International Journal of Research Studies on Environment, Earth, and Allied Sciences (IJRSEAS)
| *Volume-2 Issue-2* | *Apr-2025* | *ISSN: 3066-0637* | *Website:* https://eesrd.us

Manuscript ID:
IJRSEAS-2025-0202033

OPEN ACCESS

Quick Response Code:

Website: https://eesrd.us

DOI: 10.5281/zenodo.16870199

DOI Link:
https://doi.org/10.5281/zenodo.16870199

Volume: 2

Issue: 2

Pp. 151-154

Month: April

Year: 2025

E-ISSN: 3066-0637

Submitted: 15 Mar 2025

Revised: 20 Mar 2025

Accepted: 20 Apr 2025

Published: 30 Apr 2025

Address for correspondence:
Manisha S. Borkar
Ph.D Research Scholar, Department of Zoology, Adarsh Education Society's Art's Commerce & Science College, Hingoli (M.S.), India
Email:
borkarmanisha116@gmail.com

How to cite this article:
Borkar, M. S., & Joshi, P. P. (2025). Optimization of Biofloc Formation and Management in Fish Culture System. International Journal of Research Studies on Environment, Earth, and Allied Sciences, 2(2), 151–154.
https://doi.org/10.5281/zenodo.16870199

Optimization of Biofloc Formation and Management in Fish Culture System

Manisha S. Borkar[1], **Prashantkumar P. Joshi** [2]
[1]Ph.D Research Scholar, Department of Zoology, Adarsh Education Society's Art's Commerce & Science College, Hingoli (M.S.), India
[2]Associate Professor, Department of Zoology, Adarsh Education Society's Art's Commerce & Science College, Hingoli (M.S.), India

Abstract

The Optimization of Biofloc formation and management in fish culture system, Biofloc technology (BFT) is an innovative aquaculture technology has emerged as a sustainable approach to fish culture system. Biofloc formation is a crucial process in Biofloc Technology (BFT) systems, where microorganisms aggregate to form flocs that help maintain good water quality and support fish health. This provides substantial advantages for the implementation of sustainable and efficient aquaculture techniques. Bio floc formation in fish farming systems improves water quality and reduces environmental impacts. BFT is a new blue revolution aquaculture practice in aquafarming and () is an innovative aquaculture practice emerging from the new blue revolution. In this fish culture system, water quality is carefully managed, and nutrients are provided to the cultivated aquatic organisms by adding balanced amounts of carbon sources, such as glucose or starch. These carbon sources promote microbial growth and biofloc formation, thereby enhancing the sustainability and productivity of the system. This finding supports the formation of beneficial microbial communities. In biofloc formation their A balanced and diverse microbial community is necessary for biofloc formation. Bio flocs are essential organic materials and microbes that are abundant in proteins. The aggregation of microbes in fish culture systems functions as a natural source of organic food for fish species cultured in culture systems such as catfish, carp, and prawn, thereby reducing the cost of supplementary foods. Biofloc technology can conserve water and nutrients, reprocess waste water treatment, and prevent pollution as compared to regular fish culture practices. The aim of this study was to optimize biofloc formation and management in fish culture systems. This study investigated the effects of different carbon sources and C:N ratios on biofloc formation, water quality, and enhanced fish growth.

Keywords: *Biofloc Technology (BFT), Biofloc formation, Water quality management, Carbon sources, C:N ratio, Enhancing fish growth, Beneficial microbial community and management of fish culture system.*

Introduction

Biofloc Technology (BFT) is considered as new "blue revolution" since nutrients can be continuously recycled and reused in the culture medium, benefited by the minimum or zero-water exchange. BFT is an environmentally friendly aquaculture technique based on in situ microorganism production. Biofloc is the suspended growth in ponds/tanks, which is the aggregate of living and dead particulate organic matter, phytoplankton, bacteria, and grazers of bacteria. Microbial processes are utilized within the pond/tank itself to provide food resources for cultured organisms, while simultaneously acting as a water treatment remedy. Thus, this system is also called an active suspension pond, heterotrophic pond, or even green soup pond. The global population is expected to reach 9.6 billion Yr. 2050. As the demand for animal protein is increasing annually, it is a challenge to provide quality protein by safeguarding its natural resources for future generations. Aquaculture plays a key role in promoting health by providing animal protein and generating employment and economic growth (www.nfdb.gov.com) [1].

Biofloc technology is a sustainable aquaculture practice that involves the development of microbial communities within the water column that help to convert waste products from fish and other aquatic organisms into a food source for the animals themselves. This technology has gained popularity in recent years because of its ability to reduce the need for costly external feed and its potential to enhance the growth and health of fish. The feasibility of implementing biofloc technology in fish culture systems depends on several factors, including the availability of suitable water resources, economic viability of the technology, and willingness of local farmers to adopt this practice.

