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Tilapia hatchery production in Nigeria: Manual for best biosecurity practices



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Tilapia hatchery production in Nigeria: Manual for best biosecurity practices

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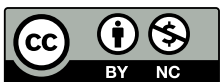
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Photo caption cover

A hatchery technician removes weak or dead fry during daily monitoring.

Photo credits

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Introduction

In April 2022, WorldFish transferred Genetically Improved Farmed Tilapia (GIFT) fry from its headquarters in Malaysia to Premium Aquaculture Limited (PAL) in Abeokuta, Nigeria. The transfer was part of an innovative initiative to enhance aquaculture sustainability and economic development in Nigeria. It was made possible through a collaboration with the Bill & Melinda Gates Foundation and the West Africa Trade and Innovation Hub, which is funded by the United States Agency for International Development.

The vision of this strategic partnership is to establish a robust GIFT breeding population at PAL to disseminate fry and fingerlings for hatchery production and grow-out across Nigeria. PAL carefully cultivated and bred the GIFT fingerlings it received, and it expected to disseminate the F2 fingerlings (second generation) to satellite hatcheries and smallholder grow-out farmers in April 2024. Spearheaded by CGIAR's Transforming AgriFood Systems in West and Central Africa project, this endeavor is poised to revolutionize aquaculture practices and the seed supply within the country.

This comprehensive tilapia biosecurity manual is an integral component of this initiative. The manual provides crucial guidelines and protocols for ensuring the health and biosecurity of tilapia hatchery operations. We hope it will prove instrumental in guiding fish farmers across Nigeria to protect their stocks from diseases. This, in turn, will enhance yields and ensure the long-term success of their aquaculture endeavors.

The aim of these collective pioneering efforts is to establish a resilient and biosecure environment for farming tilapia in Nigeria. In doing so, they combine national goals of food security, economic prosperity and sustainable aquaculture practices.

What is biosecurity?

Biosecurity entails the following measures:

- Establish and implement systematic procedures.
- Prevent the introduction of infectious agents such as bacteria, parasites, fungi and viruses that can cause disease in an indoor or outdoor fish hatchery, nursery or grow-out.
- Prevent the entry of infectious agents from external sources or within different sections of the same hatchery.

Why is biosecurity important?

- **It avoids harmful pathogens:** Biosecurity is a standard prevention method that avoids contact between fish and infectious agents (pathogens).
- **It protects grow-out ponds:** Biosecurity acts as a barrier to avert the onset of diseases.
- **It is a smart, inexpensive approach:** Biosecurity is part of good aquaculture practices to use in any hatchery.
- **It saves time and money:** Neglecting biosecurity measures can result in more time and financial resources spent on treating diseases when they occur.
- **It is a good investment:** Biosecurity includes simple and sometimes zero-cost measures that will keep pathogens away from fish and keep fish away from pathogens.
- **It can be used anywhere:** Biosecurity principles can be applied in large-scale and backyard or small-scale fish production units.

By doing smart things and being careful, we are helping our tilapia friends stay healthy and happy.



Plate 1. It is important that hatcheries put up clear notices regarding biosecurity measures.

Why is biosecurity necessary?

Biosecurity is indispensable for hatcheries. One of the main reasons is that it operates as a defense against introducing pathogens that can cause disease outbreaks. These pathogens can infiltrate the system through routine operational activities, potentially causing significant harm. They can be introduced from various sources, including new broodstock, new fry or fingerlings, contaminated equipment, birds and other animals, the water supply or visitors.

What is the role of biosecurity?

Disease prevention: Implementing robust biosecurity measures can prevent disease outbreaks, thus averting substantial financial losses and operational setbacks.

Effective design: A well-designed facility seamlessly integrates optimal biosecurity practices.

Investment protection: Biosecurity safeguards investments, ensuring consistent revenue generation.

Quality assurance: Ensuring the production of premium quality fish reinforces the trust of reliant farmers.

