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BIOFLOC TECHNOLOGY : AN EMERGING AVENUE IN AQUACULTURE

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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 environment friendly aquaculture technique based on in-situ microorganism production. Biofloc is the suspended growth in ponds/tanks which is the aggregates of living and dead particulate organic matter, phytoplankton, bacteria and grazers of the bacteria. It is the utilization of microbial processes within the pond/tank itself to provide food resources for cultured organism while at the same time acts as a water treatment remedy. Thus, this system is also called as active suspension ponds or heterotrophic ponds or even green soup ponds.

How Biofloc Floc Technology works?

- Biofloc system is a wastewater treatment which has gained vital importance as an approach in aquaculture.
- The principle of the technique is to maintain the higher C-N ratio by adding carbohydrate source and the water quality is improved through the production of high-quality single cell microbial protein.
- In such condition, heterotrophic microbial growth occurs which assimilates the nitrogenous waste that can be exploited by the cultured species as a feed and also works as bioreactor controlling of water quality.
- Immobilization of toxic nitrogen species occurs more rapidly in biofloc because of the growth rate and microbial production per unit substrate of heterotrophs are ten-times greater than that of the autotrophic nitrifying bacteria.
- This technology is based on the principle of flocculation within the system.

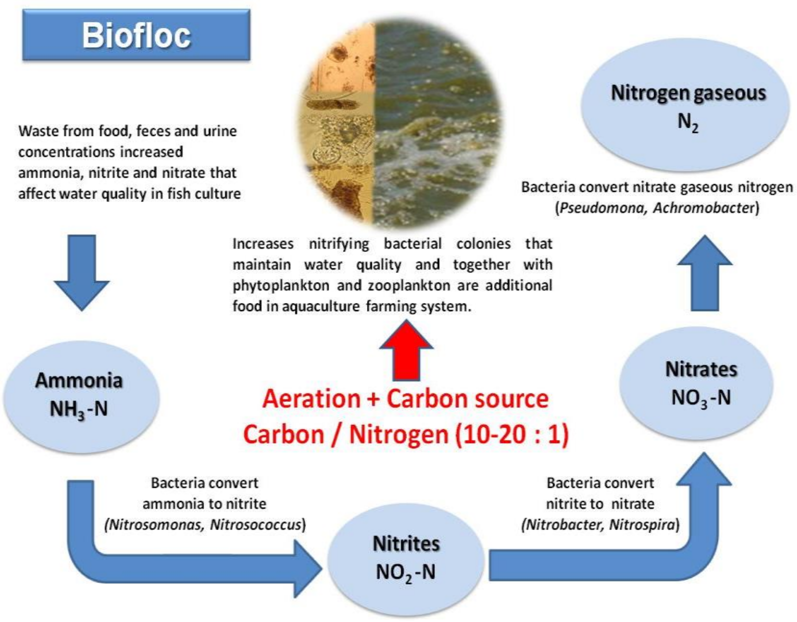

Fig 1: Biofloc system design

Composition and Nutritional Value of Biofloc

Biofloc is a heterogeneous aggregate of suspended particles and variety of microorganisms associated with extracellular polymeric substances. It is composed of microorganisms such as bacteria, algae, fungi, invertebrates and detritus, etc. It is a protein rich live feed formed as a result of conversion of unused feed and excreta into a natural food in a culture system on exposure to sunlight and vigorous aeration. Each floc is held together in a loose matrix of mucus that is secreted by bacteria and bound by filamentous microorganisms or electrostatic attraction. Large flocs can be seen with the naked eye, but most of them are microscopic. Floc size range from 50 – 200 microns. A good nutritional value is found in Biofloc. The dry weight protein ranges from 25 – 50%, fat ranges 0.5 – 15%. It is a good source of vitamins and minerals, particularly phosphorous. It has an effect similar to probiotics. The dried biofloc is proposed as an ingredient to replace the fishmeal or soybean in the feed.

Fig 2: Talwar Biofloc fish farm Khatima, Uttarakhand

Advantage of Biofloc Floc Technology

- Eco-friendly culture system
- It reduces environmental impact
- Judicial use of land and water
- Limited or zero water exchange system
- Higher productivity (It enhances survival rate, growth performance, better feed conversion in the culture systems of fish)
- Higher biosecurity
- Reduces water pollution and mitigate the risk of introduction and spread of pathogens
- It reduces utilization of protein rich feed and cost of standard feed
- It reduces the pressure on capture fisheries i.e., use of cheaper food fish and trash fish for fish feed formulation

Species suitable for Biofloc Culture

Major cultivable fish species in Biofloc Floc Technology

Biofloc system is most suitable for species that can tolerate high solids concentration in water and are generally tolerant of poor water quality. Some of the species that are suitable for BFT are:

- Air breathing fish like Singhi (*Heteropneustes fossilis*), Magur (*Clarias batrachus*), Pabda (*Ompok pabda*), Anabas/Koi (*Anabas testudineus*), Pangasius (*Pangasianodan hypophthalmus*)

- Non-air-breathing fishes like Common Carp (*Cyprinus carpio*), Rohu (*Labeo rohita*), Tilapia (*Oreochromis niloticus*), Milkfish (*Chanos chanos*)
- Shellfishes like Vannamei (*Litopenaeus vannamei*) and Tiger Shrimp (Penaeus monodon)

Singhi (*Heteropneustes fossilis*)

Tilapia (*Oreochromis niloticus*)

Technical Specifications- 100 m^3 (7 Tanks)

S.No.	Component	Details
1	Area for 7 tanks	200 m^2
2	Biofloc Tank size	4 metre diameter and 1.5-meter height (1.20 m water depth)
3	Water holding capacity of each tank	15,000 Litres capacity
4	Water quality parameters	Dissolved Oxygen-5mg/L, Temparature-26-34°C, pH-7.5 to 8, TDS-600ppm, Floc density-25-40 mg/l, Ammonia-0.5 ppm, Nitrite-0.3 ppm, Nitrate-150 ppm, Alkalinity-120-280 ppm
5	Tanks Made-up of	Tarpaulin/Fibre/HDPE
6	Stocking density	100 no. /m^3 (1000 no. per 15,000 litres tank - depending on species)
7	Species cultured	GIFT Tilapia (Oreochromis niloticus)
8	Survival (%)	80
9	Type of feed to be used	floating pellet feed
10	% of feed	2-3% per Average Body weight
11	Feeding frequency	4 times early stage, later 2 times per day
12	FCR	1:1.2
13	Duration of culture	6 months
14	Size/weight of the species(gm)	500 gm average weight
15	No. of crops per year	2
16	Production	4.2 Tonnes per crop (600kg per tank per crop)
17	Fish price (Rs.)	130/- kg fish
18	Capital cost	6.00 Lakhs
19	Input cost	1.5 lakhs per one crop
20	Total project cost	7.5 lakh

Cost Estimates of Biofloc Unit with 7 Tanks

S. No.	Component	Nos	Cost (Rs)	Total (Rs in lakhs)
Capital cost				
1	Setup of Tarpaulin/Fibre tanks (15,000 Litres capacity)	7	25,000	1.75
2	Shed material and accessories fixing charges	200 m^2	120000	1.20
3	Water supply borewell(3HP)	1	100000	1.00
4	PVC pipe fittings for air, water flow	LS	75000	0.75
5	Nets and accessories	5	3000	0.15
6	One Blower (1 HP), Air stones and other accessories	1	30000	0.30
7	Electrification	LS	10000	0.10
8	Power generator (2 KVA)	1	45000	0.45
9	Weighing balance	1	5000	0.10
10	Miscellaneous expenses			0.20
			Total Capital Cost	**6.00**
Input cost for one crop				
11	Seed cost, Feed cost, Probiotics, Test kits etc.			1.50
Total Input cost (per one crop)				**1.50**
			Grand total	**7.50**

input cost may vary depending on stocking density

Economic feasibility (one crop) from 7 Tanks

S. No.	Components	Amount (Rs in lakhs)
1	Capital Cost	6.00
2	Operational Cost	1.50
3	Total project Cost	7.50
4	Gross income per crop	5.46
5	Gross income at the end of one crop after deducting the recurring cost for the 2nd crop	3.96
6	Gross income from the 2nd crop	5.46
7	Gross income at the end of 2nd crop	9.42
8	Depreciation/maintenance @ 15% of capital cost	0.975
9	Interest @ 12% of TPC	0.90
10	Repayment @ 1/7th of the TPC	1.07
11	Recurring cost for the next crop	1.50
12	Net profit at the end of 2nd crop 9.42-(0.975+0.9+1.07+1.50)	4.975

Conclusion

Biofloc technology application offers benefits in improving aquaculture production that could contribute to the achievement of sustainable development goals. This technology could result in higher productivity with lesser impact on the environment. Furthermore, biofloc systems may be developed and performed in integration with other food production, thus promoting productive integrated systems, aiming to produce more food and feed from the same area of land with minimum input. The biofloc technology is still in its initial stage. A lot more research is needed to optimize the system (in relation to operational parameters) e.g., in relation to nutrient recycling, MAMP production and immunological effects. In addition, research findings will need to be communicated to farmers as the implementation of biofloc technology will require upgrading their skills.

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