**Biosecurity**

**in Oman**

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**Introduction**

Aquatic biosecurity is one of the most important issues worldwide. It becomes awareness around the world with the increasing in aquatic animals’ diseases especially with the increasing in aquaculture practices (Yanong & Reid 2012 and Ernst et al. 2016). These diseases spread out due to increasing in seafood international trade, exporting and importing aquatic species and equipment (Ernst et al. 2016). Moreover, development of aquaculture sector worldwide rises the requirement of aquatic biosecurity because it can be affected negatively in a case of diseases spread out in an aquaculture system.

Biosecurity describes the practices that protect the aquaculture system from spreading the diseases. These practices will reduce the risk of introducing infectious diseases and minimizing the stress to the animals (Yanong & Reid 2012 and Ernst et al. 2016).

Most countries in the Middle East have not yet start the process of creating national strategies on biosecurity (Treven, 2018). On the other hand, some conferences took place in Abu Dhabi in 2008 and Casablanca in 2009 in order to realize the need for biosecurity strategies. As a result, the awareness of the importance of biosecurity raised within the regions (Treven, 2018).

In Oman in 2015 two biosecurity related events had been held: **the introductory training course on risk analysis for movements of live aquatic animals for RECOFI members** and **the round – table meeting on RECOFI regional aquatic biosecurity (FAO, 2018).** That means Oman concerns on biosecurity issue concurrently with aquaculture development.

This essay reports the importance of biosecurity, the disease routes transmission, risk analysis, the guidelines of biosecurity plan and concluded with the generic template of the biosecurity plan to be applied in Oman.

**Why biosecurity?**

Biosecurity is important to be established in Oman because of the major goals that can be achieved like supporting aquaculture productivity with high quality and international trade exchange beside the huge development of aquaculture sector in the country (Ernst et al. 2016).

Countries which planning to focus on aquaculture sector such as Oman as a national income has to improve biosecurity plan which is an important issue to success in this field. Improving biosecurity practices result in better animal health and allow for early disease detection so that impacts can be reduced and also allow farms to meet international trade requirements (Ernst et al. 2016).

In general, the purpose of an aquaculture biosecurity plan is to reduce the risk of diseases being introduced into the farm, reduce the risk of diseases spreading within the farm, reduce the risk of diseases escaping from the farm and have emergency response protocols in place for serious disease outbreaks.

**Disease routes transmission**

Before starting improve the biosecurity plan, we have to realize that, there are many factors playing a role in diseases transmission in the farm. The main routes of transmission include animals, water, equipment, feed, people, and waste.

Animals and people

Aquatic species, which will enter the farm to be cultured, must be free from diseases with perfect health status. These aquatic animal vectors of disease can include brood stock, seed stock and eggs. Moreover, some wild aquatic animals such as birds and pest can be a disease transmission risk to the farm by water supply (Yanong & Reid 2012 and Ernst et al. 2016).

In addition, people such as staff, contractors, visitors, and unauthorised entrants can cause a significant risk of disease introduction especially when they go around more than one farm or if they were in a contaminated environment with pathogens. They introduce microbes to the farm by contaminated skin, clothing and footwear (Yanong & Reid 2012 and Ernst et al. 2016).

Equipment, vehicles and vessels

Equipment such as harvest, grading, diving, and feeding equipment can provide a risk of disease transmission onto the farm. Used equipment in other farm can cause higher risk than the new ones. Moreover, vehicles such as cars, trucks and tractors can introduce pathogens onto the farms and cause real risk when they were used in other farms or if they contacting with animals (Yanong & Reid 2012 and Ernst et al. 2016).

Water

Another important issue is supplying water to the farm. Pathogens can inter the farm with water supplied especially in sea cages where it is difficult to control diseases transmission. Otherwise, water source is very important to take into account before use it in any aquaculture systems (Ernst et al. 2016).

Feed and waste

Manufactured feeds, which are used in aquaculture farms such as extruded pellets whether it is live, fresh or frozen feeds, can present a significant risk and play strong role in disease transmission due to its presence in the manufacturing process.

Another important thing to maintain good biosecurity level is appropriate infrastructure and procedures that will help in maintaining good water quality disposal of waste like dead animals and uneaten food (Ernst et al. 2016).

**Risk analysis**

Risk analysis is the assessment of the risk level resulting from the entry and spread of pathogens and diseases and the identification of options to limit the level of biosecurity risk. It includes three stages: hazard identification, risk assessment and risk management (Ernst et al. 2016).

Risk analysis is a critical issue that helps in establishing a biosecurity plan, which will focus on the highest risks and any proposed biosecurity measures that can be more useful in reducing risk to an acceptable level (Ernst et al. 2016).

Stage one: hazard identification

First, you have to identify the disease that could affect the animal health negatively. This stage is important in determining which pathogen is the subject of risk assessment.

Stage two: risk assessment

The second stage including quantitative and qualitative of the risk that can cause a major negative impacts on the farm. Assessing the risk consequences might help in reducing depopulation of the farm.

Stage three: risk management

The third stage including management of the risk and reducing the risks to an acceptable level by choosing most suitable options according to effectiveness and cost.