Implementing biosecurity measures effectively can uphold fish health and maintain grow-out profitability. Preventing the introduction of pathogens results in high-quality fish production, reduced financial losses and sustained operations.

Prioritizing biosecurity measures will ensure the successful operation of a hatchery.



Plate 2. Disinfecting boots before every use is a critical biosecurity measure.

What are the advantages of biosecurity?

Biosecurity can help hatcheries minimize the following risks:

- disease outbreaks
- high rates of fish mortality
- high financial losses from fish loss
- setbacks caused by production disruptions
- high operational clean-up costs after a disease outbreak
- project failure
- loss of client trust in the quality of fry or fingerlings.

Even if a hatchery does a thorough clean-up following a disease outbreak, there is no guarantee that it will produce disease-free fish, as certain pathogens, like tilapia lake virus (TiLV), can persist within the fish. Implementing effective biosecurity measures, along with good management practices, is a more cost-effective approach than disease treatment.

Implementing biosecurity ensures a higher probability of overall success and contributes to long-term sustainability.



Plate 3. Installing a disinfectant footbath at the entrance can prevent potential pathogens from getting into the hatchery.

What are the key steps for effective biosecurity?

For hatcheries, focusing on apt procedures is pivotal for effective biosecurity measures. These protocols are crafted to prevent external pathogens from entering and internal pathogens from spreading, thereby mitigating the risk of fish mortalities. Adhering to these procedures substantially reduces the odds of transmitting pathogens.

