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Aquamimicry: Harnessing Nature's Blueprint for Sustainable Aquaculture

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Globally, over a billion people rely on fish as their primary source of daily animal protein, making aquaculture a key contributor to food security, nutrition, and economic development. Among aquaculture operations, shrimp farming generates the largest revenue but also presents considerable obstacles, particularly in terms of environmental degradation, disease proliferation, and waste accumulation due to high stocking densities and diminishing water quality. Aquamimicry has developed as a viable strategy that mimics natural estuarine ecosystems by producing zooplankton and beneficial bacteria through the fermentation of carbon sources like rice bran with probiotics. Unlike biofloc, Aquamimicry requires lesser carbon input and focuses on generating a stable aquatic habitat with fewer pH and oxygen variations, hence minimizing disease risks and production costs while boosting shrimp health and sustainability. As the technology continues to exhibit cost-effectiveness and ecological benefits, Aquamimicry is fast gaining global popularity and holds tremendous potential to become a standard in sustainable shrimp aquaculture.

Keywords: Aquamimicry, Plankton, Shrimp culture

Introduction

Aquaculture is vital to the world's food supply due to the global demand for fish. Over a billion individuals acquire most of their necessary daily animal protein intake only from fish. Fish farming is a significant economic activity in many nations since it provides people access to food and nutrition, besides serving as a source of life. It has been projected that the aquaculture sector employs roughly 22.10 million people worldwide. In 2022, the worldwide population was estimated to consume 20.70 kg of fish per person, while global fisheries and aquaculture production was 185.40 million tons.

Alongside these nutritional benefits and employment prospects, aquaculture offers a sustainable alternative to other farmed proteins, with the added advantage of the greatest feed conversion efficiency. Aquaculture can be deemed sustainable if it promotes the people's health in an environmentally friendly, socially responsible, and animal-friendly manner. Shrimp farming has regularly delivered the highest income within the aquaculture sector. Despite its massive production, the expansion of the culture system, notably in shrimp farming, has generated an enormous amount of waste. The high stocking density and decreased water quality in this intensified system have triggered several shrimp and prawn industry diseases.

Several diseases impacting the shrimp and prawn aquaculture sector have stimulated the formulation of diverse health management systems. Some measures encompass enhanced biosecurity, the

procurement of specialized pathogen-free animals, and in more severe instances, the application of pesticides and medicines. Nonetheless, due to the characteristics of open pond aquaculture, which is the predominant method for global shrimp production, it is frequently unfeasible to cultivate organisms in isolation by entirely eradicating all infections.

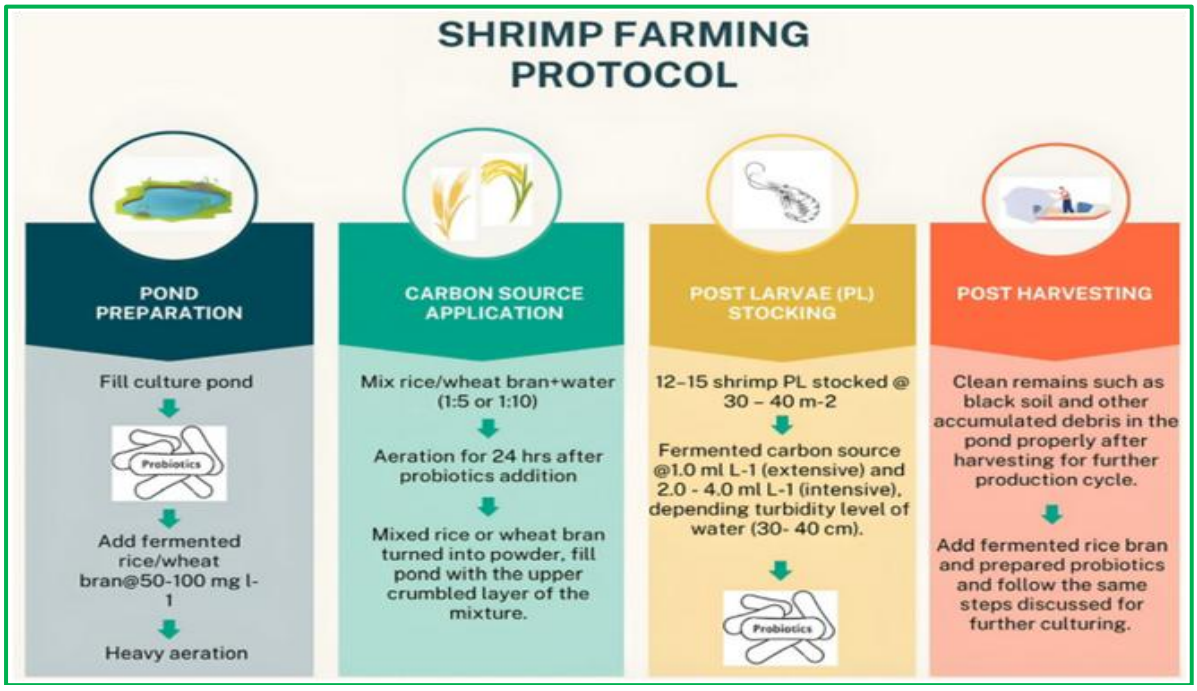
In traditional pond systems, the persistent accumulation of sediments and the resultant decline in water quality are recognized to promote the proliferation of several diseases, including pathogenic *Vibrios*. Encouraging microalgae proliferation can enhance water quality; nevertheless, management can be challenging, as these systems are susceptible to pH and dissolved oxygen variations, which may induce stress in aquatic organisms.

