THE SCIENCE WORLD
A Monthly e Magazine
ISSN:2583-2212
Popular Article
November 2024 Vol.4(11), 5202−5207

Low-Cost Aquaculture Practices

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Abstract

Low-cost pond culture and biofloc technology are becoming popular methods in aquaculture because they help increase fish production while keeping costs low. These methods are especially useful for small-scale farmers who may not have many resources. Low-cost pond culture allows farmers to raise fish in simple ponds without needing expensive equipment or facilities, making fish farming more affordable and easier for people in rural areas. Biofloc technology focuses on improving water quality by using natural processes; in this system, tiny organisms like bacteria and algae grow in the water, consuming fish waste and leftover feed and turning them into nutritious food for the fish. This means farmers can save money on feed and reduce water pollution at the same time. Together, these approaches make aquaculture more sustainable, meaning they are better for the environment and can be maintained for a long time. They help farmers produce more fish without harming natural resources, making fish farming accessible to more people.

Key words: Low-cost aquaculture system, low-cost pond culture, Bio floc culture system.

Introduction:

Aquaculture, which is the farming of fish, shellfish, and other aquatic animals, has grown quickly to meet the rising global demand for seafood. In 2022, global aquaculture production reached around 100 million tons, with India contributing nearly 9 million tons, making it one of the top producers in the world. However, this rapid growth faces big challenges, especially for small-scale farmers. High costs, limited land, and environmental concerns make it difficult to expand fish farming sustainably (Halwart, 2022**)**.

To address these challenges, two affordable approaches low-cost pond culture and biofloc technology are helping farmers make fish farming more efficient and profitable in small spaces. Traditional pond culture is a simple and low-cost way to farm fish, needing limited setup and

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Published 30/11/2024

equipment, which makes it accessible to small and medium-sized farmers. Biofloc technology is a newer method that uses helpful microbes to clean the water and recycle nutrients, allowing farmers to raise more fish in less space. Biofloc helps keep the water clean and reduces the need for extra feed, making it a sustainable option for areas with fewer resources. Together, these methods are giving farmers in low-resource settings more options to expand aquaculture sustainably and affordably (Zafar & Rana, 2022).

Low-cost pond culture system

A low-cost pond culture system provides an effective, sustainable method for small-scale fish and shrimp farming with minimal investment. This system is ideal for rural or low-income farmers due to its use of readily available materials and low-maintenance requirements. The goal of a low-cost pond culture system is to create a viable environment for aquaculture by optimizing natural resources and reducing reliance on expensive machinery and feeds (Hossain et al., 2000).

Setting Up a Low-Cost Pond Culture System

The first step in establishing a low-cost pond culture system is selecting an appropriate site. The best locations will have natural water sources nearby and clay or loamy soil, which reduces water loss through seepage. The pond should be shallow, rectangular, or square to maximize natural aeration and simplify maintenance. For areas prone to water seepage, affordable tarpaulins or plastic liners can be used as a base. Manual digging is a cost-effective method of pond construction, with an ideal depth of around 1 to 1.5 meters. Compacting the pond's bottom and sides helps to further prevent water loss. Locally sourced materials, such as bamboo or stones, are also valuable for building pond embankments to strengthen the structure (Soto-Zarazúa et al., 2010).

Simple water filtration and natural erosion control are essential in maintaining pond quality. A low-cost filtration setup can be made by layering gravel, sand, and charcoal at the pond's inlet to filter incoming water. Additionally, planting water-friendly vegetation, like reeds or cattails, along the pond edges aids in nutrient absorption and helps prevent soil erosion. Aeration, which maintains oxygen levels for the fish, is a key factor in pond culture. Basic systems rely on natural water circulation, achieved by periodically stirring the water manually. Where extra aeration is needed, DIY paddle wheels or solar-powered pumps provide efficient, affordable solutions without requiring electricity (Chang et al., 2010).

Natural fertilization plays a crucial role in supporting a low-cost pond culture system. Organic compost or manure can be added to the pond, encouraging the growth of plankton, a primary food source for many fish species. To reduce feed costs further, farmers can supplement natural plankton with kitchen waste, agricultural by-products, or locally grown plants like

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duckweed and azolla. Choosing the right fish species is also essential to maintaining an affordable system. Hardy species like tilapia, carp (such as Rohu and Catla), and catfish are well-suited to low-cost ponds due to their adaptability to fluctuating water conditions and ability to thrive on natural pond resources. For example, tilapia grows quickly and can feed on pond vegetation and plankton, while carp and catfish are resilient species that can tolerate lower oxygen levels (Edwards, 1985).

Maintenance and Advantages of the System

Once the pond is established, regular yet minimal maintenance keeps it productive. Occasional water exchange, especially after heavy feeding or during warm weather, helps control nutrient buildup. Routine removal of waste and uneaten feed also prevents excessive nutrients from accumulating, which can harm fish health. Disease prevention can be achieved through basic biosecurity practices, such as keeping pond edges free from debris and monitoring water quality. These practices help ensure a healthy environment for fish growth and reduce the risk of disease outbreaks (Murray et al., 2014).

