

ORIGINAL ARTICLE

Comparative Study of *Litopenaeus vannamei* Culture by Biofloc Method and Traditional Method Using Ground Water in Palunthurai Village, Mayiladuthurai District, Tamilnadu, India

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ABSTRACT

Biofloc innovation (BFT) is considered the modern "blue revolution" in aquaculture since supplements can be persistently reused and reused within the culture medium, profited by the least or zero-water exchange [5]. It may be a method for enhancing water quality in aquaculture by adjusting carbon and nitrogen within the framework [5]. Biofloc is characterized as 'the utilize of totals of microbes, algae, and protozoa held together in a lattice in conjunction with particulate natural matter for the reason of progressing water quality, waste treatment, and disease avoidance in intensive aquaculture systems [5]. This procedure is based on in situ microorganism generation, which plays three major roles: (i) Upkeep of water quality by the take-up of nitrogen compounds producing *in situ* microbial protein. (ii) Sustenance, expanding culture possibility by decreasing feed conversion ratio (FCR), and a decrease in feed costs. (iii) Competition with pathogens [9]. We conducted a trial in Pulanthurai, Sirkali, Mayiladuthurai area. We set up two production stages for the biofloc framework: the nursery stage (capacity: 400 m³, up to 21 days), and the grow-out stage (6000 m³ / 0.6 ha, up to harvest) in a sheeted pond, with a control study using direct stocking in a sheeted pond. This clearly shows that the biofloc strategy decreases FCR, increases production by 2.38 times, raises survival up to 90%, and reduces production cost, water use, and land use. Therefore, optimizing biofloc in production areas helps in making the technology more accessible to farmers.

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INTRODUCTION

Most Indians devour an unbalanced diet. – The Global Nutrition Report (GNR) 2021 compares the consumption of key foods and nutrients in adults aged 25 and over to achieve minimum and maximum values. The data showed that Indian adults do not meet the dietary recommendations for staple food groups of the EAT-Lancet Commission on Healthy Diets from Sustainable Food Systems, with the exception of whole grains [8]. The Indian diet is significantly low in fruits, legumes, nuts, fish, and dairy, which are crucial for optimum growth, development, and the prevention of non-communicable diseases (NCDs) [8]. Generally, sea animals contain a higher nutrient content than land animals. But the production cost of *Litopenaeus vannamei* is around 200 to 250 rupees for a 100-count animal. We are on the front lines of reducing the production cost. We focus on shrimp culture because it provides excellent opportunities for employment and income generation, especially in the more economically backward rural areas. As the number of sea animals decreases, the demand for aquatic animals rises. So, we focus on shrimp culture to generate employment along with affordable food and protein prices [1]. Biofloc shrimp farming is one of the best available methods today, which is helping farmers attain a wide range of objectives such as high output, low cost, sustainable growth, better income opportunities, reduced space requirement, and lower maintenance cost.

Biofloc system principle

Biofloc system guidelines provide two critical services: treating waste from feeding and supplying nutrition through floc consumption [1]. Biofloc systems can operate with low water exchange rates (0.5–1% per day) [6]. This long water residence time allows for the development of thick and dynamic microbial flocs, which are a source of protein for shrimp and help reduce feed costs. This innovation increases profitability and business sustainability. The principle of the method is to maintain an optimal C:N ratio by adding a carbohydrate source [10], and the water quality is improved [3] through the production of high-quality single-cell microbial protein. Biofloc technology converts uneaten feed, feces, and other organic/inorganic matter into protein-rich live feed under light exposure [4]. The main component of biofloc is heterotrophic bacteria, which consume ammonia and nitrite and convert them into protein [10]. This can be consumed by *Litopenaeus vannamei* for growth and acts as real feed.