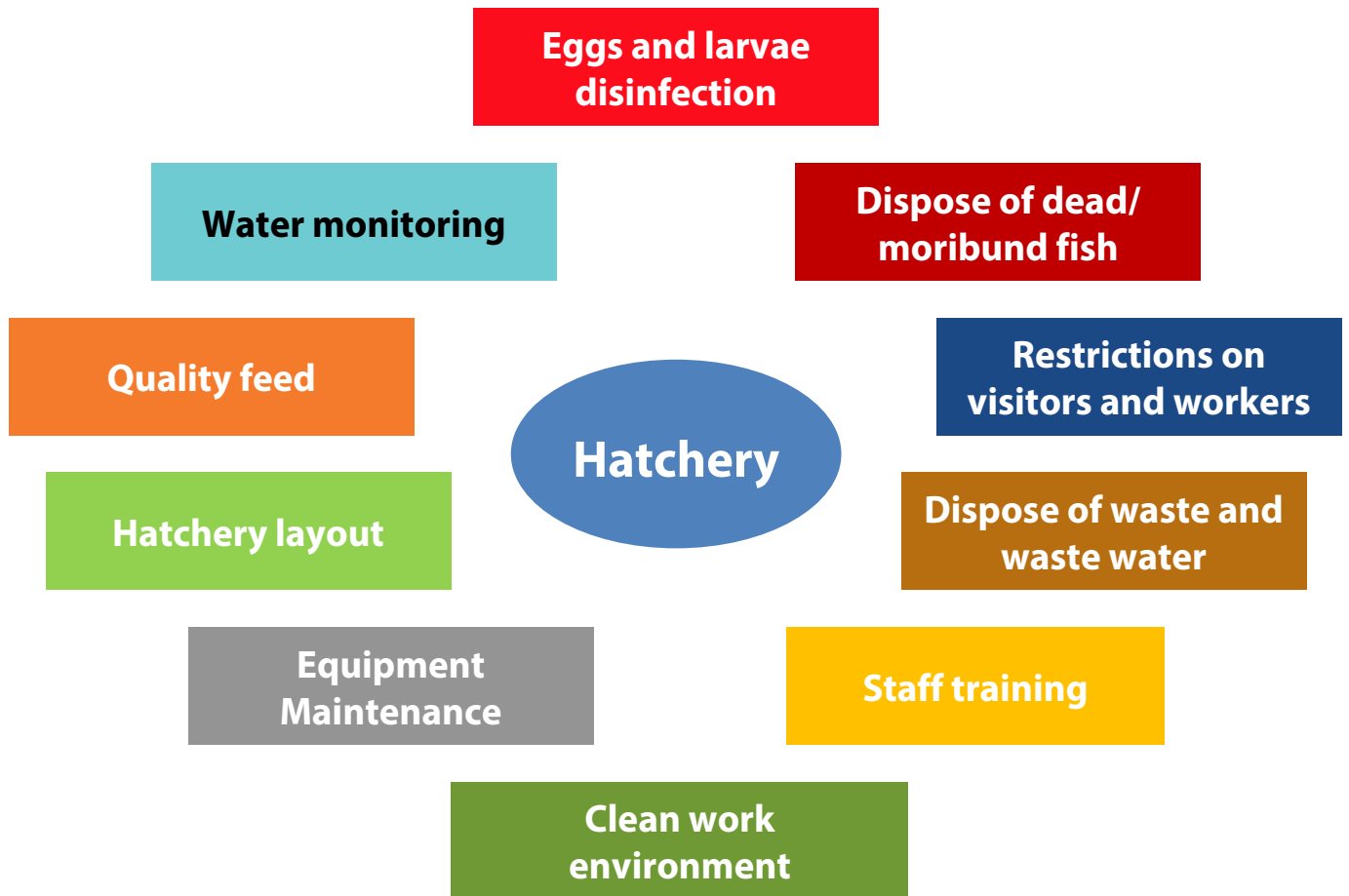


Figure 1. Key biosecurity measures for a hatchery.

How are diseases introduced into a hatchery?

Diseases can infiltrate a facility through various pathways. When new fish are brought in from external sources, like other countries, different farms or the wild, they can carry harmful pathogens without showing signs of illness. A lack of robust biosecurity measures increases the chances of a pathogen getting into a hatchery.

Tilapia can harbor the following pathogens:

- common protozoan parasites like *Ichthyophthirius multifiliis*, *Trichodina* sp., *Eimeria* spp., *Myxosoma* sp., *Nosema* sp., *Henneguya* sp. and *Hexamita*
- monogenean flukes
- helminths like *Acanthostomum* spp. and *Acanthogyrus* sp.
- bacteria such as *Pseudomonas* sp., *Aeromonas* sp., *Flavobacterium columnare*, *Francisella* sp. and *Streptococcus* spp.
- viruses like TiLV.

In addition to infected fish, using a contaminated water supply that is not properly treated or contaminated equipment can introduce pathogens into a hatchery. To prevent this from happening, operators should take the following precautions:

- **Minimize imports:** Reduce the introduction of live fish from other countries or farms outside the facility.
- **Seek expert guidance:** Consult relevant authorities, like the Department of Fisheries, before importing fish. They can help identify reputable fish sources that are free of harmful pathogens.
- **Buy certified fish:** Newly acquired fish should come with a health certificate that verifies they are free from harmful pathogens. Authoritative bodies should conduct essential tests on these fish to ensure they are healthy and free of pathogens.
- **Quarantine new fish:** Isolate new fish as a precautionary measure. The quarantine period helps hatcheries assess the fish for potential pathogens before mixing them with the existing pond population. Hasty mingling without proper assessment can lead to significant mortalities.

By adhering to these measures, hatcheries can significantly reduce the risk of introducing diseases into their facility.

How can apparently healthy fish become sick?

It is puzzling how new fish that look perfectly healthy can become sick. Several factors can cause this, including transportation stress and disease. Transported fish may look healthy, but symptoms can appear shortly after they are shipped. If fish undergo excessive stress during transportation, they will be at high risk of infection from pathogens, resulting in disease within just a few days. This usually happens with young or weak fish, resulting in high mortalities.

