

Aqua-mimicry: A Nature-Inspired Revolution in Sustainable Aquaculture



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INTRODUCTION

Aqua-mimicry is a new method in fish farming that is inspired by how natural aquatic environments work. It was developed in Thailand by Somsak Sripongpan and Sumawin Manpianchang. This system imitates the natural habitat of aquatic organisms in a controlled water setup. Instead of using plants that produce their own food, it uses animals that feed on other organisms. In this system, specific carbon materials, which act as an energy source, along with beneficial bacteria, are added. These help to break down unused nitrogen from fish food and waste, turning it into small clumps called floc. This process also supports the growth of copepods, which serve as a valuable protein source for farmed fish. Aqua-mimicry can be used in both large-scale and small-scale farming, especially in areas where there is not much air movement in the water. This technology is efficient, helps lower production costs, and provides a more sustainable way to grow fish, offering better results for farmers.

What Is Aqua-mimicry?

Aqua-mimicry is a farming technique that recreates the natural dynamics of coastal and estuarine environments inside aquaculture ponds. This is done by stimulating the growth of beneficial microorganisms especially copepods, tiny zooplankton that form a vital part of natural food webs.



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Scientific Concept Behind Aqua-mimicry:

Ecosystem Simulation: The core principle is to replicate the conditions of a natural estuarine environment within a controlled pond or tank system. This involves fostering a diverse and balanced microbial community and a thriving plankton population that would naturally occur in such an environment.

Symbiotic Application: The process is driven by the regular application of symbiotics a combination of beneficial probiotics (like *Bacillus* species bacteria) and prebiotics (fermented organic carbon sources such as rice or wheat bran). This symbiotic relationship is key to managing the ecosystem.

Nutrient Recycling and Bioremediation: The added probiotics and carbon sources promote the growth of heterotrophic bacteria that absorb and recycle nitrogenous waste products (like ammonia and nitrite) from uneaten feed and animal waste, converting them into non-toxic compounds. This in situ water bioremediation reduces toxic gas accumulation and helps maintain stable water quality without the need for frequent water exchanges.

Natural Live Feed Production: The fermentation of the carbon source promotes the bloom of zooplankton, particularly copepods, which serve as a highly nutritious, natural, and protein-rich live feed for the cultured shrimp. This significantly reduces the reliance on expensive commercial feeds, cutting operational costs.

Disease Prevention and Immunity Enhancement: By creating a more natural and less stressful environment, aqua-mimicry reduces conditions favourable to pathogens. The consumption of natural live feed rich in essential fatty acids (LC-PUFAs), minerals, and pigments enhances the shrimp's immune system and overall health, leading to better disease resistance and survival rates.

Waste Management and Polyculture: Solid waste (sediment) is typically concentrated in a central drain and transferred to a separate, deeper sedimentation pond. In this secondary pond, other aquatic species like catfish or tilapia can be cultured to consume the detritus and the worms that grow in the sediment, further filtering the water and creating an additional income stream (polyculture).

Implementation Steps

1. Preparation of fermented rice bran or plant-based substrate to seed microbial growth.
2. Gentle aeration setup for continuous oxygenation and circulation.
3. Consistent water movement using aerators, paddle wheels, or air diffusers.
4. Gradual introduction of plankton bloom before stocking.
5. Selective and moderate feeding to complement natural diets.
6. Regular monitoring of water quality, plankton density, and bottom conditions.

Advantages

- Helps keep water quality more stable.
- Allows for producing high quality fish at a lower cost in a better way that is easier to keep going.
- Makes the fish healthier because they mainly eat FRB and copepods.
- Makes the fish grow faster and better.
- Uses less feed to make the fish grow.
- Reduces the chances of common diseases happening.

Disadvantages

- Needs bigger ponds for treatment.
- Has to get rid of extra dirt and waste that can't be reused.
- Costs a lot to use energy.
- Hard to use in indoor farming setups.