The low-cost pond culture system offers numerous advantages. Its low start-up and maintenance costs make it accessible to small-scale farmers who may lack resources for intensive aquaculture systems. It supports sustainable feeding by relying on natural food sources, reducing the need for commercial feeds. Additionally, this system is highly scalable, adaptable to small family ponds or larger community operations, making it versatile across various settings. However, low-cost systems have some limitations, such as supporting only a low stocking density compared to intensive systems and experiencing seasonal variations in natural food production and water quality, which can impact growth rates (Samat et al., 2024).

Biofloc culture system:

Introduction

With the growing global demand for seafood, aquaculture systems need to expand sustainably to protect natural resources. Biofloc technology (BFT) is a promising method that allows fish and shrimp farming to increase output while conserving water and reducing environmental impact. In this system, carbon and nitrogen in the water are balanced, leading to the formation of bioflocs—clusters of useful bacteria and particles that help clean the water and provide extra food for farmed species like tilapia, shrimp, and catfish (Browdy et al., 2012).

How biofloc technology work?

BFT adds extra carbon, such as sugar or molasses, to stimulate beneficial bacteria in the water. These bacteria consume nitrogenous waste, like ammonia, and transform it into bioflocs. These

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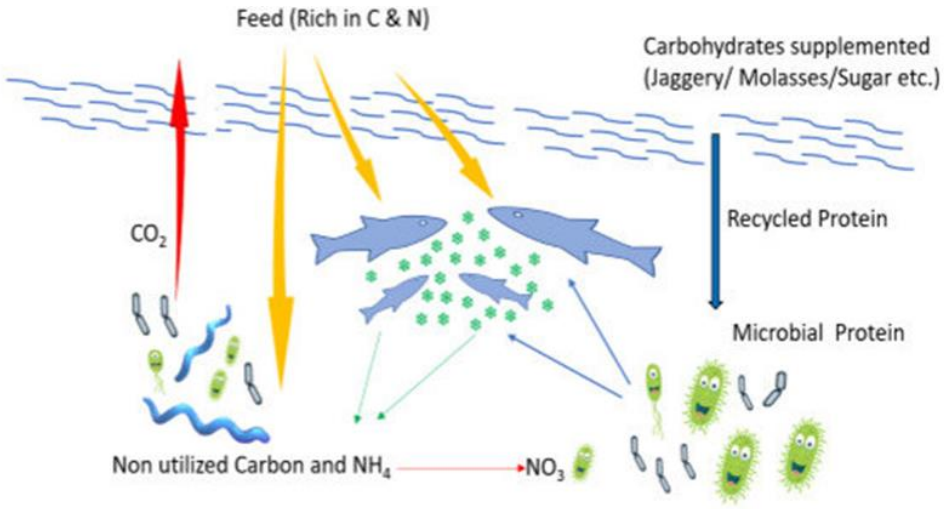
bioflocs serve as a natural source of protein-rich feed for the cultured species, improving water quality and reducing the need for costly commercial feed (Emerenciano et al., 2013).

(Poonam et al.,2021)



Aquaculture Species in Biofloc Systems (Mugwanya et al., 2021**)**

1. **Tilapia**: A hardy species often raised in biofloc systems due to its adaptability and ability to thrive on biofloc particles. Tilapia can consume bioflocs directly, which improves growth rates and reduces feed costs.

2. **Shrimp**: Pacific white shrimp (*Litopenaeus vannamei*) is commonly raised in biofloc systems, as bioflocs help control diseases and improve water quality, which is crucial for shrimp health. Biofloc-based feed also reduces the need for fishmeal.

3. **Catfish**: Biofloc systems can support catfish, which benefit from the extra protein in bioflocs, allowing them to grow faster and healthier. Catfish are also relatively resilient and well-suited to the nutrient-rich environment created in biofloc systems.

4. **Carp**: Species like common carp can benefit from bioflocs, particularly in low-density settings. Carp can eat biofloc particles directly, reducing feed expenses while also aiding in waste management within the system.

Benefits of Biofloc Technology (Bossier & Ekasari, 2017**)**

1. Water Conservation: By reducing the need for frequent water changes, BFT conserves water and prevents pollution, making it more eco-friendly.

2. Natural Feed Source: The bioflocs serve as a free, protein-rich feed for species like tilapia and shrimp, decreasing the need for commercial feed and cutting production costs.

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Improved Disease Resistance: Bioflocs can help suppress harmful bacteria, reducing disease risks for species like shrimp, which are often prone to infections.

Challenges of Biofloc Technology

Farmers may hesitate to use biofloc systems due to cloudy pond water, which contrasts with the traditional preference for clear water. Additionally, managing the proper carbon-to-nitrogen balance can be technically demanding. Training and technological support are needed to help farmers implement BFT effectively, especially for small-scale farms (Mahanand & Pandey, 2022).

Conclusion

Low-cost pond culture systems and biofloc technology offer practical, sustainable solutions to aquaculture, particularly for small-scale farmers. By utilizing simple construction, natural water filtration, and organic fertilization, low-cost pond culture minimizes operational expenses while creating a productive environment that supports resilient fish and shrimp species with low-effort upkeep. This system provides communities with an affordable, reliable source of food and income with minimal initial investment. Biofloc technology complements these benefits, providing an eco-friendly, efficient approach to cultivating species like tilapia, shrimp, and catfish. With continued research and support, biofloc technology can enhance the sustainability of aquaculture, helping meet rising food demands without depleting natural resources. Together, these methods form a robust foundation for sustainable, community-centered aquaculture, promoting food security and economic resilience.

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