MATERIAL AND METHODS

We set up two production stages for the biofloc system (Table 2): the nursery phase, which had a capacity of 400 m³ for up to 21 days, and the grow-out phase (6000 m³ or 0.6 ha) until harvest in a sheeted pond, including direct stocking for a control study. Nursery tanks were filled using bore water, followed by aeration for 24 hours. Alkalinity was measured and found to be between 600–650 ppm. The bore water also contained 2–2.5 ppm ammonia and 0.01–0.05 ppm phosphorus. To initiate biofloc formation, a carbon source was added to maintain a C:N:P ratio of 15:1:0.01 to convert ammonia into microbial biomass [2]. A commercial bio culture was used for seeding microbial communities. The amount of brown sugar added to the nursery tanks was calculated based on the daily feed input using a biofloc calculator, considering feed protein content and moisture data printed on the feed sacks [9]. The carbon-to-nitrogen (C:N) ratio in BFT is typically managed in two phases: (i) An initial and formation phase, applying a C:N ratio of 12–20:1 to promote heterotrophic bacterial growth, and (ii) A maintenance phase, adjusting to a C:N ratio of 6:1 based on total ammonia nitrogen (TAN) levels [7]. Brown sugar was added daily during the first week post-stocking, every 2 days from day 8 to 14, every 3 days from day 15 to 23, and every 4 days from day 24 until just before transfer to the grow-out system. The sugar was completely dissolved in pond water and broadcast evenly across the tank. The calculated daily amount was divided equally and applied one hour after the morning and evening feedings. Physical, chemical, and biological water parameters were regularly monitored and maintained following standard aquaculture protocols (Table 1) [10].

Manipulation of Carbon: Nitrogen Ratio

Feed (1 Kilogram)	= 1000 grams
Moisture content of feed	= 10%
Dry matter	= total feed minus moisture content
So dry matter	= 100% - 10% = 90%.
Crude protein (CP) content	= 35%
Carbon content in the feed	= 50%, or factor 2
Protein-to-nitrogen factor	= 6.25
1. Total carbon content in the feed	= (grams of feed) X (% of dry matter) X (% of unutilized feed)
/ 2	= 1000 x 0.9 x 0.7/2
	= 315 grams.
2. Total nitrogen in the feed	= (grams of feed) X (% of dry matter) X (% of unutilized feed) X
(% of protein content) = 6.25	= (1000 x 0.9 x 0.7 x 0.35) / 6.25
	= 35.28 g
C: N ratio	= 315:35.28 grams in the feed
So the carbon ratio is	= 315/35.28.
	= 8.92: 1
To keep 15, multiply 1 by 15 and multiply by 35.28.	
Required Carbon Source	= 529.20
Total carbon required	= required carbon content minus feed content
	= 529.20 - 315
	= 214.2 g
So to maintain a 15:1 carbon ratio, we need to add 214.2 g of carbon per kg of feed.	
Carbon percentage in sugar: 40% [8]	
So 1000 grams of sugar contains 400 grams of carbon.	

$$= (214.2/40) \times 100$$

= 535.5 grams of sugar.

Carbon addition based on Total Ammonical Nitrogen (TAN).

TAN (Total Ammonical Nitrogen) = 1.5 mg/liter in a 40000-liter tank

$$1.5 \text{ mg} = 0.0015 \text{ gram}$$

$$= 0.0015 \times 40000 (\text{Nursery Tank water level})$$

$$= 60 \text{ grams of TAN in a 40000-liter tank}$$

If you want to maintain the C:N ratio at 6:1,

$$6 \times 60 = 360 \text{ g of carbon are required. Based on these molasses.}$$

RESULTS AND DISCUSSION

Trial results commercially confirm that the biofloc strategy is more beneficial than the conventional method (Table 4). The biofloc strategy yields 2.8 times more profit than the traditional strategy. As shown in Table 5, adopting biofloc technology reduces several costs due to higher yield [2] and improved feed conversion ratio (FCR) [9]. The reduced operational costs include land rent, soil work, biosecurity measures, and bleaching, seed cost, feed cost, and labor and technician expenses. For example, feed costs under the biofloc strategy were recorded at 60.53 INR/kg, whereas in conventional systems they reached 62.35 INR/kg. Other cost reductions under biofloc were observed for land rent (2.48 vs. 2.73), soil work (1.24 vs. 1.37), bleaching (0.83 vs. 0.98), seed cost (8.69 vs. 9.57), and labour (6.21 vs. 6.84). Production-related advantages of the biofloc system include a yield increase to 2350 kg, a reduction in FCR by 0.35 units, and a final shrimp count reaching 49 compared to 57 in the conventional system. However, certain limitations are associated with biofloc adoption, such as the requirement for highly skilled technical personnel and the necessity for consistent power and aeration backups [7, 11].

