnerabilities are identified, which may include threats to aquaculture biosecurity and production, wild populations, ecosystems, or human health in the vicinity. A list of nationally significant pathogens and diseases of aquatic organisms is defined using internationally accepted criteria.

Stage 2: Biosecurity systems initiated

Surveillance will be conducted for mapping the presence/absence of pathogens and diseases of aquatic organisms that are risk-assessed and listed as being of national concern (i.e. those pathogens and diseases of aquatic organisms that pose significant threats to national socioeconomic stability or environmental health)

Stage 3: Biosecurity systems and preparedness enhanced

Sufficient capacity is developed to support sustainable aquaculture and safeguard the country against nationally-listed pathogens and their associated diseases,

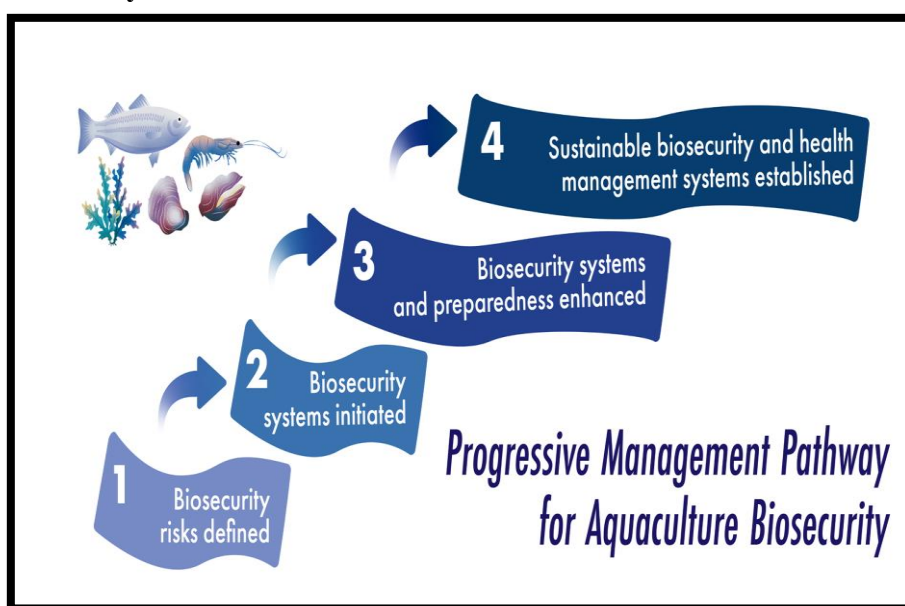


including those that are exotic to the country or emerging or re-emerging in a population. Preparedness to detect and respond rapidly to emergencies is ensured through development of field, laboratory and research capacity.

Stage 4: Sustainable biosecurity and health management systems established

The risk communication mechanism has been fully established to ensure a transparent and auditable biosecurity implementation for all stakeholders in the aquaculture sector. The end-goal is to have confidence from national and international stakeholders in national aquaculture to enable sustainable production and safe trade while maintaining ecosystem health.

Goals of Biosecurity



1. Animal management
(obtaining healthy stocks and their health and immunity through good husbandry)
2. People management
(educating and managing staff and visitors)
3. Pathogen management
(preventing, reducing or eliminating pathogens)

1. **Animal management:** In animal management obtaining health status of brooder or seeds from the suppliers are very important. Furthermore, taking the lineage or genetics of species being reared are necessary for maximization of growth and prevent inbreeding.
2. **Pathogen Management:** Not all pathogens (disease-causing organisms such as bacteria, parasites, viruses and fungi) are of equal concern. Pathogens varies in their regulatory significance, survivability in reservoirs, pathogenicity (how effortlessly they can infect and

cause disease), diagnostics, and control. Although some pathogens cause infection more frequently than others, environmental and host factors especially the species and its immune status will ultimately decide whether fish become sick.

Source of pathogen

- Pathogens can survive and thrive in “reservoirs” within a facility.