Biofloc technology was implemented to address several of these challenges. This is achieved by introducing additional carbon to the water, transforming potentially detrimental organic debris and sludge into viable biomass. This procedure can remove or substantially diminish the necessity for water exchanges, making it more environmentally sustainable and enhancing biosecurity.

Biofloc technology has achieved global success; nonetheless, the operational expenses can be considerably elevated to sustain bioflocs in continuous suspension. A potentially more balanced strategy between using both microalgae and biofloc in aquaculture is known as Aquamimicry.

Aquamimicry simulates natural conditions

Aquamimicry is a concept that seeks to mimic natural estuary conditions by developing zooplankton blooms (primarily copepods) as supplemental nutrition to the cultivated shrimp and beneficial bacteria to maintain water quality. This is done by fermenting a carbon source, such as rice or wheat bran, with probiotics like Bacillus sp. and releasing their nutrients. This process is in some respects comparable to biofloc technology, but there are some important differences.

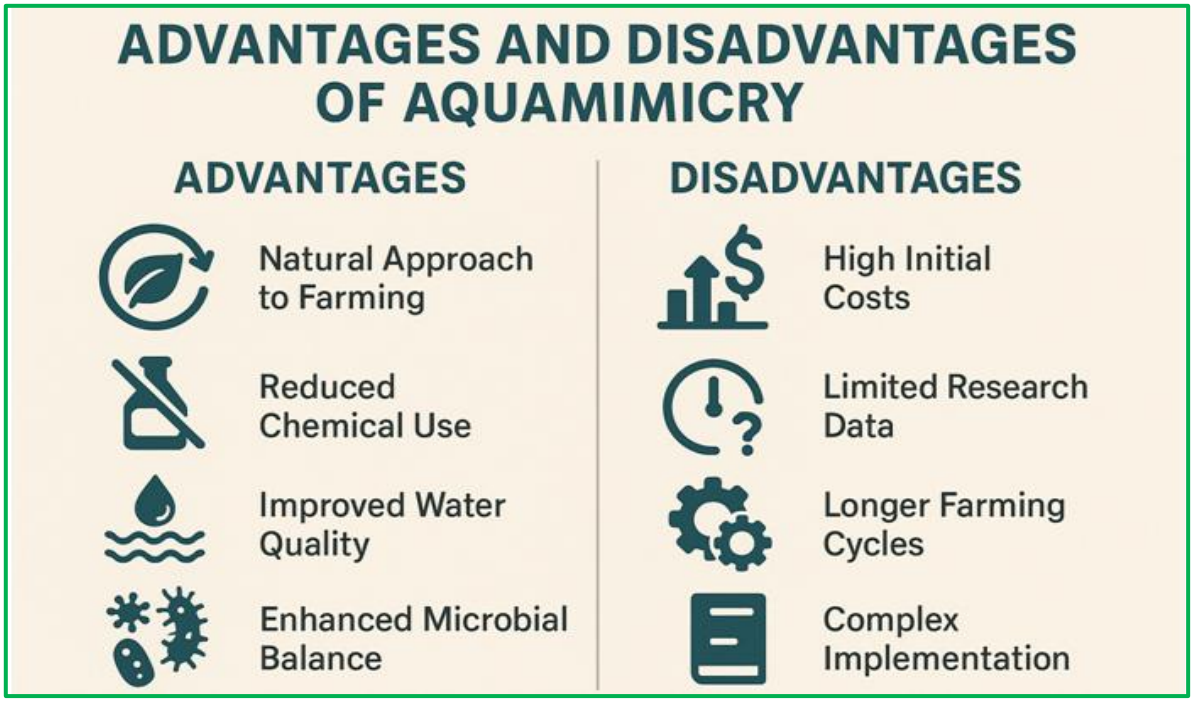


(Source: Deepti et al., 2024**)**

Firstly, the amount of carbon supplied is lowered and is not strictly reliant on ratios to nitrogen input. Secondly, rather than fostering and suspending high amounts of bioflocs, sediments are removed in more intensive systems to be reused by other organisms.

Ideally, the water should have the appearance and content of natural estuary water, which includes microalgae and zooplankton. When such a balance is achieved, pH and dissolved oxygen fluctuations are reduced, and no antibiotics or chemicals are required because rice bran provides nutrition for zooplankton and bacteria (as a prebiotic), resulting in

"symbiotic", which are dietary supplements or ingredients that synergistically combine prebiotics and probiotics.



Perspectives

Two main downsides of the Aquamimicry approach are the potential difficulty of extending this concept to indoor environments and the necessity of rather large treatment ponds. This concept yielded greater outcomes than a biofloc-based system in Korea's indoor raceway systems. However, it became essential to discharge surplus sediments, which were not reused.

There are currently efforts to minimize this ratio with the grow-out ponds to deal with the issue of huge treatment ponds; however, in more broad systems, no treatment ponds are essential. As with any new aquaculture technique, farmers interested in this new methodology should perform trial runs to establish whether this can be successfully implemented in their local circumstances.

Because better-quality shrimp may be produced at a lower cost and more sustainably, the concept of Aquamimicry is fast spreading worldwide. Some interpretation of the notion will surely become a new norm in shrimp farming and help future generations in the sector.

References

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