WORKSHOP & TRAINING (RESIDENTIAL)

# THE INDIAN FRESHWATER FISHERIES SECTOR

## How to scale up preventive approaches to minimise antibiotic use

# THE INDIAN FRESHWATER FISHERIES SECTOR

How to scale up preventive approaches to minimise antibiotic use

## PREVENTION OF DISEASES IN FRESHWATER AQUACULTURE

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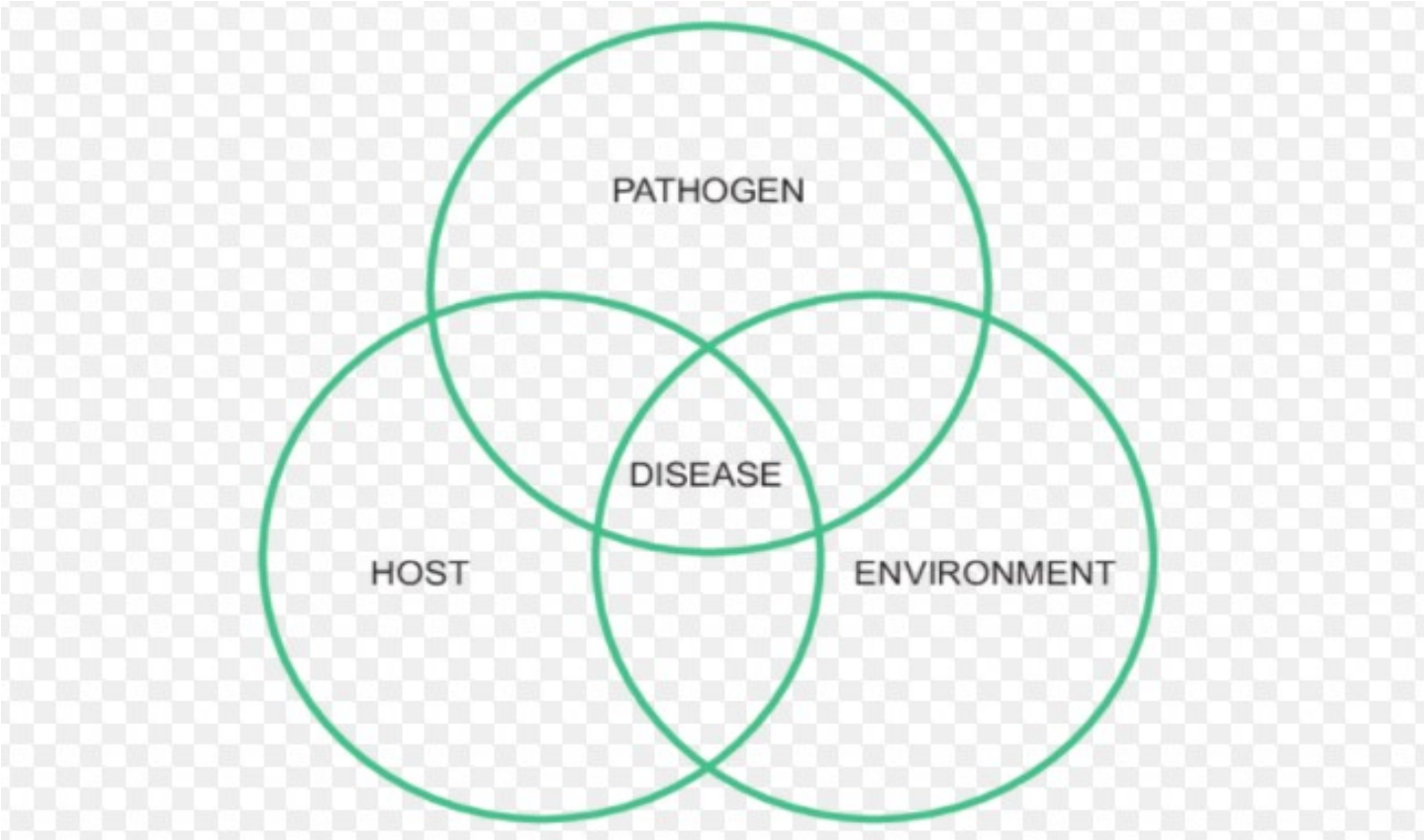



**Sniezko's triad: DISEASE : BREAKDOWN OF DELICATE BALANCE BETWEEN HOST PATHOGEN & ENVIRONMENT**

# Diseases aquaculture

- **Infection**: means the presence of a multiplying or otherwise developing or latent *pathogenic agent* in a host. This term is understood to include infestation where the *pathogenic agent* is a parasite in or on a host.
- **Disease**: Presence of clinical signs of infection due to a pathogenic agent. In case of non-communicable diseases, pathological changes or alterations in the animal physiology that has adverse effects

# World Trade Organisation SPS and TBT Agreements


- Sanitary and Phytosanitary (SPS) agreement: Members can take measures to protect public health based on their Appropriate Level of Protection
- Based on principles of:
- **Sovereignty**: countries have right to establish measures to protect public and animal health. Measures should not be arbitrary, should be based on scientific risk assessment.
- **Harmonization :** should be harmonised with international standards. Standards recognised are Codex Alimentarius standards for food safety and WOAH (OIE) standards for animal health.
- **Equivalency :** should recognise measures applied by others as equivalent when same results are achieved