Table 1 : Water quality parameters in Study period

Parameters	Range	units
pH	7.7 to 8.8	
Salinity ppt	15 to 17	ppt
Alkalinity ppm	350 to 150	ppm
Ammonia ppm	0.1 to 1	ppm
Nitrite ppm	0.01 to 0.3	ppm
Iron ppm	nil	ppm
Total Hardness ppm	3000 to 3500	ppm
Ca++ ppm	110 to 250	ppm
Mg++ ppm	480 to 600	ppm
Vibrio		
Green cfu/ml	30 to 120	cfu/ml
Yellow cfu/ml	50 to 250	cfu/ml
Biofloc	5 to 15	ml/litre

Table 2: Comparison Data's of Biofloc Strategy and Conventional Method			
Culture Analysis	Biofloc Method	Green Water method	Units
Total Stocking Nos	4.8	4.8	lakhs
Area	6000	6000	m2
stocking density/m2	80	80	m2
partial harvest	2	1.5	Tons
Animal Weight	10.9	8.5	grams
Partial Harvest Animal nos	183436	176470	nos
Animal Number in pond	263313	231529	nos
Density in Pond	44	38	m2
Final Harvest	20.5	17.5	grams
Harvest	4.95	3.9	Tons
Survival Nos	241463	177143	Nos
Survival %	91.7	76.5	%
Total harvest kgs	6950	5400	kgs
Feed consumed	7992	7200	kgs
FCR in Biofloc	01:01.1	01:01.3	

Table 3: Cost Comparisons of Biofloc and Green Water Method

Particulars	Biofloc Method	Production cost	Spilt Percentage	Traditional method	Production cost	Spilt Percentage
Land lease Amount	30000	1208500	2.48%	30000	1097000	2.73%
Earth work	15000	1208500	1.24%	15000	1097000	1.37%
Biosecurity measures	2000	1208500	0.17%	2000	1097000	0.18%
Bleaching	10000	1208500	0.83%	10000	1097000	0.91%
OTHERS	2000	1208500	0.17%	2000	1097000	0.18%
seed cost	105000	1208500	8.69%	105000	1097000	9.57%
labour and Technician	75000	1208500	6.21%	75000	1097000	6.84%
Feed Cost	731500	1208500	60.53%	684000	1097000	62.35%
Mollases & Probiotics	30000	1208500	2.48%	15000	1097000	1.37%
mineral	15000	1208500	1.24%	15000	1097000	1.37%
Feed Additives and others	8000	1208500	0.66%	14000	1097000	1.28%
electricity	150000	1208500	12.41%	100000	1097000	9.12%
fuel	10000	1208500	0.83%	7000	1097000	0.64%
Harvest handling	10000	1208500	0.83%	10000	1097000	0.91%
Repair & Maintenance	5000	1208500	0.41%	3000	1097000	0.27%
Miscellaneous	10000	1208500	0.83%	10000	1097000	0.91%
Total Production Cost	1208500		100.00%	1097000		100.00%

Table 4 : Total cost Analysis

Particulars	Biofloc	Green Water	units
Partial Harvest	2000	1500	kgs
Count	94	118	Nos
Price/kg	190	170	Rs
Amount	380000	255000	Rs
Final Harvest kgs	4950	3900	kgs
Count	49	58	Nos
Selling Price /kg	280	250	Rs
Amount	1386000	975000	Rs
Total Amount	1617500	1230000	RS
Total Expense	1208500	1097000	RS
Total Profit	381260	133000	RS
Ratio	2.8	1	

