EMERGING TRENDS: THE RISE OF BIOFLOC FISH FARMING IN MODERN AQUACULTURE

***[1]Auwalu Jalo**
[1]Biology Department, School of Secondary Education (Sciences), Federal College of Education Katsina
**Corresponding author email: auwalujalo@gmail.com , Phone Number: +2348133036001*

ABSTRACT
Modern aquaculture is continually evolving to meet the growing demand for sustainable and efficient methods of fish production. One emerging trend gaining considerable attention is biofloc fish farming, a revolutionary approach that integrates microbial-rich environments to enhance water quality and optimize fish growth. This paper provides an overview of the key principles and benefits of biofloc technology, shedding light on its potential to shape the future of aquaculture. Biofloc technology involves the cultivation of dense communities of microorganisms, primarily bacteria and algae, within the aquaculture system. These microorganisms form aggregates known as bioflocs, creating a dynamic ecosystem that contributes to water purification and nutrient recycling. This approach stands in contrast to traditional aquaculture systems that rely on water exchange, often leading to environmental concerns and increased resource usage. The main advantages of biofloc fish farming include improved water quality, enhanced biosecurity, and increased production efficiency. This paper reviews case studies and research findings that showcase the successful implementation of biofloc technology in different fish species, highlighting its versatility and adaptability. The potential economic benefits, coupled with environmental sustainability, position biofloc fish farming as a viable and attractive option for modern aquaculture. As the global demand for seafood continues to rise, exploring innovative and sustainable practices becomes imperative. The rise of biofloc fish farming represents a paradigm shift in aquaculture practices, offering a promising solution to address the challenges of traditional systems while fostering a more environmentally responsible and economically viable industry.
Keywords: Biofloc, Fish farming, Aquaculture, Emerging Issues

INTRODUCTION

Biofloc technology is an emerging, eco-friendly and cost-effective approach for sustainable fish farming. Earlier, the biofloc system was used as the means to treat wastewater and control fish production. Over a while, it gained popularity and become the top choice for fish farmers. Biofloc technology began to be used commercially at aquaculture farms in Central America. Later, the technology was successfully implemented and utilized in many countries such as the USA, China, Japan, Brazil, Israel, Italy etc. In developing countries, fish farmers have gradually started to gain interest in this technology FAO (2020). The main highlight of biofloc fish farming is that it can decrease the overall expense involved in fish farming activities. Moreover, it is a sustainable process that does not harm the environment in any manner.

Traditional Fish Farming Problems

Generally, in the fish farming industry, a large space of land is required. Additionally, an extensive amount of water is necessary to do fish farming (Kaya D.*et.al.,*2019). Moreover, fish farmers require to change the water every 30-35 days. The infrastructure, systems, land and water recycling; all ask for huge investments. This increases cost and hence the technique is expensive and not environmentally friendly due to the huge quantum of water used (Diaz H.A.A *et.al.,*2021). The high stocking density (maintained to keep the system economically viable) can cause fish a lot of stress due to excessive build up of fish excreta. This can cause dips in their immunity, making them even more susceptible to disease. This leads to fish deaths and huge loss for farmers Hoang M.N. *et.al.,*2020).

The Technology behind Biofloc fish farming

When feed is given to the fish in the tank, there is uneaten feed left behind, feces, and extra nutrients left behind in the water. The floc or biofloc in biofloc technology, which is microscopic in nature, is a heterogeneous aggregate of suspended particles or organic matter, physical substrate, and probiotic organisms held together by electrostatic attraction and bound by bacterial mucous (Diatin I.

*et.al.,*2021). When the aggregate becomes large it acts as a rich protein-lipid natural source of food & probiotics for fish, containing vitamins and minerals too. The nitrogen in protein is discharged as waste. The heterotrophic bacteria in biofloc technology reduces the nitrogenous waste as well. This can be treated using advanced and natural biological solutions (Harun A.A.C.,*et.al.,*2019).

Thus, the biofloc technology carries out the maintenance of water and improves its quality, recycles nutrients by reducing feed conversion rate, and competes against pathogens. It acts similar to probiotics. About 60 to 70% of the variable cost is attributed to feed. The cost and water scarcity have been an issue for farm fishing and directly impacted food security (AftabUddin S.*et.al.*, 2020). But the biofloc system improves fish health, provides better farm profitability and it is a sustainable and eco-friendly process as well FAO (2022).

Biofloc Fish Farming For Sustainable Aquaculture

Today, fish is one of the cheapest and nutritious sources of protein for billions of people across the world. Rich in vitamins, minerals, essential amino acids and oils, fish consumption has increased exponentially in the last five decades FAO (2020). Aquaculture, also called fish farming, has played an instrumental role in producing seafood for human consumption and its contribution to food and nutritional security (Vasava R.,*et.al.,*2020). According to the Food and Agricultural Organization – FAO of the U.N, aquaculture will be responsible for almost two-thirds of the fish humans consume by the year 2030. However, fish farmers face various challenges today to fulfil the growing demand FAO (2022).

Silva T.S.& Piana P.A. (2020) explained that the traditional fish farming methods are harming the aquatic ecosystem in many ways as well. The fish excreta and leftover feed splash out of the net and causes nutrient pollution of water resources. It may lead to oxygen depletion, which can cause fish kills.

Fish produced through farming can foster diseases that may spread fast and cause stress in the aquatic ecosystem. Additionally, pesticides and antibiotics are used which can affect aquatic living beings and human health too (Van Doan H.*et.al.,*2022). Therefore, there is an urgent need for sustainable aquaculture solutions, and biofloc fish farming is the most preferred method.