Biofloc fish farming systems are used in different Indian states to improve carp and prawn culture output, enhance quality, and help aquafarmers increase their fish production. The increasing demand for sustainable and efficient fish farming practices has led to the development of innovative technologies including Biofloc Technology (BFT). BFT is a promising approach that utilizes microorganisms to maintain good water quality, promote fish health, and reduce environmental impacts. Biofloc formation is a critical component of BFT systems, in which microorganisms aggregate to form flocs that help remove excess nutrients and provide a nutritious food source for fish. However, optimizing biofloc formation and management remains a challenge, as it requires a delicate balance of factors, such as carbon source, C:N ratio, water quality, and microbial community composition. This study aimed to investigate the optimal conditions for biofloc formation and management in a fish culture system with the goal of improving water quality, fish growth, and sustainability.

Literature Review:

Biofloc Technology (BFT) has become popular in the farming of Pacific white shrimp (Litopenaeus vannamei). It has also been successfully applied at shrimp farms in idonesia and malaysia by the author (by Nyan Tow, Ph.D. Sep. 2012). This combination can make operations much more sustainable and economically viable (Nyan Taw, Ph.D. Sep. 2012). BFT allows good pond management by minimizing zero water exchange with abundant microbial populations based on a balance of carbon: nitrogen (C: N) ratio in water (Cadiz et al., 2016, Lee et al., 2017, panigrahi et. al, 2019), BFT can maintain water quality as it is rich in organic matter [biomass) (Abdel Fattah M.E 1-sayed, 2020). Bio flocs in the BFT system are formed by the aggregation of many substances, including microorganisms, microalgae, zooplankton, and trapped organic particles or solids from inedible feeds (Lee et. al, 2017). This is consumed by bacterial communities with added probiotics (Aguilera-Rivera et al., 2019). In Aquacultural farming of Aquatic animals there was Water plays a vital role in the aquaculture farming of aquatic animals.

The prospects of bioflick technology (BFT) for aqua farming during the past 20 years have enabled global aquaculture enterprises to succeed and continue to increase while achieving critical global environmental, economic, and societal sustainability (June 2020). Aquaculture is the fastest-growing food-production technology, now globally accounting for more fish biomass than capture fisheries If non-edible amounts are included (Edwards, zhang, Belton, and Little, 2019) and more total biomass than beef. The first bioflick technology (BFT) was established in the 1970s at the ifremer Cop (French Research Institute). Prof. Yoram Avnimelech, an Israeli environmentalist in the 70's to promote a more sustainable mode of fish farming. In the past few decades, Biofloc has become increasingly popular worldwide, including in India (Dec 2022).

Aims & Objectives:

The Optimization of Biofloc Formation and Management in Fish Culture system, there are some objectives selected to target research work focusing on Biofloc technology (BFT), the objectives of research they are as follows:

- To study new aquaculture practice, Biofloc Technology (BFT).
- To study process of Biofloc formation.
- To study microbial ecology in floc formation and the C:N ratio in fish culture systems.
- To study water quality management as well as biofloc formation management.
- To study fish yield parameters for enhancing fish growth in culture system.

Materials and Methods:

The methodology used to adopt Optimization of Biofloc Formation and Management in Fish Culture System: First, we studied methods of bifloc development, microbial ecology, and C:N ratio, different carbon sources used for floc development, and water quality parameters of biofloc formation and their management in fish culture systems. The entire procedure of biofloc formation and management in fish culture systems is detailed as follows:

Principal Operations Used in BFT:

- **Tanks / Pond Formation:**

  Main tool required to set up a bioflick farm is a tank. The size and number of tanks depend on the scale of operation. Tanks can be made of plastic, iron mesh sheets, or concrete, but it recommends the use of dark-coloured tanks to prevent the growth of unwanted algae. The tanks should be of sufficient size to hold the desired number of fish or shrimp and provide sufficient space for the growth of bioflicks.

- **Aeration System:**

  Oxygen is critical component in maintaining a healthy bioflick system. The aeration system helps to circulate water in the tanks, providing oxygen to the aquatic animals and microorganisms that convert the waste into food. It is essential to use high- quality aerators and diffusers to ensure the maximum oxygen transfer to water.

- **Water Quality Testing Kits:**

  Monitoring the water quality is crucial for maintaining a healthy biofloc system. Water quality testing kits help measure parameters such as pH, dissolved oxygen, ammonia, nitrate, and nitrite levels, ensuring that the conditions in the tanks are optimal for aquatic animals and the growth of biofloc.