# Aquatic Code Online Access

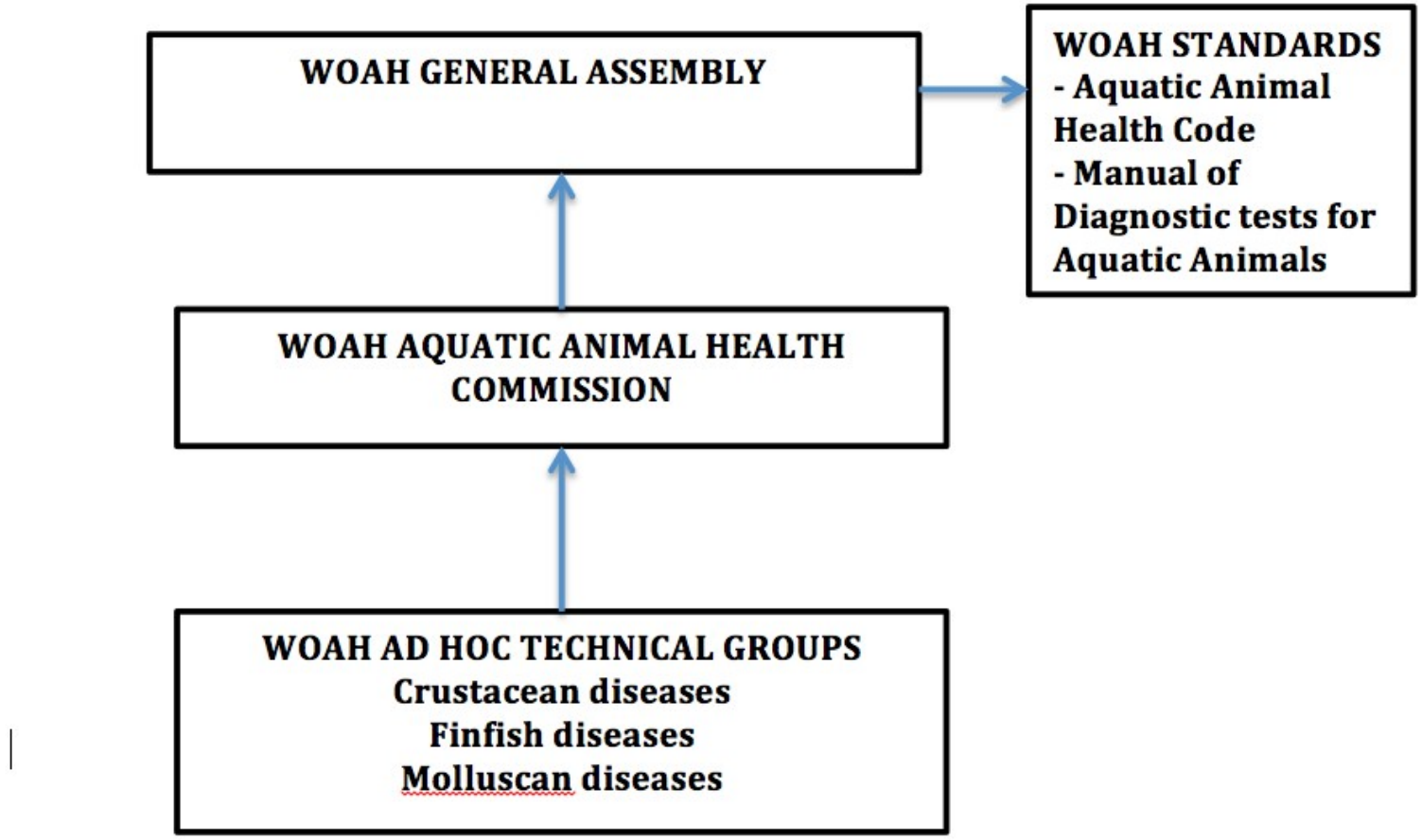


# Manual of Diagnostic Tests for Aquatic Animals

## Online version

# Certain diseases have international trade obligations


- WOAH Lists diseases of international importance
- WOAH Member countries have obligation of reporting WOAH listed diseases to WOAH.
- WOAH encourages countries to report emerging diseases.
- The purpose of reporting is to alert other aquaculture producing countries to take action to prevent the entry of disease.
- This is particularly important when there is international trade of live animals eg brood stock, larve or live feed.


WOAH GENERAL ASSEMBLY
WOAH STANDARDS
- Aquatic Animal Health Code
- Manual of Diagnostic tests for Aquatic Animals
WOAH AQUATIC ANIMAL HEALTH COMMISSION
WOAH AD HOC TECHNICAL GROUPS
Crustacean diseases
Finfish diseases
Molluscan diseases

# Aquatic Animal Health Code


- Section 1: Notification, diseases listed by OIE and surveillance
- Section 2: Risk Analysis
- Section 3: Quality of Aquatic Animal Health Services
- Section 4: Disease prevention and control
- Section 5: Trade measures, import/export procedures, health certification
- Section 6: Antimicrobial use in aquatic animals
- Section 7: Welfare of farmed fish
- Section 8: Diseases of amphibians
- Section 9: Diseases of crustaceans
- Section 10: Diseases of fish
- Section 11: Diseases of molluscs