**Biosecurity plan guidelines**

Record keeping

To establish good biosecurity plan, records should include so many things: the origin of all animals on the farm, movements of animals onto within and from the farm, and records of staff and visitors. Recording all this information will help in identifying the source of the disease outbreak and the possible extent of its spread in and outside the farm. Moreover, recording information about the health status of animals in the farm will assist in identifying any emerging health problems and diseases and to improve husbandry conditions. The level of details required will depend on the condition of the farm and the level of predicted risk (Ernst et al. 2016). This information may include:

* Animal movement records.
* Observations on health status (for example, behaviour changes, morbidity and mortality).
* Husbandry records (for example, stocking densities, feeding rates and growth rates).
* Application of treatments or vaccinations.
* Water quality data.
* Disease testing (for example, pathology reports).

Staff training

To maintain farm biosecurity, it is important that all staff should understand their responsibilities. They should be able to recognise any health issue, aware of the major disease routes, transmission onto, within and outside the farm. They should have experience in safe work practices and standard operating procedures that support the farm biosecurity plan (Ernst et al. 2016).

Farm staff should have training on correct practices in the farm and should include emergency procedures. In addition, they have to be improved in all issues related to good aquatic biosecurity.

Property management

All farms should have a secure perimeter to establish a clear defined biosecurity zone. Entrances should be able to restrict vehicle and foot traffic and should be locked during all non-visitor hours.

It is important to apply good management plan for disease routes transmission so that effective control points can be established. All inputs to the farm such as animals, people, water, equipment and vehicles should be assessed for potential biosecurity risks. Moreover, all production units should have appropriate features to prevent entry of wild animals and escape of farmed animals.

Protocols to address major transmission routes

In order to minimize the effects of diseases transmission into the farm, people movement including staff, contractors and visitors should be controlled

It is important to manage staff and visitor access through access controls and signage and the risk they present should be assessed. The rules of farm biosecurity should be explained to all visitors and applied to all persons entering and exiting the farm and for people moving between productions areas of different disease status within the farm. Moreover, accessing to sensitive areas should be restricted and the production units should be managed separately to reduce the risk of disease spread within the farm (Ernst et al. 2016).

**How to implement biosecurity plan?**

In order to implement biosecurity plan in any region, it is necessary to have new procedures, new equipment, new farm infrastructure, new signs…etc. In addition, staff consultation and training will be important in applying the biosecurity plan (Ernst et al. 2016).

Standard operating procedure

To establish a new biosecurity processes in Oman for example, it should be described in a standard operating procedure (SOP) which includes the title, objective, responsibilities, procedure, precautions, review data and further information. This SOP aims to support the general goal of this biosecurity plan by the farm staff. For this reason it must be clear, easy to follow and available to staff.

The biosecurity plan requires many records about different aspects of farm operation as it was mentioned previously. Records management should collect only the necessary information and be as simple and practical as possible. This information might be training records, visitor register, stock receipt and inspection records, visitor/staff risk assessment, cleaning records and audit records.

Equipment and Signage

Labelling new equipment putted in the farm is an important issue to clarify and understand proper use and maintenance (for example, use of footbaths and procedures for refreshing disinfectant).

Moreover, the biosecurity plan requires signs that are erected at access points, to label different production areas and to identify restricted areas.

Staff training

Staff training and consultation is very critical for effective implementation of any success biosecurity plan. It is important that staff are fully aware and trained on any new responsibilities under the farm biosecurity plan and clearly understand their role.