Fig: 1 Comparison Data's of Biofloc Strategy and Conventional Method

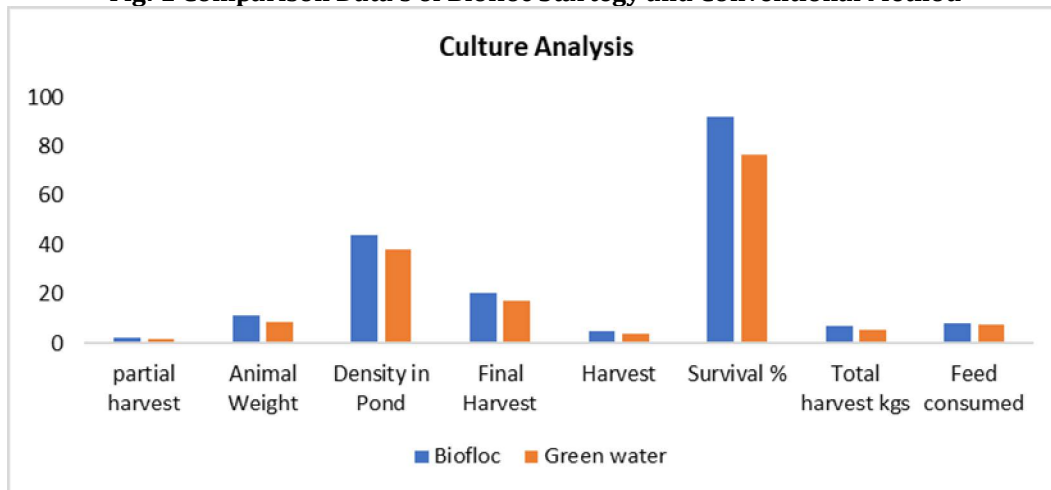


Fig: 2 Cost Comparisons of Biofloc and Green Water Method

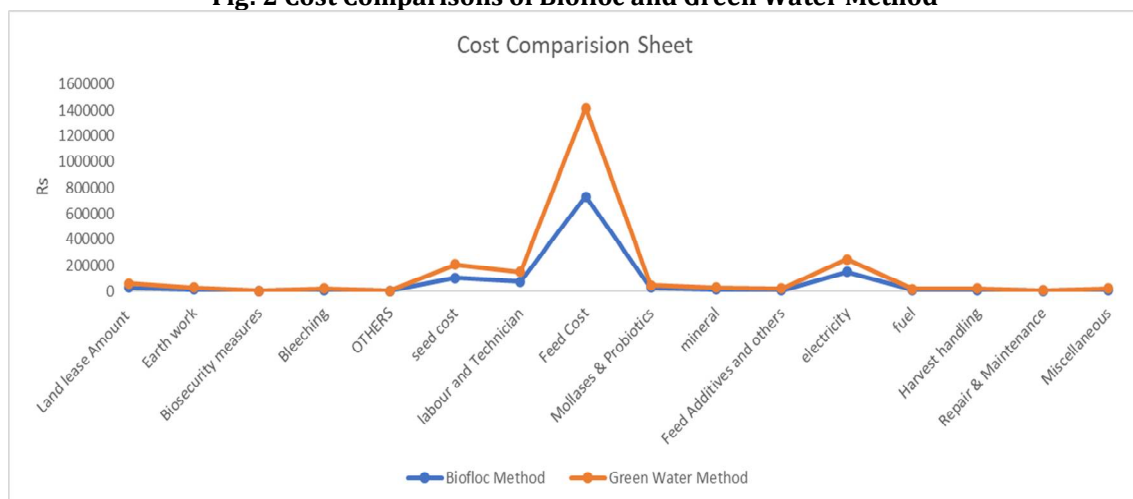
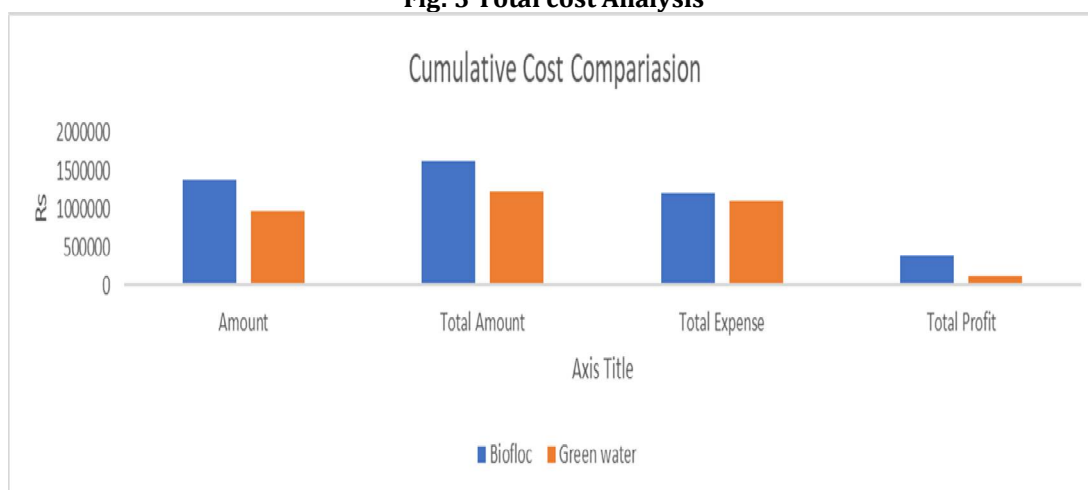