Non-living reservoirs	Living reservoirs
Water	Cultured animals themselves
System components	Frogs and birds
Equipment	Plants
Floors	Live food
Walls	
Feed	

- Understanding the biology of pathogens is important, including the factors that permit them to survive in reservoirs and how easily they can be killed by common disinfectants.

3. People Management: Biosecurity will be successful only if managers, staff and visitors understand and follow the necessary practices. Employees and visitors who do not follow established protocols will increase the risk of disease. Access to sensitive areas should be restricted to authorized personnel only. Visitors who come to your facility immediately after visiting another aquaculture facility should be considered a serious risk.

Sanitation and Disinfection

Cleaning is the first step; it involves removing all foreign material (soil, organic material, biofilm) from objects by scrubbing them thoroughly. Disinfection is the second step; it eliminates many or all pathogenic microorganisms. Disinfection is effective only if organisms on all surfaces are exposed to an appropriate disinfectant at the recommended concentration for the recommended length of time.

Physical Disinfection

Heat	Exposure to temperatures of 80 to 100 °C for 10 minutes kills all active microorganisms, but some life stages such as spores may require much longer time periods.
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Sunlight	Sunlight can be effective, but duration of an exposure will vary depending upon intensity, temperature and various factors, and little research has been done on effective exposure times.
Drying	Drying equipment can also reduce pathogen numbers, although spores, cysts or eggs may survive treatment.

Disinfectant name	Active ingredient
Virkon® aquatic	Potassium peroxymonosulfate (21.41%) and sodium chloride (1.5%)
Quaternary ammonium compounds	Benzalkonium chlorides
Virosan™	Chlorhexidine gluconate
Alcohols	Isopropyl alcohol or ethanol
Iodophors	Povidone-iodine
Perox-aid®	Hydrogen peroxide
Lysol®.	Phenol derivatives
Formaldehyde	Formalin

Chemical Disinfectants

Following is the table representing various disinfectants with their active ingredients

Quarantine

Quarantine should be seen as one of a wide range of risk management options that can be applied, either alone or in combination, to reduce the risk posed by aquatic animal pathogens. The decision of whether or not to require quarantine or other biosecurity measures should be done on a case-by-case basis and determined by a risk analysis (Arthur *et al.*, 2006).

Quarantine means maintaining a group of aquatic animals in isolation with no direct or indirect contact with other aquatic animals, in order to undergo observation for a specified length of time and, if appropriate, testing and treatment, including proper treatment of the effluent waters.” The principles of quarantine apply for new fish coming into a facility, fish moving from one area or system to another within the facility, and resident fish that become diseased.

Water in quarantine systems also should be separate from that on the main farm, and

discharges should be handled appropriately. Proper quarantine not only protects established populations from potential exposure to pathogens but also gives the new animals time to acclimate to water, feeds and management and to recover from handling and transport. Handling and transport have been shown to reduce disease resistance and recovery may take weeks (Scarfe and Palić, 2020).

Levels of Quarantine

1. Quarantine of “high risk” species.
2. Quarantine of “lower risk” species.
3. Routine quarantine of aquatic animals at production facilities.

Quarantine of “high risk” species

Aquatic animals being moved either internationally (introductions and transfers) or domestically between regions of different health status that are destined for use in aquaculture, capture fishery development or other applications where release or escape of animals or any pathogens they may be carrying into the natural environment is likely to occur.

Quarantine of “low risk” species

Aquatic animals whose trade is an established practice; for example Exotic ornamental fish are imported to India from other countries.

Routine quarantine of aquatic animals at production facilities.

New, domestically produced or locally-captured broodstock or juveniles or animals whose movement has been contingent upon additional, risk management measures, such as the use of specific pathogen free (SPF) stocks, international health certification, pre-border and/or border quarantine, etc..

Components in Quarantine

1. All-in-all-out stocking

This involves bringing animals in as a group from only one original source population and maintaining them as a group throughout the quarantine period. It prevents exposure to other pathogens not currently in that population. Ideally, no new animals should be added to a group currently in quarantine.



