

Biofloc Fish Farming

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Abstract: Biofloc system was developed to improve the environmental control over the aquatic animal production. The principle of this technology is the generation of the nitrogen cycle by maintaining higher C/N ratio through stimulating heterotrophic microbial growth which assimilates nitrogenous waste that can be exploited by cultured species as food. Higher C/N ratio is maintained by the addition of carbohydrate source and the water quality is improved through production of high quality single cell protein.

Keyword: Biofloc Technology (BFT), environment, carbon/nitrogen ratio aquatic, protein.

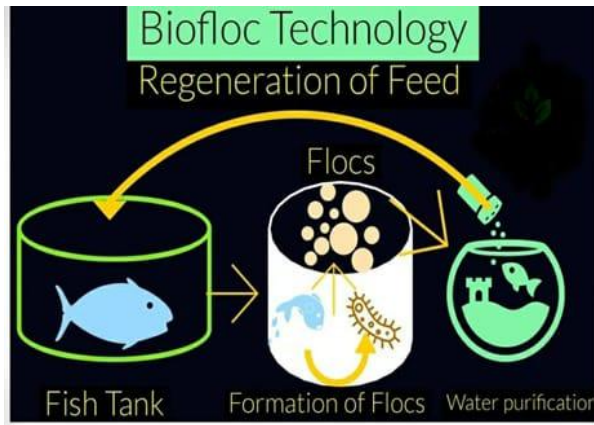
Introduction: Biofloc fish farming is an environment friendly aquaculture technique based on in-situ microorganism's production. Biofloc is the suspended growth in ponds/ tanks which is the aggregates of living and dead particulate organic matters, phytoplankton, bacteria and grazers of the bacteria. Biofloc technology is a fish farming system that recycles waste nutrients as fish food. Biofloc, specifically cultured microorganism, are introduced into the water to form microbial protein from toxic fish waste and other organic matter in the water. This helps to maintain water quality as well as lowering costs. Biofloc is very profitable business. Profit can go higher depending upon the fish breed along with market demand.

Demand for animal protein is increasing every year, 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 as well as generating employment and economic growth. 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 environment friendly aquaculture technique based on in-situ microorganism production.

The principle of BFT technique to maintain the higher C/N ratio and flocculation within the system. Heterotrophic microbial growth assimilates the nitrogenous waste that can be exploited by the cultured species as a feed and also works as bio-reactor.

Controlling of water quality, immobilization of toxic nitrogen species occurs more rapidly in Biofloc because of the growth rate. Microbial production per unit substrate of

heterotrophs are much greater than that of the autotrophic nitrifying bacteria. Biofloc is a heterogeneous aggregate of suspended particles and variety of microorganisms associated with extracellular polymorphic substances. It is composed of bacteria, algae, fungi, invertebrates and detritus etc.



Depiction of Biofloc technology in Fish farming



Biofloc Fish Farming Tank

Nutritional value of Biofloc:

A good nutritional value is found in Biofloc. It is a protein rich live feed formed as a result of conversion of unused feed and excreta into a natural food in culture system on exposure to sunlight and aeration. Each floc is held together in a loose matrix of mucus that is secreted by bacteria and bound by filamentous microorganism or by electrostatic attraction. Large floc can be seen with the naked eye, but most of them are microscopic. Dry weight protein of Biofloc ranges from 25 – 50%, fat ranges 0.5- 15%. It is a good source of vitamins and minerals, particularly phosphorus. The dried biofloc is proposed as an ingredient to replace the fish meal or soybean in the food.

The basis of biofloc technology is biomaterials, dead organic particles, microbes algae, protozoa and other organism. The biofloc acts as a biological filter and is an environment for bacteria that can remove the ammonia. By maintaining water quality, biofloc reduce the need for water exchange and reduce the feed conversion ratio by producing consumable microbial proteins (Abdirad and Qaednia, 2016). Using biofloc with fish or shrimp has many benefits such as improved growth rate, reduced FCR, (feed construction ratio) and feed costs (Avnimelech, 2009). The cost of food accounts for more than 50% of total production costs,

most of which are related to the supply of dietary protein sources (Bender et al., 2014). In addition, climate change in recent decades, the occurrence of numerous droughts and lack of freshwater resources and other problems facing this industry (Bakhshi et al. 2016). Due to higher biosafety and greater environmental benefits, the use of BFT system has increased. BFT systems reduce the entry of parasites and other species and the burden of bio-pollution (Ray, 2012). The rotational system is based on the principle of reuse of water that is excreted after the breeding process (Putra and Dan Setiyanto, 2011). The use of biofloc technology to breed species that are more adapted to environmental conditions is more successful (Souza et al. 2014). Studies on the effect of biofloc on physical and chemical parameters of water, blood indices and growth of various aquatic animals has been conducted by (Bakhshiet al. 2014) on the efficiency of using biomass production system in common carp. Khanjani et al. (2016), on the production and evaluation of bioflocs for use in systems without water exchange, Haghparast Radmard et al., on the effect of different carbon-nitrogen ratios in intensive breeding system, Biofloc on growth and health indices of common carp, Crab et al. (2010), on the application of biofloc technology to protect shrimp salinewater (*Artemia franciscana*) against *Vibrio harvegi*, Mahanand and Srinivasa (2012) on optimal feed formulation for *Labeo rohita* with biofloc, Suantika et al. (2015), on the function of the drainage system with nitrifying bacteria and micro algae *Chaetoceros calcitrans* in super-intensive breeding of white shrimp (*Litopenaeus vannamei*).