**Conclusion**

Omani government has to work hard to reach the perfect biosecurity level in order to protect its huge development in aquaculture sector. Oman has to develop training centres to teach biosecurity curriculum that match with the needs of the country. This is important to prepare qualified human resources that is critical in developing biosecurity strategies. The table below show the generic biosecurity plan template (Ernst et al. 2016).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Guidelines** | **Management****response** | **Responsibility** | **When** | **Resources** |
| Record keeping |
| G1. Movement records should be maintained for all animals moved onto the farm, between zones of different biosecurity status within the farm and from the farm. |  |  |  |  |
| G2. Health monitoring records should be kept for differentanimal populations within the farm and should include details of any sickness, mortality, treatments, disease testing and relevant environmental information. |  |  |  |  |
| Staff training |
| G3. A staff member should be made responsible for overseeing farm biosecurity. |  |  |  |  |
| G4. All farm staff should understand disease risks to thefarm, the role of the farm biosecurity plan in managingdisease risks and their responsibilities for its implementation, including response protocols. |  |  |  |  |
| G5. Staff should receive training on aspects of the farmbiosecurity plan relevant to their work and have access to the farm biosecurity plan and supporting procedures. |  |  |  |  |
| Property management |
| G6. The farm should have a secure perimeter fence orotherwise well-defined boundary, establishing a clearly defined biosecurity zone. Entrances to the propertyshould be able to restrict vehicle and foot traffic and should be locked during all non-visitor hours. |  |  |  |  |
| G7. All inputs to the farm (for example, animals, people,water, equipment and vehicles) and between zones within the farm should be assessed for potential biosecurity risks. |  |  |  |  |
| G8. All production units (for example, sheds, ponds, tanks, raceways) should have a unique and permanent identifier. |  |  |  |  |
| G9. All production units should have appropriate features to prevent entry of wild animals and escape of farmed animals. |  |  |  |  |
| People |
| G10. Staff and visitor access should be managed (through access controls and signage) and the risk they present should be assessed. |  |  |  |  |
| G11. The farm biosecurity rules should be explained to all visitors. |  |  |  |  |
| G12. Measures to prevent disease entry should beapplied to all persons entering and exiting the farm (forexample, dedicated changing areas, farm footwear and hand washing facilities), and for persons moving between productions areas of different disease status within the farm. |  |  |  |  |
| G13. Access to sensitive areas (for example, broodstock units) should be restricted. |  |  |  |  |
| G14. Production units should be managed separately to reduce the risk of disease spread within the farm. Staff should be assigned to production units based on risk. |  |  |  |  |
| G15. If staff must work in multiple production units,higher health animals should be visited first and lowerhealth or diseased animals last, with appropriate cleaning and disinfection protocols followed between visits. |  |  |  |  |
| Animals |
| G16. Animals should only be introduced to the farm if they are of known health status and that status is of equal or better status than animals on the farm.Translocation approvals or permits must be obtained if required by the receiving state or territory authority. |  |  |  |  |
| G17. If the health status of introduced animals is unknown(for example, wild broodstock; seed stock ofunknown health status) the animals should be isolated from other farm populations in separate production units or dedicated quarantine facilities. |  |  |  |  |
| G18. If risks are found to be high, quarantine ofbroodstock should be lifelong with a view to producing high health or specific-pathogen-free progeny that would become broodstock. |  |  |  |  |
| G19. Where feasible, treatment of quarantined animals may be considered to mitigate disease risks (for example, for external parasites). Treatments must be conducted in accordance with legislative and regulatory requirements. |  |  |  |  |
| G20. Movement of animals between different farmpopulations should only occur following consideration of the disease risks and with a view to maintaining high health status. |  |  |  |  |
| G21. If animal populations become sick, precautionsshould be taken to avoid contact with other farm populations until the cause is known and the situation resolved. |  |  |  |  |
| G22. Sick or dead animals should be removed from production units as soon as possible and disposed of in accordance with section 9.6 (see G37–G 38). |  |  |  |  |
| G23. In semi-closed systems prevent entry of aquatic animals in the water supply. |  |  |  |  |
| G24. In semi-open systems consider options for limiting entry of animals to, or aggregation near production units. |  |  |  |  |
| G25. Measures should be put in place to prevent escape of aquatic animals. |  |  |  |  |
| G26. Predatory or scavenging animal populations should be controlled or excluded from production facilities. |  |  |  |  |
| Equipment, vehicles and vessels |
| G27. Any equipment, vehicles or vessels brought onto the farm should be assessed for biosecurity risk. |  |  |  |  |
| G28. Procedures and infrastructure should be in place to clean and disinfect equipment, vehicles or vessels. |  |  |  |  |
| G29. The farm should have designated delivery and loading areas. |  |  |  |  |
| G30. Separate equipment should be assigned for use in production units of different health status. Whereequipment must be used in multiple production units itshould be cleaned and disinfected prior to movement between units. |  |  |  |  |
| Water |
| G31. The biosecurity risk of a farm’s water source shouldbe considered and appropriate actions taken to manage any identified risks. |  |  |  |  |
| G32. Infrastructure for decontamination of water should be adequately monitored and maintained to ensure it remains effective. |  |  |  |  |
| G33. For land-based farms, water intake and outflows should be located to avoid cross- contamination. Theflow of water within the farm should be managed tominimise the potential for diseases to spread betweendifferent production units or populations with different health status. |  |  |  |  |
| G34. For sea-based farms, lease sites should be located to maintain epidemiological separation of populations with different health status (for example, different year classes). |  |  |  |  |
| Feed |
| G35. The biosecurity risk of feeds should be considered and appropriate actions taken to manage any identified risks. |  |  |  |  |
| G36. Manufactured feeds should be used wherever possible in preference to live or unprocessed feeds. |  |  |  |  |
| Waste |
| G37. Waste products (for example, dead animals, water and effluent) should be assessed to determine potential biosecurity risk to the farm and the environment. |  |  |  |  |
| G38. Containment, handling and disposal of wasteproducts should minimise identified disease transmission risks. |  |  |  |  |
| Emergency procedures |
| G39. The farm biosecurity plan should include procedures for the response to a suspected emergency biosecurity incident. |  |  |  |  |
| G40. All farm staff should understand the farm’s emergency procedures and their own role in an emergency. |  |  |  |  |
| Monitoring and audit |
| G41. The farm biosecurity plan should include a schedule for routine review and identify any triggers for extraordinary review. |  |  |  |  |
| G42. Audit of the farm biosecurity plan (and effective record keeping of formal audits) should be conducted to ensure it is being implemented effectively. |  |  |  |  |

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