To prevent mortalities after transportation, operators should adhere to the following practices:

- **Buy fish locally:** Purchase fish from a nearby facility to avoid the stress of a long journey.
- **Use a reliable source:** Obtain fish from farms with no record of disease outbreaks. These farms are usually certified by the fisheries authorities and should provide a health certificate confirming the fish are free from harmful pathogens or diseases.
- **Ensure optimal water conditions:** Maintain favorable water quality in your ponds, including temperature, pH and oxygen levels, to keep fish healthy.
- **Conduct routine checks:** Regularly examine your fish for any signs of disease. Early identification, isolation and treatment of diseased fish will minimize losses and spread of the disease.
- **Use timely treatment:** If feasible, treat diseases effectively before introducing fish into a grow-out pond.

By implementing these steps, operators can significantly reduce the impact of transportation stress and enhance the overall health and survival rates of their fish.

How are diseases transmitted within a hatchery?

Diseases can swiftly propagate within a hatchery through various channels. One common avenue involves daily operational items becoming contaminated from multiple uses. These include buckets, nets, siphon hoses, footwear and other materials. Wild animals and visitors can bring in diseases as well.

Unintentional contact with diseased fish or pathogens can occur when contaminated items are used in routine operations, whether they are brought into a hatchery or contaminated during interactions with people or animals, like dogs, cats, squirrels and other stray creatures. This can, in turn, transmit pathogens to the fish.

To prevent diseases from spreading, it is important to have strict biosecurity measures in place. These include regularly cleaning and disinfecting equipment, ensuring that staff follow proper hygiene practices and maintaining strong pest control efforts.

Essential preventive measures are crucial steps in minimizing the spread of disease. Any items introduced into a hatchery, such as buckets or nets, must be disinfected to eliminate possible pathogens. During breaks between cycles, staff must disinfect all equipment used in the facility.

By vigilantly implementing these measures, hatcheries can effectively prevent diseases from spreading, which will safeguard the health and vitality of their fish.

What are the key requirements for better biosecurity?

Before establishing a new hatchery, proper planning is crucial to meet the prerequisites for biosecurity. Consider the following aspects when selecting a site for a hatchery:

- **Find a suitable location:** Opt for elevated land to ensure proper drainage to prevent water logging. In addition, the site should be at a considerable distance from other ponds or farms to mitigate the risk of infection. Select a site with access to a reliable water source for filling and maintaining the pond.
- **Avoid flood prone areas:** Do not site a hatchery in flood prone areas. This will prevent damage to the facility from flooding and make it easier to implement biosecurity measures.
- **Manage effluents:** Treat effluent properly and discharge it onsite.
- **Ensure accessibility:** Select a site with easy road access to transport fish and materials effectively.
- **Use reliable utilities:** Secure a reliable supply of electricity and clean water, both of which are essential for a proper functioning hatchery.
- **Modify facilities:** Make minor modifications to existing facilities to effectively implement better biosecurity measures.

What is the optimal hatchery design for efficient biosecurity?

The success or failure of fish production depends on the design of the facility. Hatcheries should implement the following measures to ensure cost-effectiveness and operational efficiency while maintaining good biosecurity:

- **Construction:** Use budget-friendly, locally available materials to build the hatchery.
- **Sealed building:** Construct a sealed building to prevent the entry of animals, such as rats and birds, which can introduce and spread pathogens. This will also reduce temperature fluctuations, thus minimizing stress on the fish.
- **Fencing:** Put proper fencing in place to prevent animals and unauthorized personnel from entering the facility.
- **Aeration:** Make sure the hatchery has uninterrupted 24/7 aeration for the fish.
- **Lighting:** Provide sufficient lighting to monitor operations effectively.
- **Compartmentalization:** Establish different compartments to segregate diverse hatchery operations. This includes separate sections for hatching eggs, holding fingerlings, quarantining fish and holding new introductions.
- **Accessibility:** Only essential personnel should have access to areas where live fish are kept. Each division should have designated footbaths and equipment with mandatory hand-washing for each zone. Avoid direct movement from the quarantine room into the hatching area.
- **Contamination:** Install separate entrances for different hatchery zones, such as storage rooms for feed and equipment, to avoid cross-contamination. This ensures staff can move around without going through the live fish section.
- **Drive-thru dip:** Install a drive-thru dip mechanism at the main entrance to sanitize incoming and outgoing vehicles.
- **Footbath and hand-washing stations:** Provide footbaths and hand-washing stations at the entrance to the hatchery for all staff and visitors.
- **Fish packing:** Locate the packing area near the main entrance.
- **Aerators and water pumps:** Isolate aerators and water pumps to prevent disturbances from noises and vibrations.