# Section 1: Notification, diseases listed by OIE and surveillance

- Chapter 1.1 Notification of diseases and provision of epidemiological information
- Chapter 1.2 Criteria for listing of Aquatic Animal Diseases
- Chapter 1.3 Diseases listed by the OIE
- Chapter 1.4 Aquatic animal disease surveillance
- Chapter 1.5 Criteria for listing species as susceptible to infection by a specific pathogen

# Obligations of disease notification

- Member countries should make available through WOAH to other member countries, information necessary to minimise the spread of disease of aquatic animals and their pathogenic agents and to assist in achieving better worldwide control of these diseases.
- Event means outbreak or epidemiologically related outbreaks of a disease that is subject to notification. Report of an event includes susceptible species, number and geographical distribution of affected aquatic animals and epidemiological units.
- Detection of pathogenic agent of listed disease should be reported even in the absence of clinical signs.
- Report measures taken to prevent spread of disease

# Obligations of disease notification


- Members should report
- First occurrence of a listed disease in the country, zone or compartment;
- Recurrence of a listed disease in the country, zone or compartment after final report that declared the outbreak ended;
- First occurrence of a new strain of the pathogenic agent of a listed disease in the country, zone or compartment;
- Sudden and unexpected change in the distribution or increase in the incidence or virulence or morbidity or mortality caused by a pathogenic agent in the country, zone or compartment;
- Occurrence of a listed disease in a new host species.

# Criteria for listing


- The international spread of the pathogenic agent (through aquatic animals, animal products or fomites) is likely;
- At lease one country may demonstrate freedom from diseases in susceptible animals in the country, zone or compartment;
- A precise case definition is available and reliable method of diagnosis exists;
- The disease is known to affect the health of aquatic animals in a country, zone or compartment and cause significant consequences eg production loss, morbidity or mortality at level of zone or country;
-

# Diseases listed by OIE


- **Diseases of finfish**
- Infection with epizootic hematopoietic necrosis virus
- Epizootic ulcerative syndrome – *Aphanomyces invadens*
- Infection with *Gyrodactylussalaris*
- Infection with infectious salmon anaemia virus
- Infection with salmonid alphavirus
- Infection with infectious haematopoietic necrosis virus
- Infection with koi herpesvirus
- Infection with red sea bream iridovirus
- Infection with spring viraemia of carp virus
- Infection with spring viraemia of carp virus

# Diseases listed by OIE


- **Diseases of crustaceans**
- Acute hepatopancreatic necrosis disease
- Infection with *Aphanomyces astaci* (Crayfish plague)
- Infection with *Hepatobacter penaei* (Necrotising hepatopancreatitis)
- Infection with infectious hypodermal and haematopoietic necrosis virus
- Infection with infectious myonecrosis virus
- Infection with *Macrobrachium rosenbergii* nodavirus (White tail disease)
- Infection with Taura syndrome virus
- Infection with white spot syndrome virus
- Infection with yellow head virus genotype 1
- Infection with decapod iridescent virus 1

# WOAH Aquatic Animal Health Code


- Chapter 4 Disease prevention and control
- 4.1. *Biosecurity for aquaculture establishments*
- 4.2. *Zoning and compartmentalisation*
- 4.3. *Application of compartmentalisation*
- 4.4. *Disinfection of aquaculture establishments*
- 4.5. *Recommendations for surface disinfection of salmonid eggs*
- *4.6. Control of pathogenic agents in traded gametes and fertilised eggs of fish*
- 4.7. *Fallowing in aquaculture*

# WOAH Aquatic Animal Health Code

4.8. *Handling, disposal and treatment of aquatic animal waste*

4.9. *Control of pathogenic agents in aquatic animal feed*

4.10. *Emergency disease preparedness*

4.11. *Disease outbreak management*

World Organisation for Animal Health
Founded as OIE

DEFINITION

**BIOSECURITY:**

A set of management and physical measures designed **to mitigate the risk of introduction of pathogenic agents** into, or spread within, or release from, aquatic animal populations

**BIOSECURITY PLAN:**

A document that **identifies potential pathways** for the introduction of pathogenic agents into, or spread within, or release from, a zone, compartment or aquaculture establishment and **describes the measures applied to mitigate the identified risk**, in accordance with the recommendations in the aquatic code

World Organisation for Animal Health
Founded as OIE

**Levels of aquaculture biosecurity:**

- ✓Level of country
- ✓Level of zone or compartment
- ✓Level of aquaculture establishments

# Biosecurity at country level

- **Biosecurity in Australia** >
- **Biosecurity legislation** >
- **Biosecurity risk analysis** >
- **Ag White Paper - Biosecurity Surveillance and Analysis** >
- **Aircraft, vessels and military** >
- **Animal** >
- **Plant** >
- **Pests, diseases and weeds** >
- **Locusts** >
- **National Carp Control Plan** >
- **Emergency preparedness and outbreak response** >
- **Report a biosecurity concern** >

# BIOSECURITY IN AQUACULTURE ESTABLISHMENTS

- The development of a biosecurity plan for aquaculture establishments is a **complex task** due to the various factors involved, such as

  i. **Varied aquaculture production systems** – Eg open system, closed systems, natural waters, dug out ponds, marine, fresh water, extensive, semi intensive, intensive

  ii. **Vast diversity of animal species** – finfish, crustaceans, marine

  iii. **Assessment of pathogenic agents and their potential transmission pathway** - pathogens and species combinations; types of pathogens – bacteria, viruses, parasites; route of transmission – vertical, horizontal.