Biofloc fish farming in Rajasthan

Fish farming is becoming another hot trade in Rajasthan. Fishfarmers have been started searching a few other farming options from which they can use the available resources but can earn more as traditional farming is not much paying business now a days. Traditional pond fish farming systems can produce approximately 5 Ton in 1 acre of land on the other hand in intensive Biofloc fish farming system farmer can stock in high density and can get up to 500 kg of biomass from every 10000 ltr. Biofloc tank easily. Jaipur, the capital of state is becoming one of the well-known place when it comes to get trained or doing fish farming through Biofloc fish farming system. Govt. of Rajasthan is planning to start Biofloc fish farming training in Rajasthan as it has potential and even small farmers can get good returns with small investment being at their native place using the available land and resources.

Although research has been underway since 1990's with the precursors of biofloc systems and commercial application has been in place since the early 2000's some key issues of the function of the biofloc system are still poorly understood. Biofloctechnology is best for closed system management and providing bio-security in aquaculture, as per research. The periodic increase to total suspended solids is one of the major risk factors of this technology, because clogging of gills requires more energy to meet the oxygen demands. It is necessary to investigate the biofloc probiotic effect. Multiplication of heterotrophic bacteria in the BFT system causes excessive turbidity, which may have adverse effect on sensitive fish species compartmental design of BFT is suggested so fish cultivation and microbial production take place in separate compartments. For future BFT practices a good understanding of microbes and advanced biological biofloc monitoring technologies are necessary.

BFT is eco-friendly culture with minimum environmental impact. It enhances survival rate, growth performance better feed conversion in the culture systems of fish. In BFT there is judicious use of land and water (limited or zero water exchange system). There is higher bio-security, reduces water pollution and mitigate the risk of introduction of spread of pathogens. It reduces the pressure of capture fisheries utilization of protein rich feed.

Biofloc system works best with species that are able to derive some nutritional benefits from the direct consumption of floc. BFT is most suitable for species that can tolerate high solids concentration in water and tolerate of poor water quality. For eg. Singh (*Heteropneustes fossilis*), Magur (*Clarias batrachus*), Pabda (*Ompok pabda*), Anabas/Koi (*Anabas testudineus*), Pangasius (*Pangasianodon hypophthalmus*), common carp (*Cyprinus carpio*), Rohu (*Labeo rohita*), Tilapia (*Oreochromis niloticus*), Milkfish (*Chanos chanos*), Vannamei (*Litopenaeus vannamei*) and shrimp (*Penaeus monodon*).

Biofloc is more than it looks. The system requires a warm-up period and output is not always constant between seasons. Energy costs may be higher than expected. Producers need to actively manage biofloc ponds to prevent nitrate accumulation and keep alkalinity levels within limits. Monitoring the health of fish is also essential. Microbial flocs may have a probiotic effect on the culture environment and modulate vibrio activity. Bioflocs can increase the content of suspended solids in the water.

Controlling the inorganic nitrogen by manipulating the carbon / nitrogen ratio is a potential control method for aquaculture system. This approach seems to be a practical and inexpensive means to reduce the accumulation of inorganic nitrogen in the pond. It is possible to add cheap sources of carbohydrates in cases such as a series of cloudy days slowing down algae growth, or severe algae crash. However additional pond aeration maybe required.

Biofloc technology has gained significant popularity in Rajasthan as a sustainable and innovative method of fish farming. The government has offered various grants and subsidies to farmers who want to adopt biofloc technology in state. These include financial assistance for setting up biofloc systems training programs, and technical support to farmers. The government has also set up fish seed production centres to ensure the availability of high quality fish seeds for farmers. It has also had a positive social impact. It has provided employment opportunities for local communities, particularly women. BFT has also contributed to food security, providing a source of affordable and nutritious protein for local consumers. BFT has resulted in the reduction of environmental pollution caused by traditional aquaculture method (3 Rs). Biofloc system help to reduce recycle and reuse the water within the pond, reducing the water requirement for fish farming. It reduces the need for external feed sources. The grants and subsidies provided by the government have encouraged farmers to adopt the technology and have resulted in a positive social impact on local communities. The BFT technology has the potential to revolutionize the aquaculture sector in Rajasthan

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