Meticulous design considerations not only ensure optimal operational efficiency but also strengthen the hatchery's biosecurity measures.



Plate 4. Hatcheries should have multiple sections, such as an incubator room, that have their own specific function.



Plate 5. Using secure fencing around an outdoor nursery pond protects against potential threats from animal predators.

Why is optimal water quality important?

For effective biosecurity practices, maintaining appropriate water quality is essential to prevent disease transmission and ensure the health and growth of the fish. Here are the recommended water quality requirements for tilapia hatcheries:

- **Water supply:** Maintain clean water for optimal fish health. Poor water quality can lead to low larval survival and impact overall production. Use filtration or UV treatment to ensure the water supply meets optimal standards and is free from pathogens.
- **Water quality:** Maintain parameters such as temperature, dissolved oxygen levels, pH, and ammonia and nitrite levels within the acceptable range.
- **Water source:** If drawing water from a borewell, be sure to filter the water. If water is obtained from an open source, such as a river or lake, treat the water to eliminate pathogens. Use sand filters, UV light or ozone to ensure water is safe.
- **Cross-contamination:** Avoid splashes and aerosols between tanks, as these can spread pathogens.
- **Heavy metals:** Proper treatment is essential before use if the water is contaminated with arsenic or other heavy metals.

By carefully addressing water quality, hatcheries can secure the foundation for thriving fish health and production.



Plate 6. Using comprehensive water filtration across multiple chambers can eradicate organic matter, aquatic predators and potential pathogens.



Plate 7. Treating the water supply with a sand filter can remove organic matter and possible pathogens.

What are optimal nutrition practices?

Hatcheries should follow these measures for proper nutrition to ensure a successful operation:

- Provide fish fry or fingerlings with the right quality feed to ensure growth, stress tolerance and disease resistance.
- Take care when sourcing live feed, such as rotifers, from aquatic environments, as they have a higher risk of transmitting disease than commercial feeds.
- Obtain good quality feed from reliable sources, as poor quality feed can lead to disease outbreaks.
- Use feed before the expiry date to maintain the nutritional content and avoid the risk of contamination with pathogens. Keep feed in a cool and dry place that rats and other animals cannot access. This helps preserve the nutritional content of the feed.
- Exercise caution with fresh feed, such as trash fish or bivalves, which can carry pathogens. Use fresh feed only if it can be treated to eliminate pathogens.
- Commercial feeds are generally safe and present a low risk of disease transmission.

By adopting these nutritional principles, hatcheries can bolster their potential for successful production while mitigating the risk of disease outbreaks.



Plate 8. Keeping feed in a cool environment will safeguard the integrity of its nutrient content.

How do you maintain biosecurity for hatchery equipment?

To prevent disease transmission, implementing effective cleaning and disinfection procedures for equipment is crucial to avoid introducing and spreading pathogens.

Hatcheries should adopt the following protocols to minimize the risk of contamination:

- **Facility:** Clean and disinfect all tanks and equipment thoroughly after each use and before starting a new production cycle. Also, regularly clean, disinfect and dry all equipment, such as nets, buckets and boots, after use. Maintaining a clean working environment is essential.
- **Filters:** Wash and disinfect filters regularly. Flush sand filters and sun-dry the sand to ensure optimal performance.
- **Equipment:** To prevent external contamination, avoid taking items outside the hatchery. In addition, limit the movement of equipment between tanks. Equip each tank with its own set of small items (beakers, scoop nets, buckets) and avoid interchanging them. If sharing items between tanks is unavoidable, ensure proper disinfecting after use.
- **Instruments:** Use reliable instruments for measurements to ensure accuracy and prevent cross-contamination.