# BIOSECURITY IN AQUACULTURE ESTABLISHMENTS

- To ensure a biosecurity plan to be feasible and efficient, stakeholders such as

    i. Aquaculture establishment personnel

    ii. Input manufacturers and suppliers

    iii. Service providers

    iv. Aquatic animal health professionals or veterinarians

Should be involved in developing and implementing the biosecurity plan

# BIOSECURITY IN AQUACULTURE ESTABLISHMENTS

- The **outcome** achieved through the implementation of biosecurity at aquaculture establishments are:
    i. Improved health and welfare of aquatic animals
    ii. Improved market access
    iii. Increased productivity
    iv. Reduction in the use of veterinary medicinal products
    v. Reduction in the rate of emergence of antimicrobial resistance

# GENERAL PRINCIPLES

- Biosecurity is a set of management and physical measures which, **reduce the risk of infection in aquatic animal populations** within an aquaculture establishment, when used together, cumulatively.
- **Risk analysis** should be undertaken periodically to identify and evaluate disease threats and identify cost effective measures to achieve biosecurity objectives.
- The measures required will vary among aquaculture establishments, depending on factors such as
  - likelihood of exposure to pathogenic agents, the species of farmed aquatic animal,
  - the category of aquaculture production system,
  - husbandry practices, environmental conditions and geographical location

# GENERAL PRINCIPLES

- Biosecurity measures to address identified disease risks should be evaluated on the basis of their
  - Potential effectiveness
  - Initial and ongoing costs (e.g. building works, maintenance)
  - Management requirements
- **Management practices should be integrated** into the aquaculture establishment's operating procedures and relevant training provided to personnel.
- **Appropriate records and documentation** are essential to demonstrate effective implementation of the biosecurity plan.
- A schedule for **routine reviews and audits** of the biosecurity plan should be described. Triggers for ad hoc review must be determined.

# CATEGORIES OF AQUACULTURE PRODUCTION SYSTEMS

1. Open systems
2. Semi-open systems
3. Semi-closed systems
4. Closed systems

## Open systems

- ✓ This system is **not regarded as a "aquaculture establishment,"** as it is not possible to regulate the flow of water, environmental conditions, aquatic animals, or vectors in an open aquaculture production system.
- ✓ These production systems may include stock enhancement of wild populations with aquatic animals originating from aquaculture establishments or from the wild.

Open system of aquaculture establishment

## Semi-open systems

✓ In a semi-open aquaculture production system, **it is not possible to have control over the flow of water, environmental conditions, aquatic animals, or vectors**

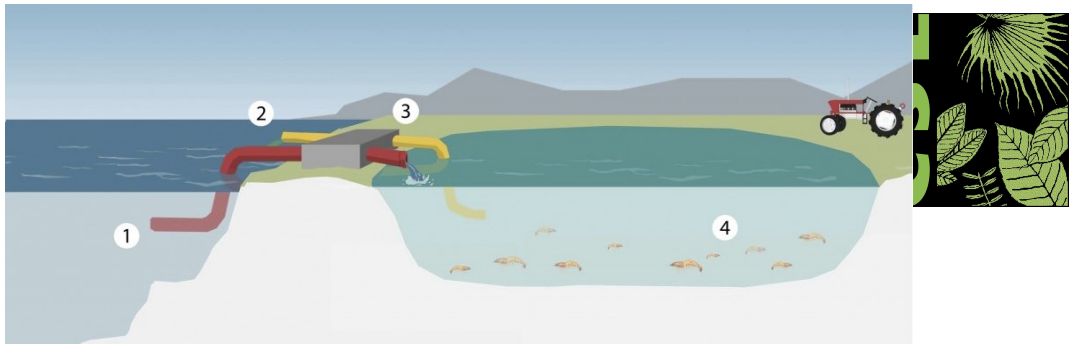
✓ Examples of semi-open aquaculture production systems are:

- ➢ Net pens or cages for finfish
- ➢ Suspended baskets or rope systems for molluscs in natural water bodies

Cage culture

Rope system for molluscs

- Semi-closed systems




1. Inlet pipe 2. Outlet pipe 3. Pump 4. Cultivated aquaculture organism

✓ In a semi-closed aquaculture production system, there is some control over the flow of water and environmental conditions

✓ **Aquatic animals and vectors can be prevented from entering and exiting the system**; however, there is limited control to prevent the entry or exit of pathogenic agents

✓ Examples of semi-closed aquaculture production systems:

- ponds, raceways, floating enclosures, and flow through tanks

- Closed systems

- ✓ In a closed aquaculture production system, there is **sufficient control over water entering and exiting the system** to exclude aquatic animals, **vectors and pathogenic agents**
- ✓ Environmental conditions can also be controlled
- ✓ Examples of closed aquaculture systems:
  - ➢ Recirculating aquaculture production systems
  - ➢ Systems with high levels of treatment (and redundancy) of water entering and exiting the system

# AREA MANAGEMENT

- Controlling the spread of pathogenic agents between partially open or closed aquaculture facilities, located in a shared water bodies may not be possible.
- Consistent set of biosecurity measures should be applied to all establishments epidemiologically linked.
- Area management agreements should formalise the coordination of biosecurity measures to be followed by such epidemiologically linked aquaculture establishments.