Fig: 3 Total cost Analysis



CONCLUSION

Biofloc strategy of culturing *Litopenaeus Vannamei* generates more income and benefit than green pond methods. It needs more instrumented, technical and practical training. To commercialize biofloc handle further studies is required for all perspectives of farming.

REFERENCES

1. Abdirad, S. M., & Ghaednia, B. (2016). Biofloc technology: An overview of its role in aquaculture. *International Journal of Aquatic Biology*, 4(4), 163–170.
2. Avnimelech, Y. (2009). *Biofloc Technology: A Practical Guide Book*. The World Aquaculture Society, Baton Rouge, Louisiana, USA.
3. Boyd, C. E. (2003). *Water quality management for pond fish culture*. Research and Development Series No. 43, International Center for Aquaculture and Aquatic Environments, Auburn University.
4. Correia, E. S., Wilkenfeld, J. S., Morris, T. C., Wei, L., Prangnell, D. I., & Samocha, T. M. (2014). Intensive nursery production of *Litopenaeus vannamei postlarvae* using biofloc technology. *Aquacultural Engineering*, 58, 39–44.
5. Crab, R., Defoirdt, T., Bossier, P., & Verstraete, W. (2012). Biofloc technology in aquaculture: Beneficial effects and future challenges. *Aquaculture*, 356-357, 351–356. <https://doi.org/10.1016/j.aquaculture.2012.04.046>
6. Emerenciano, M., Gaxiola, G., & Cuzon, G. (2012). Biofloc technology (BFT): A review for aquaculture application and animal food industry. *Biomass Now – Cultivation and Utilization*, InTech. <https://doi.org/10.5772/25969>
7. Ferreira, G. S., Lara, G., Wainberg, A. A., Wasielesky Jr, W., & Ballester, E. L. C. (2020). C:N ratio dynamics in biofloc systems and its influence on water quality and shrimp performance. *Aquaculture Research*, 51(4), 1400–1411.
8. Global Nutrition Report. (2021). *The State of Global Nutrition: 2021*. Development Initiatives. <https://globalnutritionreport.org>
9. Hargreaves, J.A. (2013). *Biofloc production systems for aquaculture*. Southern Regional Aquaculture Center (SRAC) Publication No. 4503. United States Department of Agriculture.
10. Khanjani, M. H., Sajjadi, M. M., & Alizadeh, M. (2017). The effect of different C/N ratios on the growth performance of Pacific white shrimp (*Litopenaeus vannamei*) in biofloc systems. *Aquaculture Research*, 48(4), 1491–1501.
11. Timmons, M. B., Ebeling, J. M., Wheaton, F. W., Summerfelt, S. T., & Vinci, B. J. (2002). *Recirculating Aquaculture Systems*, 2nd ed. Cayuga Aqua Ventures, New York, USA.

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