Plate 9. Meticulously disinfecting equipment after each use is important to ensure it is properly sanitized.

How do you optimize disinfection practices in hatcheries?

Disinfection plays a crucial role in preventing and controlling diseases. Hatcheries should adopt the following procedures to ensure adequate disinfection:

- **Apply disinfectant:** Use appropriate disinfectants at the recommended concentrations and specific duration.
- **Disinfect equipment:** Regularly disinfect all hatchery equipment, such as trays, nets and buckets, and dry them thoroughly.
- **Rinse equipment:** If necessary, wash items thoroughly after disinfection to remove potential toxic residues.
- **Maintain airbag filters:** Soak airbag filters in a disinfectant solution and then dry them in the sun.
- **Maintain tanks:** Wash and disinfect tanks at the end of every production cycle.
- **Store equipment:** Store nets and other equipment off the floor to prevent contamination.
- **Prevent cross-contamination:** Keep hatchery equipment within the designated area to avoid the risk of cross-contamination. Disinfect before and after use.

How do disinfectants combat infectious organisms?

A disinfectant is a substance that eliminates infection-producing organisms. The effectiveness of a disinfectant depends on the concentration and duration of application and procedures undertaken.

When handling disinfectants, wear protective gear and follow the instructions carefully. Dispose of expired disinfectants correctly to prevent misuse.

Table 1 contains a selection of common disinfectants and recommended doses. The list is intended for informational and educational purposes only. Please seek the advice of professionals on how to use disinfectants properly.

Disinfectant	Concentration	Duration	Comments
Benzalkonium chloride	250–500 ppm	10–30 min	Plastics, floors, footbaths, walls, equipment and furnishings
Didecyl dimethyl ammonium chloride	400 ppm	5 min	Plastics, floors
Phenols	2%–5% active ingredients	10–30 min	General disinfection
Chlorine	200–500 ppm	10–60 min	All surfaces except plastic
Ethyl alcohol	70%–80%	10–30 min	Hands, tools, work surfaces
Isopropyl alcohol	60%–80%	10–30 min	Hands, tools, work surfaces
Iodine	100–250 ppm	20–30 min	Antiseptic on tissues (follow the instructions on the label for disinfecting eggs)
Hydrogen peroxide	3%–30% (weight percentage) 3–5%	5–30 min 5–15 min	General disinfection Follow label instructions to treat fish or disinfect eggs
Virkon Aquatic	0.5%–1% or 50–100 g per 10 L of water	10–15 min	General disinfection (commonly used for footbaths)
Chlorhexidine (most solutions contain 2% active chlorhexidine)	Add 100 ml to 1 L of water	5–10 min	General disinfection (commonly used for footbaths)

Sources: Bowker et al. 2014; Yanong and Erlacher-Reid 2012.

Table 1. Common disinfectants used in hatcheries.

How do you manage vehicles entering the facility?

Stringent protocols for vehicles are important to minimize the risk of transmitting diseases within and beyond the hatchery. Unauthorized vehicles should be prohibited from entering the hatchery. Install a disinfectant bath at the gate for vehicles to pass through to cleanse their wheels and undercarriage. Replace the disinfectant regularly according to the instructions on the label.



Plate 10. A drive-thru wheel bath at the entrance of the hatchery can mitigate the risk of potential pathogens.

How do you manage visitors effectively?

It is important to minimize the risk of visitors transmitting diseases within and beyond the grow-out ponds. Neglecting protocols can inadvertently lead to fish infection, as individuals who have visited other sites may unknowingly carry pathogens that could contaminate the hatchery. Likewise, frequent movement across different sections can also spread pathogens.