Aquaculture facility in a shared water body

# TRANSMISSION PATHWAYS AND MITIGATION MEASURES

The **identification of all potential transmission pathways** is essential for the development of an effective biosecurity plan

## ❑ Aquatic animals

- ✓ The **movement of aquatic animals in and out of aquaculture facilities** can increase the risk of transmitting pathogenic agents
- ✓ The transmission may include broodstock, larvae, juvenile stock for on-growing, and genetic material such as eggs and milt
- ✓ Both **horizontal and vertical transmission mechanisms** of pathogenic agents should be considered for aquatic animals

- **Mitigation measures**

✓ Only aquatic animals with known health status, should be introduced into aquatic establishments

✓ If aquatic animals of unknown disease status are to be introduced, they should be placed into quarantine

✓ Ensure biosecure transport of aquatic animals that prevents exposure to and release of pathogenic agent.

✓ Moving aquatic animals between different populations within the establishment, should follow the consideration of the disease risks and health of major population

✓ Isolate aquatic animal population exhibiting symptoms of illness, until the cause is known or issue is resolved

- **Mitigation measures**

✓Dispose moribund or dead aquatic animals in a biosecure manner

✓Report unexplained or unusual mortalities, or suspicion of a notifiable disease to the competent authority

✓Investigation and diagnosis should be undertaken by aquatic animal health professionals

✓Cleaning, disinfection, drying and fallowing of aquatic establishments should be done periodically

✓Measures should be taken to prevent farmed aquatic animals from escaping or wild aquatic animals from entering the aquaculture establishment

## ❑ Aquatic animal products and aquatic animal waste


Movement of aquatic animal products and aquatic animal waste into, within or from aquaculture establishments may pose a risk of pathogenic agent transmission. Aquatic animal waste may be generated when aquatic animals die or when they are killed for disease control purposes or for human consumption.

- **Mitigation measures**

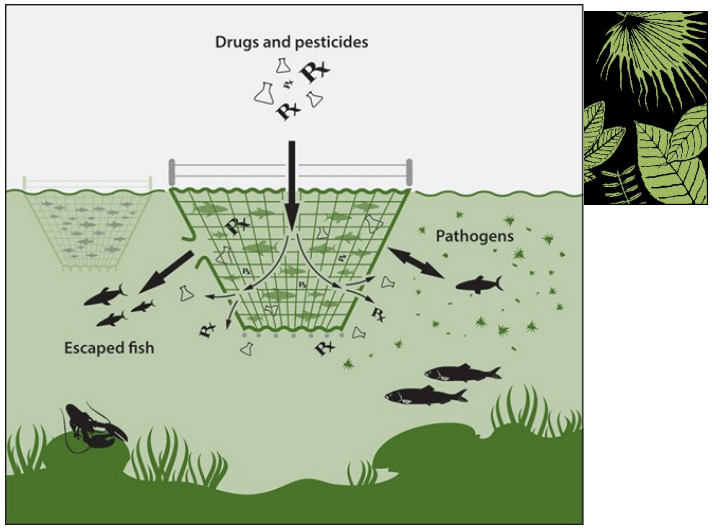
✓**Determine the potential disease risk** of aquatic animal products and aquatic animal waste to aquatic animals in the establishments.

✓**Manage** aquatic animal products and aquatic animal waste **in isolated areas** within the aquaculture establishment to minimize transmission risks.

✓**Ensure appropriate procedures** are implemented for collection, transport, storage or disposal of aquatic animal products and aquatic animal waste.

## ❑ Water

- Water - a potential risk for transmission of pathogenic agents
- The risk of exposing to water containing pathogenic agents is higher for semi-open than for semi-closed and closed systems.
- The source of the water, and how it may provide an epidemiological link between the aquaculture establishment and other farmed or wild populations or processing plants, should be identified and considered.



- **Mitigation measures**

✓Choose **water source that is free of susceptible aquatic animal populations and pathogenic agents of concern**. ex., ground water, de-chlorinated municipal water, artificial sea water etc.

✓For water from unknown sources provide an **appropriate level of screening, filtration or disinfection.**

✓Provide an appropriate level of **filtration and disinfection of effluent water** from aquaculture establishments.

✓The position of water intakes, outlets should be taken care of.

✓Assess the risk and establish procedures to **treat and dispose of waste water** resulting from the transport of aquatic animals.

✓The likelihood of **ingress of contaminated water either through flooding from external sources or from defective infrastructure** (e.g. leaking pipes, blocked drains, bund wall failure) should be assessed and appropriate management or infrastructure measures applied.

## ❑ Feed

- Feed is primarily contaminated during,
  1. Manufacturing – infected animal used
  2. Harvest, transport, storage or processing
- The chances of contamination through feed is **high in semi-open production systems**, as aquatic animals may obtain food from their environment

  e.g. filter-feeding molluscs or predation of wild fish by farmed fish in net pens or cages

- **Mitigation measures:**

✓Feed should have undergone **sufficient processing to inactivate pathogenic agents** of concern.

✓Feed are from sources that are declared free from the pathogenic agents of concern (by testing).