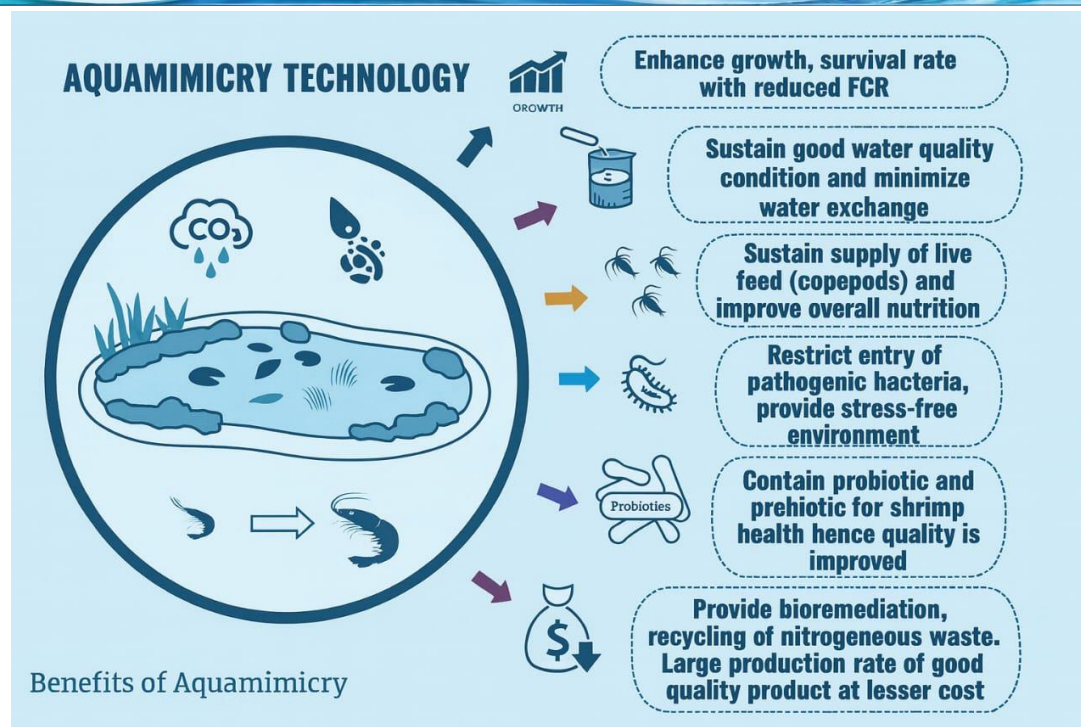


Table 1: Comparative aspects of aqua-mimicry and Bio-floc technology

Aspects	Aqua-mimicry	Bio-floc technology
Carbon sources	Rice bran or wheat bran	Molasses, carbohydrates, or commercial carbon sources
System Description	Creates a natural underwater environment in a controlled setting using special bacteria that eat organic matter. These bacteria help grow tiny animals like copepods, which serve as food for shrimp. This process also encourages helpful bacteria that keep the water clean, balance nutrients, and support a healthy ecosystem.	Builds up a thick population of bacteria in the water that break down waste and lower harmful ammonia levels. This helps manage waste, reuse nutrients, prevent diseases, and lessen the harm caused by heavy fish farming.
Disease Management	Probiotics work together with fermented carbon-based substances to support the health of shrimp. They help keep harmful bacteria in check by using a communication process called quorum sensing, and they also strengthen the shrimp's natural defenses.	These beneficial microbes compete with bad bacteria, which helps improve the overall safety of the farming environment. This reduces the chances of disease, prevents shrimp from escaping, and cuts down on the need for drugs and chemicals used in aquaculture.
Water Quality Management	Keeps water clean by using natural methods like recycling nutrients, filtering with living organisms, and letting sediments settle down.	Manages water quality by using microorganisms and biological filters to control levels of ammonia, nitrite, and nitrate.
Sustainability	Helps the environment by using fewer outside resources and making less of an impact.	Makes better use of resources and lowers its effect on the environment by reusing organic materials and nutrients.

Challenges of Aqua-mimicry

- **Technical Complexity:** Replicating the intricate balance of natural aquatic ecosystems requires a deep understanding of biological and chemical processes, which can be difficult to manage perfectly.
- **Difficulty with Indoor/Intensive Systems:** The approach can be challenging to apply effectively in indoor or highly intensive culture conditions compared to more extensive pond systems.
- **Large Infrastructure Requirements:** Implementation often necessitates relatively large treatment or sedimentation ponds to manage waste and water quality, which may not be feasible for all farmers.
- **Sediment Management:** The system generates excess organic sediments that need to be discharged or managed appropriately, requiring specific infrastructure like central sumps and sludge pumps.
- **Potential for New Pathogens:** The complex microbial environment, if not managed correctly, might present a potential chance for the occurrence of new or opportunistic pathogens.
- **Lack of Standardized Protocols:** As a farmer-developed innovation, protocols can vary based on local resources and experience, which can make it harder for new farmers to adopt without trial and error.

Future Adoption and Prospects

- **Growing Popularity:** Aqua-mimicry is rapidly spreading globally, with adoption reported in countries including Vietnam, China, India,

Ecuador, Korea, and Egypt, due to its ability to produce high-quality shrimp at a lower cost.

- **Sustainability and Eco-friendliness:** The system significantly reduces reliance on chemical inputs, antibiotics, and excessive water exchange, aligning with increasing demand for sustainable and environmentally responsible food production.
- **Economic Viability:** By generating natural live feed (zooplankton, especially copepods) using inexpensive carbon sources like fermented rice bran, it drastically lowers operational costs, particularly feed expenses, and increases profitability.
- **Improved Animal Health and Quality:** Shrimp and fish raised in these naturalistic, low-stress environments often exhibit enhanced immunity, better growth rates, and improved overall nutritional quality, leading to premium market positioning.
- **Integration with Other Technologies:** There is potential for the integration of aqua-mimicry principles with other microbial-based systems like bio-floc technology (BFT) to leverage the strengths of both approaches, further enhancing resilience and efficiency.
- **New Industry Standard:** The concept is widely believed to become a new standard in shrimp farming, benefiting future generations of aqua-culturists by offering a viable blueprint for meeting growing seafood demands sustainably.

CONCLUSION

Aqua-mimicry is a method that uses ideas from nature to create a more sustainable way of raising aquatic animals. It has many advantages, such as better water conditions, faster growth, and fewer diseases. This approach imitates natural environments, which helps cut down on the need for man-made food and chemicals, leading to a healthier and more eco-friendly way of farming fish and other water creatures.

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