Hatcheries should implement the following procedures to mitigate possible contamination from people:

- **Control the movement of visitors:** Regulate the movement of visitors to curb the spread of diseases.
- **Implement hygiene measures at the entrance:** Enforce the use of hand-wash and footbath facilities at the entrance to the pond facility.
- **Prohibit unauthorized access:** Prevent unauthorized individuals from entering the facility.
- **Document visitors:** Maintain a comprehensive visitors logbook to monitor their entry and exit.
- **Escort entrants:** Escort visitors into the facility.
- **Maintain disinfectant:** Replace the disinfectant regularly, as per the instructions on the label, to ensure its effectiveness.

By meticulously implementing these measures, hatcheries can strengthen their defenses against disease transmission through individuals.



Plate 11. Having a hand-washing station can maintain cleanliness and prevent the spread of diseases.

How do you manage wastewater and solid waste?

Hatcheries must ensure that any water discharged from the facility is devoid of pathogens. Implementing proper treatment and discharge practices will reduce the risk of disease within the ponds and their vicinity.

To treat wastewater, channel it from the ponds into a sedimentation pond. From there, treat the water using chlorination and dechlorination processes before discharging it. Do not discharge water close to the water supply intake point.

Waste products such as dead fish, wastewater and processing waste can transmit diseases in hatcheries. As such, proper disposal is necessary to reduce the risk. Bury or incinerate dead fish to prevent disease transmission, and dispose of solid waste according to local regulations and laws.



Plate 12. Fitting the main sump tank with a UV will kill pathogens before discharging effluent.



Plate 13. Hatcheries should have a wastewater treatment section with settling tanks and a sand filter.

How do you empower hatchery staff through comprehensive training?

To optimize the effectiveness of a hatchery's biosecurity plan, staff must clearly understand their responsibilities. All staff should be trained on the protocols to have a good understanding of biosecurity principles and to ensure the effective implementation of measures to prevent the spread of disease in the hatchery.

Hatchery owners/managers must ensure the following:

- Allow staff to have access to the biosecurity manual to ensure they have a comprehensive resource to refer to.
- Regularly review the biosecurity program and update it when necessary.
- Continuously educate hatchery staff on evolving biosecurity measures through periodic refresher training.

By adhering to training in biosecurity practices, hatcheries empower their staff to become vigilant guardians of biosecurity, cultivating a safer and more resilient environment.

How do you identify sick fish and take prompt action?

Like any other animal, fish will show symptoms when unwell, so observing any changes in their behavior is crucial. The two most obvious signs are a lack of appetite and lethargic movement. Other symptoms include blood spots, extra mucus, a swollen abdomen, and cloudy and/or swollen eyes.

Depending on the disease, sick fish will die daily or in large numbers in a short span. Minimizing stress is vital. Reducing overcrowding, maintaining a constant temperature, ensuring good water quality and providing adequate feed will make fish more resilient to sickness and reduce mortalities.

Grow-out farms should implement the following procedures to minimize losses:

- **Report diseases:** Notify local authorities immediately upon an outbreak to facilitate rapid control measures.
- **Isolate infected fish:** Segregate sick fish to another section of the hatchery to prevent disease transmission.
- **Seek expert evaluation:** Get an expert to assess a sample of infected fish to determine whether treatment is possible or euthanasia is necessary. If curable, treat all the remaining fish in the tank. For incurable diseases, bury infected fish to prevent disease transmission and then disinfect the entire hatchery, including the equipment.
- **Respond quickly:** Execute the preceding steps within 2–5 days, depending on the disease characteristics.

By detecting diseases early and acting upon outbreaks quickly, hatcheries can mitigate losses effectively.



Plate 14. Observing behavioral changes in fish is part of regular monitoring.

How do you diagnose sick fish?