✓Feeds should be processed, manufactured, stored, transported and delivered in a manner to prevent contamination from pathogenic agents.

## ❑ Fomites

- Equipment, vehicles, packaging material, clothing, footwear, sediments, infrastructure and other fomites can mechanically transfer pathogenic agents into, within and from an aquaculture establishment.
- The liklihood of transferring the pathogenic agent will depend on the stability in the environment, the presence and nature of organic matter on the fomite surface, as well as the type of surface and its capacity to hold water. The likelihood of transferring pathogenic agents may be higher for fomites which are difficult to clean and disinfect.
- Sharing equipment between
  - Different aquaculture establishments
  - Different production units within an aquaculture establishment
  - between aquaculture establishments and processing facilities

may also result in the spread of pathogenic agents.

Equipment

Clothing, footwear

## Mitigation measures:

- ✓ Assess the disease risk associated with any fomites moved into, within or from the aquaculture establishment.
- ✓ Ensure procedures and infrastructure are in place to clean and disinfect fomites, including delivery and loading areas (entry & exit).
- ✓ Assign hard-to-disinfect or high-risk items to a specific aquaculture facility or area within it, rather than relocating them after disinfection.


Foot bath at the entry of the facility

Periodic disinfection of fomites

## ❑ Vectors

- Vectors transmit pathogenic agents to susceptible aquatic animals through water supply, predators, wild birds, scavengers and pest animals
- The likelihood of transmitting pathogenic agents via vectors varies with
  - Type of vector
  - Nature of the pathogenic agent
  - Category of aquaculture production system
  - Level of biosecurity

## Mitigation measures

- ✓**Filter or screen water**, entering and exiting semi-closed and closed aquaculture production systems.
- ✓**Controlled access** for authorized personnel and visitors.
- ✓In land based ponds, fencing to prevent access for animals.
- ✓In a floating aquaculture production system, surround the establishment by **barriers to prevent contact with or entry of wild aquatic animals** and other animals.
- ✓Covering outdoor or unenclosed aquaculture production systems with nets to prevent access by birds.

## ❑Personnel and visitors



**Measures to be taken**

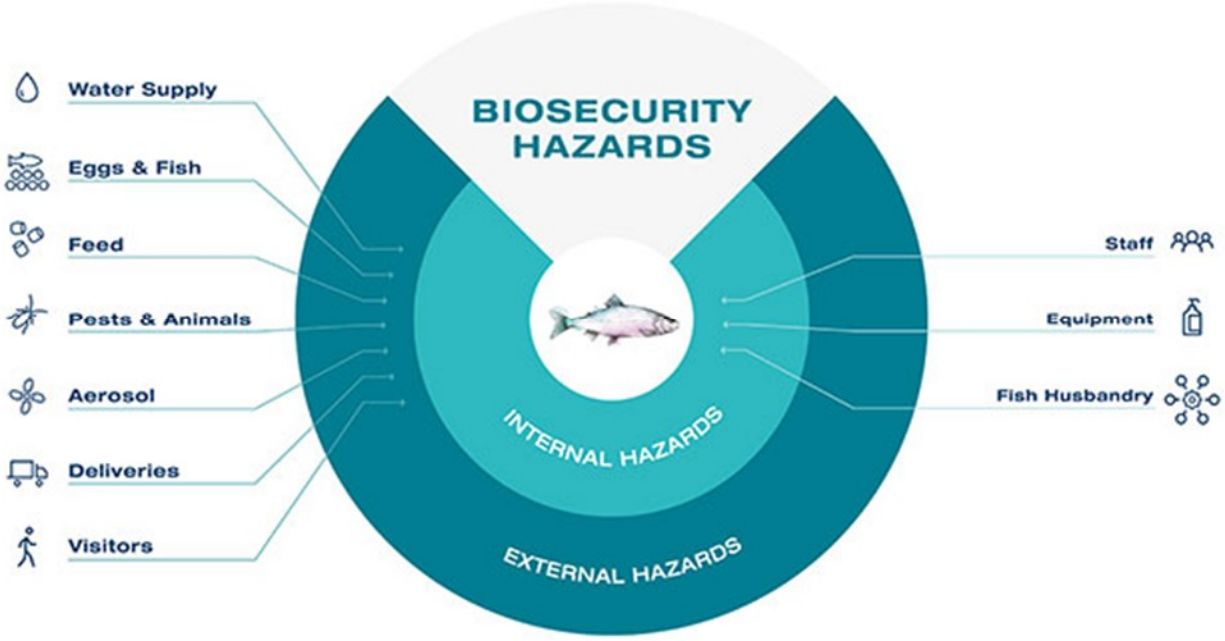
- ✓All visitors should be briefed and supervised to ensure compliance with the biosecurity plan.
- ✓Completion of a register, which should include visitor's details and purpose of visit.
- ✓Changing of clothes and shoes, or use of disposable coverings (e.g. hoods, coats, gloves, shoe coverings); disinfection of hands, and the use of foot baths.
- ✓Clear signage should be displayed to promote awareness and compliance with biosecurity plan.