- **Biofloc Starter Culture:**
  A biofloc starter culture is a collection of beneficial microorganisms that are added to the water to kick- start the growth of biofloc. This culture was obtained from established biofloc farms that were purchased from a commercial supplier.
- **Feed:**
  The quality and type of feed are critical to the growth and health of aquatic mads in a biofloc system, which is a mixture of commercial feed and organic matter generated by microorganisms in the water. It is essential to use high-quality commercial feed that contains all essential nutrients required by aquatic animals.
- **Netting and Harvest Equipment:**
  When the fish or shrimp are ready for harvest, it is necessary to use netting and other equipment to facilitate the process. Netting should be of appropriate size to prevent injury to aquatic animals.
- **Backup Power Source:**
  A backup power source such as a generator or battery system is necessary to keep the aeration system running in the event of a power outage. This ensured that the oxygen levels in the water were maintained, preventing the death of the aquatic animals.
- **Other Material:**
  Iron pole, green curtain, plastic pipes, tarpaulins containing 650 gsm.
- **Drainage System:**
  The biofloc tank was washed with potassium permanganate or any antifungal detergent, cleaned with fresh water, and dried the biofloc tank for one day. Half of the bioflick tank was filled with freshwater from the borewell. Do not use water from underground tanks or wells.
  Before the fish seeds were sanitized. The polythene bag that the fish seed has heen brought into, without opening the same polythene bag, should be kept for15 to 20 min in the water to be stocked after sanitization; thus, when we open the polythene bag, there is no temperature difference between the biofloc tank water and the
  Polythene bag.
- **Probiotic:**
  The following chart shows the formulation and maintenance of floc development using the microbial community as nutrients, such as Saccharomyces cerevisiae and Enterococcus. Sp., Bacillus sp., and Lactobacillus sp., as well as yeast and lactic acid bacteria.

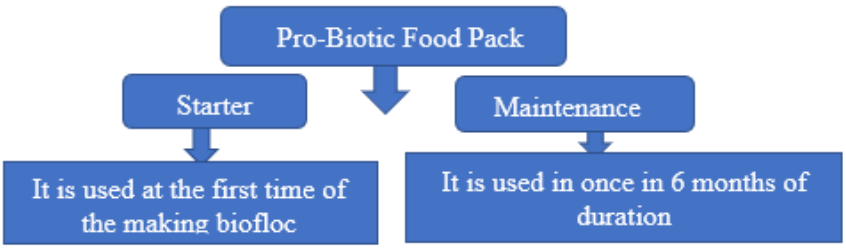

Fig: Formulation & maintenance of floc development

Result & Discussion:

Biofloc fish farming management involves several key aspects that ensure optimal system performance, water quality, and fish health. Some key considerations include Water Quality Management; Monitoring of water parameters to check their quality. Maintain optimal water quality to ensure that water quality parameters are within the optimal ranges for fish growth and biofloc formation. Bio floc Management provides a suitable carbon source to promote biofloc formation and maintain an optimal C:N ratio. To Monitor biofloc formation and adjust the carbon source and other parameters as needed. Regularly clean and maintain the biofloc system to prevent clogging and to ensure optimal performance. Fish Health Management monitors fish health, regularly monitors fish health, and adjusts the system parameters as needed. Implementation of disease prevention measures, such as quarantine, vaccination, and biosecurity protocols. Nutritional management ensures that fish receive adequate nutrition through a balanced diet. System Design and Operation; System designs a biofloc system to optimize water circulation, aeration, and biofloc formation. Water circulation and aeration to ensure adequate water circulation and aeration promote biofloc formation and maintain a good water quality. The system was regularly maintained to prevent equipment failure and ensure optimal performance. Keep detailed records of system performance, water quality, and fish health. Data were analyzed to identify trends and areas for improvement. Bio floc fish farming systems can be optimized to promote sustainable and profitable fish production.

Conclusion:

The present study deals with the Optimization of biofloc formation and their management in fish culture system is a new innovative blue revolution tenchnolgy in aquaculture. It helps to increasing aquaculture production in world as well as in India. India providing the organic aqua food like fish culture, shrimp culture trough human purposes because day to day the demand of aqua food is increasing because of high population needs a animal

protein. Biofloc formation and their management in fish culture systems plays a very important role and benefits like enhancing fish growth by providing the nutritious food source for fish to their healthy growth and development. Bioflocs helps to improving the good water quality to fish culture system, it removing excess nutrients and waste to maintain optimal water. It helps to control fish disease by out breaking of a beneficial microbial environment.

Biofloc thechnolgy (BFT) in fish culture system increased sustainability of exchanging and minimizes waste discharge, reduces the need for water exchange and making the sustainable development in aquafarming practices. In biofloc formation there is very careful management of system design, C: N ratio , microbial management and water quality parameters gives the optimal conditions for floc development and fish growth. Through this research it benefited to optimizing biofloc formation and their management for fish culture system, fish farmers improve sustainable development and fish culture production of their aquaculture practices.

Acknowledgements
I am Ms. Manisha Santoshrao Borkar thankful to my research supervisor, Dr. Prashantkumar Joshi, Department of Zoology, Adarsh Education Society's Art's Commerce and Science College, Hingoli affiliated with Swami Ramanand Teerth Marathwada University, Nanded, for granting permission to carry out the work and providing the essential research facilities that supported this study.

Financial Support and Scholarship:
I am also give my appreciation to Chhatrapati Shahu Maharaj Research, Training and Human Development Institute (SARTHI), Pune National Research Fellowship (CSMNRF- 2023) for their financial assistance, which made this research possible. Their collective contributions were instrumental in the successful completion of work.

Conflicts of interest
The authors declare that there are no conflicts of interest regarding the publication of this paper.

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