Benefits of Biofloc System To Meet Future Challenges

The human population is rapidly increasing at an alarming rate. There is an urgent need for food production industries like aquaculture to expand and innovate so that food needs can be met in the future with much better output both quality and quantity-wise Manzoor P.S.*et.al.,*2020).

Silva T.S.& Piana P.A. (2020) suggested that to meet future challenges, a special focus must be given to aquaculture systems which produce more by reducing dependence and exploitation of natural resources like water and land. Moreover, sustainable fish farming techniques have to be encouraged to prevent the environment and at the same time, it can be cost-effective for those involved in the aquaculture industry. Keeping future goals in mind, biofloc system or biofloc fish farming is one of the best methods to achieve all these objectives (Hostins B.*et.al.,*2019).

Role of Biofloc Fish Farming (Minaz M.& Kubilay A. 2021), (Khanjani M.H., Sharifinia M. 2020) & (Kaya D.*et.al.,*2019)

- It reduces the need for water exchange and water usage in aquaculture systems and helps in maintaining the water quality. This reduces water treatment expenses for farmers.
- Biofloc act as a food source for fishes. This saves money for the feed and thus it is a cost-effective way to provide necessary food.
- Expensive technologies required to remove nitrogen compounds and their frequent maintenance expenses can be avoided.
- Biofloc system is capable to remove nitrogen in cases of high BOD and presence of organic matter in water.
- Since waste accumulation is reduced, it significantly improves water quality and fish survival rate.

CONCLUSION

The rise of biofloc fish farming marks a significant shift in the aquaculture industry, offering a more sustainable and efficient approach to fish cultivation. This system has shown promise in addressing

issues such as water quality management, disease control, and resource optimization. As global demand for seafood continues to rise, the adoption of biofloc technology is likely to increase as it presents a viable solution to enhance productivity while minimizing environmental impact.

REFERENCES

AftabUddin S., Siddique M.A.M., Sein A., Dey P.K., Rashed-Un-Nabi M., Haque M.A. (2020). First use of biofloc technology for Penaeus monodon culture in Bangladesh: Effects of stocking density on growth performance of shrimp, water quality and bacterial growth. Aquac. Reports, 18: 100518.

Diatin I., Shafruddin D., Hude N., Sholihah M., Mutsmir I. (2021). Production performance and financial feasibility analysis of farming catfish (Clarias gariepinus) utilizing water exchange system, aquaponic, and biofloc technology. J. Saudi Soc. Agric. Sci., 20: 344–351.

Diaz H.A.A., Ramfrez A.P.M., Emerenciano M.G.C., Carrasco S.C.P. (2021). Organoleptic and nutritional characteristics of fillets of pirapitinga fed different protein sources in a biofloc system. Pesqui. Agropecuária Bras., 55: 2020.

FAO (2020). The State of World Fisheries and Aquaculture 2020. Sustainability in action.

FAO (2022). The State of World Fisheries and Aquaculture 2022. Towards Blue Transformation. FAO.

Harun A.A.C., Mohammad N.A.H., Ikhwanuddin M., Jauhari I., Sohaili J., Kasan N.A. (2019). Effect of different aeration units, nitrogen types and inoculum on biofloc formation for improvement of Pacific Whiteleg shrimp production. Egypt. J. Aquat. Res., 45: 287–292.

Hoang M.N., Nguyen P.N., Bossier P. (2020). Water quality, animal performance, nutrient budgets and microbial community in the biofloc-based polyculture system of white shrimp, Litopenaeus vannamei and gray mullet, Mugil cephalus. Aquaculture, 515: 734610.

Hostins B., Wasielesky W., Decamp O., Bossier P., De Schryver P. (2019). Managing input C/N ratio to reduce the risk of Acute Hepatopancreatic Necrosis Disease (AHPND) outbreaks in biofloc systems – A laboratory study. Aquaculture, 508: 60–65.

Kaya D., Genc M.A., Aktas M., Eroldogan O.T., Aydin F.G., Genc E. (2019 a). Effects of Biofloc Technology (BFT) on Growth of Speckled Shrimp (Metapenaeus monoceros). Tarım Bilim. Derg., 25: 491–497.

Khanjani M.H., Sharifinia M. (2020). Biofloc technology as a promising tool to improve aquaculture production. Rev. Aquac., 12: 1836–1850.

Manzoor P.S., Rawat K.D., Tiwari V.K., Poojary N., Asanaru Majeedkutty B.R. (2020). Dietary lipid influences gonadal maturation, digestive enzymes and serum biochemical indices of Cyprinus carpio reared in biofloc system. Aquac. Res., 51: 3244–3254.

Minaz M., Kubilay A. (2021). Operating parameters affecting biofloc technology: carbon source, carbon/nitrogen ratio, feeding regime, stocking density, salinity, aeration, and microbial community manipulation. Aquac. Int., 29: 1121–1140.

Silva T.S., Piana P.A. (2020). Production of tilapia in biofloc with different salt condictions: An evaluation of body composition and organoleptic properties. Bol. Do Inst. Pesca, 46.

Van Doan H., Lumsangkul C., Hoseinifar S.H., Jaturasitha S., Tran H.Q., Chanbang Y., Ringø E., Stejskal V. (2022). Influences of spent coffee grounds on skin mucosal and serum immunities, disease resistance, and growth rate of Nile tilapia (Oreochromis niloticus) reared under biofloc system. Fish Shellfish Immunol., 120: 67–74.

Vasava R., Hodar A.R., Elchelwar V.R., Deepak A.P., Patel K.M., Shrivastava V., Yusufzai S.I., Acharya P., Prabhakar P. (2020). Biofloc technology: An innovative approach to zero-water exchange and tentative zero-feed system: A review. J. Entomol. Zool. Stud., 8: 1036–1040.