# RISK ANALYSIS

- Risk analysis is an accepted approach for evaluating biosecurity threats.
- A biosecurity plan may not necessarily require a comprehensive risk analysis to evaluate disease risks linked to transmission pathways.
- The chosen approach may depend on the objectives of the biosecurity plan, the level of biosecurity that is appropriate for the specific production requirements of the aquaculture establishment, the complexity of the threats to be addressed, and the availability of information and resources.
- Depending on these circumstances, a partial analysis may be appropriate, and can build on previous experiences to identify the hazards associated with relevant transmission pathways
- The three formal steps of the risk analysis process to underpin a biosecurity plan are:
    1. Hazard identification
    2. Risk assessment
    3. Risk management

# 1. Hazard identification


- Hazard identification determines which pathogenic agents should be the subject of the risk assessment.
- This step includes **identifying and collecting relevant information on the pathogenic agents** that have potential to cause diseases.
- This process must consider
  - The aquatic animal health status of the establishment.
  - **For semi-open and semi-closed aquaculture production systems:** the aquatic animal health status of establishment and of the epidemiologically linked environments.


BIOSECURITY HAZARDS
Water Supply
Eggs & Fish
Feed
Pests & Animals
Aerosol
Deliveries
Visitors
Staff
Equipment
Fish Husbandry
INTERNAL HAZARDS
EXTERNAL HAZARDS

- To assess the hazard, following information on the identified hazards is required

i. The frequency of occurrence

ii. The biophysical characteristics

iii. The likelihood of detection if present

iv. The possible transmission pathways

# 2. Risk assessment


- A risk assessment can be initiated once hazard is identified and required information is gathered
- **The aim of the risk assessment is to establish a risk estimate**, which is a product of the likelihood and consequences of entry of a pathogenic agent into, spread within or release from the aquaculture establishment
- A risk assessment can be quantitative or qualitative
  - ✓Qualitative assessment: In a qualitative assessment, introduction and establishment are estimated using descriptors of likelihood.
  - ✓Quantitative assessment requires data on which to estimate the likelihood.
  - ✓In most circumstances, the likelihood of disease transmission and associated consequences will be assessed qualitatively but within a formal risk assessment framework.

# Table 1. Qualitative descriptors of likelihood

| Estimate | Descriptor |
|---|---|
| Remote | Very unlikely but not impossible |
| Unlikely | May occur, but only in rare circumstances |
| Possible | There is clear evidence that it may occur |
| Likely | It is likely to occur but not certain |
| Certain | It is certain to occur |

# Table 2. Qualitative descriptors of consequences

| Estimate | Descriptors of consequence at te level of establishment |
|---|---|
| Insignificant | Impact not detectable or minimal. No trade impacts. |
| Minor | Limited decreased production affecting only a small number of units, and transitory disruption to trade |
| Moderate | Decreased production, some short-term to medium-term disruption to trade, resulting in financial loss |
| Major | Considerable, decreased production, and/or some medium-term to long-term disruption to trade, resulting in significant financial loss |
| Catastrophic | Complete production loss, possibly barriers to resumption of production, and/or complete loss of trade, resulting in extreme financial loss |

# Table 3. Matrix for estimating risk

| Likelihood estimate | Consequence rating | | | | | |
|---|---|---|---|---|---|---|
| | | **Insignificant** | **Minor** | **Moderate** | **Major** | **Catastrophic** |
| | **remote** | negligible | low | low | low | medium |
| | **unlikely** | low | low | medium | medium | high |
| | **possible** | low | medium | medium | high | high |
| | **likely** | low | medium | high | high | extreme |
| | **certain** | low | high | high | extreme | extreme |

# Table 4. Interpretation of risk estimates

| Risk estimate | Descriptor |
|---|---|
| Negligible | Acceptable level of risk. No action required |
| Low | Acceptable level of risk. Ongoing monitoring may be required |
| Medium | Unacceptable level of risk. Review and strengthen risk mitigation measures |
| High | Unacceptable level of risk. Identify and implement additional risk mitigation measures |
| Extreme | Unacceptable level of risk. Take immediate action to mitigate risk |

## 3. Risk management


- Risk management is **to determine the appropriate management response** for the assessed level of risk as described in the previous Table.
- Most hazards share the same pathway and therefore mitigation measure may be effective against number of hazards.
- Information on the hazard and pathways of transmission should be combined with the assessment of risk for each pathway and identify the most cost effective mitigation measure.
- The most appropriate mitigation measures for a specific aquaculture establishment will depend on
  - ✓The effectiveness and reliability of the mitigation measure
  - ✓The category of aquaculture production system and cost

**After the implementation of the biosecurity plan, hazards should be regularly reassessed, and measures adjusted according to any changed risk estimates**

# Biosecurity plan development

- The primary objective of a biosecurity plan is **to minimize the chance of introduction of pathogenic agents** to aquaculture facility. If introduced, to reduce the risk of further spreading
- The plan will document
  - ✓transmission pathways
  - ✓outputs of any risk analysis performed
  - ✓information relevant to ongoing implementation, monitoring and review of the plan