In most cases, sick fish require further examination in a laboratory for accurate diagnosis. To facilitate this, there are three methods for sending sick fish to a lab:

1. Packed in oxygenated bags

- Place sick fish in oxygenated bags for transportation to the laboratory. Avoid overcrowding to prevent mortalities.
- Depending on the size of the fish, provide the lab with sufficient samples to determine the cause of the disease. If the fish are small, 10–20 should suffice.
- Include healthy fish in a separate bag so that the lab can use them as a comparison.
- Label the bags or boxes properly with the owner's or farmer's name and the tank number from which the fish were collected.
- Include a separate sheet with details about when the fish started showing symptoms, how many were affected, mortality timing and any additional information, such as the number of tanks involved and the percentage of mortalities.

2. Preserved in formalin

- If the laboratory is too far away, preserve the fish in a 10% buffered formalin solution.
- For small fish, slit the fish vertically from the anus to the gills and fix them in a buffered formalin vial.
- For larger fish, such as fingerlings and juveniles, the process takes longer. First, cut the spinal cord behind the operculum (pithing). Next, slit the fish ventrally from the anus to the gills. Dissect it to move the viscera away from the kidney and then puncture the swim bladder for proper fixation of the kidney. For fish that are larger than 5 cm, slit the muscles lengthwise on either side of the body, and place them in fixative at a ratio of 1:10 (fish to fixative). For fish that are larger than 10 cm, open the intestinal tract and make several slits in the liver, spleen and kidney for better fixation. Divide the head lengthwise along the midline to allow fixation of the brain.

3. Sent in an ice box

- In certain cases, operators can use an insulated box filled with ice to transport freshly collected fish from their tank.

It is important for hatcheries to take prudent measures when sending fish to a laboratory. Do not send dead fish. Always check with the lab before sending any fish. Ask how many the lab needs for diagnosis, and ascertain the requirements for sending fish and its preferred method, whether in oxygen, formalin or on ice. Notify the lab when the fish have been sent and provide an expected arrival date.

By adhering to these precautions, hatcheries will ensure accurate diagnosis and contribute to a comprehensive understanding of disease dynamics in their fish populations.

How do you keep effective records?

Maintaining comprehensive records is an essential component of a successful hatchery operation. Each activity must be recorded to trace or investigate an event linked to the possible cause of a disease outbreak. Precision, reliability and consistency are the hallmarks of successful recordkeeping. All records must include the event date, the signature of the person who made the entry and any additional remarks or comments.

Hatcheries should keep records of the following activities:

- Maintain a complete visitors log for any people who visit the farm.
- Document any incoming fish or internal movement of fish.
- Record any purchases and introductions of new fish.
- Note any changes in fish behavior.
- Document fish mortalities and specify symptoms, where applicable.
- Record findings from disease investigations, either from laboratories or visits from experts.
- Detail fish handling or treatment procedures.
- Track key water quality parameters regularly.
- Record quantities of each fry consignment produced and the corresponding destination farm.
- Keep a log of staff training initiatives.
- Document any modifications in farm operations, such as feed changes, changes in water supply, use of new disinfectant and the corresponding dose.

By adopting this comprehensive recordkeeping approach, hatcheries will secure a robust foundation for disease management and informed decision-making, ultimately nurturing a more productive and disease-resilient environment.

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A large, stylized graphic of a fish's tail, rendered in various shades of blue, occupies the right side of the page. The tail is curved and has several distinct rays, creating a sense of movement and depth. The background is a solid, dark blue color.

About WorldFish

WorldFish is a leading international research organization working to transform aquatic food systems to reduce hunger, malnutrition and poverty. It collaborates with international, regional and national partners to co-develop and deliver scientific innovations, evidence for policy, and knowledge to enable equitable and inclusive impact for millions who depend on fish for their livelihoods. As a member of CGIAR, WorldFish contributes to building a food- and nutrition-secure future and restoring natural resources. Headquartered in Penang, Malaysia, with country offices across Africa, Asia and the Pacific, WorldFish strives to create resilient and inclusive food systems for shared prosperity.

For more information, please visit www.worldfishcenter.org