2. Isolation or separation

A group of animals in quarantine should be physically isolated from other quarantined

populations and from the resident populations. Methods of isolation should be built into the facility and system design. Appropriate sanitation and disinfection measures must be used to reduce cross-contamination.

3. Observation and diet adjustment

Animals should be observed for normal and abnormal appearance and behaviors throughout the quarantine period so disease problems can be detected early. For example, loss of appetite. Good nutrition will increase disease resistance and careful adjustment from the diet of origin to the on-farm diet will reduce problems from sudden changes.

Sampling and treatment in Quarantine

Fish should be sampled for specific diseases of concern at the beginning and end of the quarantine period and at any time that disease signs develop. By examining small sections of skin, fin and gills for parasites and doing a blood culture for systemic bacterial infections. The results can then be used to improve quarantine methods and the use of drugs.



Period of quarantine

No set period of quarantine should be established. The period of holding in the Quarantine Facility will depend on the results of observation and testing of the imported stock and the resulting F1 generation. In all cases, once the chief authorized personal is satisfied that the F1 or a subsequent generation is safe for limited release, the parent stock should be destroyed and the Quarantine Facility thoroughly disinfected (MacKinnon, 2020).

Risk management measures complementary to quarantine

Pre-border measures	Post border measures
Certification of production source	Restrictions on initial use.
Use of specific pathogen free (SPF) stocks	Monitoring programmes.
Zoning according to past experience	Contingency planning in case of escape of animals

Restrictions on life cycle stages	Provide appropriate quarantine period
Evaluation of Competent Authorities	
Lists of approved species	
Lists of approved exporting countries	
On-site inspection of exporting facilities	
International and other health certificates	

Factors limiting the application of Quarantine

- Most importantly, the lag time between when a new disease emerges, when it is first recognized as a serious pathogen of international importance, and when accurate and reliable diagnostics tests are developed and become generally available;
- The diversity of forms in which trade occurs;
- The sheer volume of aquatic animals traded;
- The lack of simple and accurate diagnostics tests for some pathogens;
- The ability of pathogens to take advantage of novel host species and new environments;
- The limited capital and human resources that governments are able to commit to this effort.

Supporting services for effective quarantine

- Adequate legislation;
- Effective enforcement (e.g., Border customs and inspection, post-border follow up);
- Knowledgeable and supportive aquaculture industry;
- Sufficient political will;
- Competent and readily available diagnostics support;
- Existence of reliable diagnostics tests for major pathogens;
- Good working relationships between importing and exporting country case;
- Good knowledge base of pathogens present in the exporting and importing countries (surveillance and monitoring, disease surveys); and
- Good information base on pathogen biology, prevention, treatment, etc.

Health certification

It is a process associated with any stock of aquatic animals that are either exported or imported and issued by well qualified personnel from a quarantine facility. Samples collected for health surveillance should be large enough for screening and proper pathogen detection. Samples should be collected preferably by stratified random sampling. Surveillance sampling has also to be carried out in season best known to aggravate the incidence of the disease (Wei *et al.*, 2023).

REFERENCES

- Wei, J., Guo, S., Wang, Q. and Xu, H., 2023. Present situation and countermeasure of animal quarantine in animal husbandry and veterinary. *International Journal of Food Science and Agriculture*, 7(3), pp.123-134.
- MacKinnon, B. (2020). *The Progressive Management Pathway for Improving Aquaculture Biosecurity (PMP/AB)*. Food and Agriculture Organization of the United Nations.
https://www.fao.org/fileadmin/user_upload/COFI/VirtualDialoguesCOFI34/06_BrettMacKinnonetalExpertpanel3PMP_AB.pdf
- Scarfe, A. D., & Palić, D. (2020). Aquaculture biosecurity: Practical approach to prevent, control, and eradicate diseases. In *Aquaculture Health Management* (pp. 75-116). Academic Press.
- Yanong, R. P., & Erlacher-Reid, C. (2012). Biosecurity in aquaculture, Part 1: An overview.
- Arthur, M. (2006). An Economic Analysis of Quarantine: The Economies of Australia's Ban on New Zealand Apple Imports.