# 1. Development of a biosecurity plan

In the process of developing a biosecurity plan consider the following issues:

a. Objectives, scope and regulatory requirements for the biosecurity plan

b. Information about Layout and production unit

c. The **potential pathways for entry of pathogenic agents** into, spread within or release from the aquaculture establishment

d. Risk analysis

e. The mitigation measures that have been determined to address risks

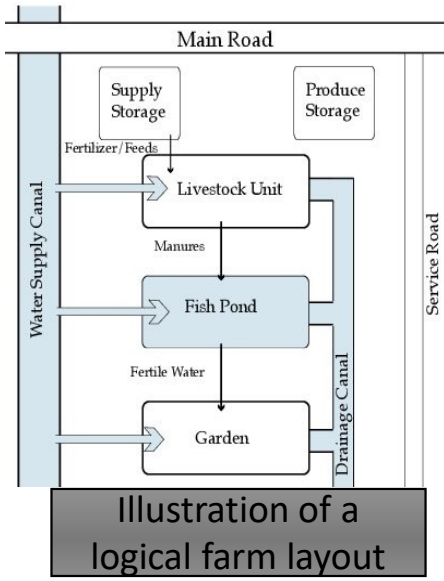



Illustration of a logical farm layout

## Biosecurity Plan


f. Emergency procedures in the event of a biosecurity failure

g. Internal and external communication procedures, and essential contact information

h. Monitoring and audit schedule

i. Roles and responsibilities of aquaculture establishment personnel, performance evaluation

j. Standard operating procedures required to support implementation of the mitigation measures

## 2. Key components of a biosecurity plan


- Standard operating procedures (SOPs)
- Training of personnel
- Documentation and record keeping
- Emergency procedures
- Health monitoring
- Routine review and auditing

a. Standard operating procedures (SOPs)

- ✓ SOPs should describe the routine management processes that must be performed **to support the effectiveness of the biosecurity plan**
- ✓ SOP should clearly describe objectives, personnel responsibilities, procedure (including record keeping), precautions and a review date

b. Training of personnel

- ✓ Personnel should be trained in the application of the SOPs
- ✓ Conducting training programmes periodically

## c. Documentation and record keeping

✓ The documentation provides evidence of compliance with the plan

✓ Examples of documentation required include:

- ➢ Aquaculture establishment layout
- ➢ Movements and health of aquatic animals
- ➢ Records of visitors
- ➢ Feeding and growth rates
- ➢ Records of personnel training (treatments/vaccination)
- ➢ Water quality
- ➢ Cleaning and disinfection events
- ➢ Morbidity and mortality
- ➢ Surveillance and laboratory records etc.,

d. Emergency procedures

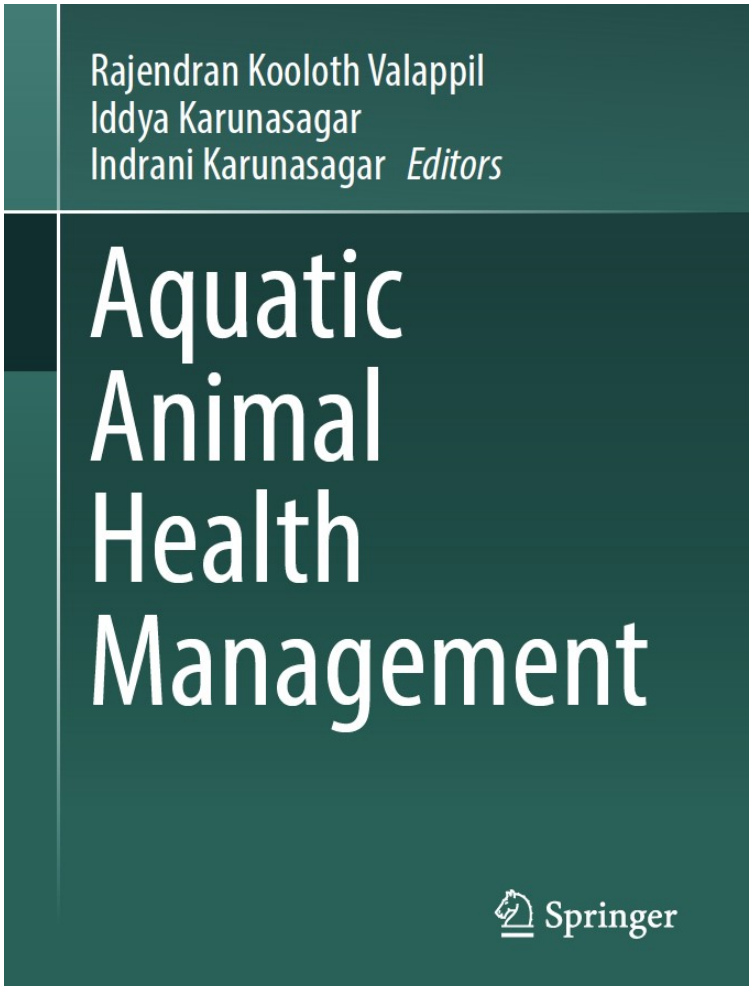
- ✓ Protocols must be established to reduce the impacts of emergencies, disease outbreaks, or unexplained deaths of aquatic animals
- ✓ Procedure should define thresholds that help to identify an emergency incident and activate response protocols, including reporting requirements

e. Health monitoring

- ✓ Monitoring should be performed at a production unit and establishment level
- ✓ Activities may include disease surveillance, routine monitoring of stock, recording of clinical signs of disease and check on morbidity and mortality

f. Routine review and auditing

- ✓ Routine revision of the biosecurity plan is necessary to ensure that it continues to effectively address biosecurity risks
- ✓ The biosecurity plan should also be **reviewed at least annually** or in response to changes to the aquaculture establishment operations

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# THANK YOU