Journal of Applied Life Sciences International

Volume 27, Issue 6, Page 74-85, 2024; Article no.JALSI.127088
ISSN: 2394-1103

Effect of Floating and Sinking Formulated Feed on Growth and Production of GIFT Tilapia (*Oreochromis niloticus*) in Earthen Ponds

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/jalsi/2024/v27i6668

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/127088

Original Research Article

Received: 26/09/2024
Accepted: 29/11/2024
Published: 04/12/2024

ABSTRACT

Tilapia farming is a significant sector in global aquaculture, with Nile tilapia (*Oreochromis niloticus*) being one of the most widely cultivated species. However, the continued increase in tilapia production raises concerns about genetic deterioration. This study aimed to evaluate the effects of different types of farm-made and floating feeds on the growth performance of Genetically Improved Farmed Tilapia (GIFT) tilapia in an on-farm trial (OFT) conducted in a farmer's pond in Namakkal District, India. GIFT tilapia fingerlings with an average weight of 3.25 ± 0.15g were stocked at a

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Cite as: *S.Paulpandi, S.Sathya, and K.Velmurugan. 2024. "Effect of Floating and Sinking Formulated Feed on Growth and Production of GIFT Tilapia (Oreochromis Niloticus) in Earthen Ponds". Journal of Applied Life Sciences International 27 (6):74-85. https://doi.org/10.9734/jalsi/2024/v27i6668.*

density of 50,000 fingerlings/ha across three feeding treatments. In Treatment 1 (T1), fish were fed low-cost handmade feed, while Treatment 2 (T2) used TNJFU feed, and Treatment 3 (T3) involved a commercially available floating feed with 34.53% crude protein. Fingerlings were initially fed twice a day at 18% of their body weight for the first 15 days, after which the feeding rate was gradually reduced to 1.8% until harvest. Growth was measured biweekly using a measuring board and balance. Water quality parameters, including temperature, dissolved oxygen, pH, ammonia (NH_3), nitrite (NO_2), and nitrate (NO_3) concentrations, were monitored, as these factors significantly influence fish growth, feed intake, health, and survival. Results cleared that final mean weight and weight gain were significantly ($P \leq 0.05$) better with (T3), while lower values were recorded with (T2 and T1), Feed intake was significantly decreased with (T3). FCR values were significantly better with T3 than T2 and T3. Survival rates insignificantly affected and ranged between 96 ± 0.88 (T3) and 85 ± 0.88(T2) 72± 0.58(T1). The Production and net profit showed significant differences ($P < 0.05$) in gross production and net profit per hectare across the treatments. Treatment (T3) resulted in the highest production (7247.47 ± 9.63 kg/ha) and net profit ($203,740), followed by Treatment (T2) with 6588.88 ± 38.14 kg/ha and $195,080, and Treatment (T1) with 5354.36 ± 23.61 kg/ha and $2,567.73. Based on results obtained in this study and on the economical evaluation, it could be concluded that feeding floating pellets were better than feeding sinking other types of pellets, in addition to the increasing of protein percentage in diet was best in terms of economic efficiency compared with other treatments.

Keywords: GIFT Tilapia; growth rate; survivability; floating feed; cast benefit ratio and water quality.

1. INTRODUCTION

The fisheries sector is a cornerstone of the Indian economy, offering vital contributions to food and nutritional security, foreign exchange earnings, employment, and national income. As one of the most promising sources of animal protein, aquaculture has gained importance not only for its economic benefits but also for its role in supporting the livelihoods of approximately 30 million people in India, particularly those within marginalized and vulnerable communities. Recognized as a "Sunrise Sector," fisheries hold tremendous potential for sustainable growth and development, fostering food security and income generation across the country. India's inland aquaculture segment has emerged as the fastest-growing component within the fisheries sub-sector, driven by advancements in species diversification, farming technologies, and intensification of pond and tank-based systems. With record fish production reaching 17.545 million tons in FY 2022-23 (Department of Fisheries, Ministry of Fisheries, Animal Husbandry, and Dairying, 2023), India is now the third-largest fish-producing nation, contributing approximately 1.09% to the national Gross Value Added (GVA) and over 6.72% to the agricultural GVA. India’s aquaculture sector not only contributes to domestic food security but also plays a vital role in meeting the global demand for protein-rich food.

Despite significant progress, most of the 600 aquatic species currently farmed worldwide rely on unimproved stocks, which have genetic characteristics similar to their wild counterparts, resulting in relatively low production efficiency [1,2]. Tilapia (*Oreochromis niloticus*), in particular, is a species of high economic value that has encountered several challenges related to growth efficiency, feed quality, and resource management. Tilapia culture, which began as an alternative to capture fisheries, faces the continued need for nutritionally balanced feeds to support optimal growth. For intensive aquaculture practices, where high-density stocking relies heavily on artificial feeds, feed quality is critical, influencing growth performance, production costs, and water quality [3,4].

Feed comprises about one half of the variable cost associated with fish production. Understandably, producers are interested in knowing how much feed the fish are consuming. In addition to extra expense, water quality can deteriorate unnecessarily due to the addition of excess feed. Extruded, floating feeds offer the advantage of watching the feeding response as opposed to a sinking, steam -pelleted feed [5]. Feed costs represent a major portion of operational expenses in aquaculture, with protein sources constituting the most costly component. This places importance on formulating feeds that maximize protein deposition and growth while minimizing input costs [6]. Advances in feed production, genetics, and rearing practices have shown potential for enhancing tilapia growth under intensive culture conditions. Studies have demonstrated that tilapia can adapt to a variety of nutrient sources, from natural pond algae to high-quality commercial feedstuffs such as grains, oilseeds, and fishmeal [7]. Additionally, research on species-specific requirements, such as feeding frequency, has provided insights into optimizing feed utilization and nutrient intake [8].

Capture fisheries are considered the sole source of fish products before fish farming was introduced. Nile tilapia farming has faced a lot of hurdles and setbacks since it started. The feed should meet the nutritional requirements of cultured fish, as stated by Munguti et al., [9]. Farmed tilapia is genetically inferior compared to their wild counterparts. Their decreased fecundity, growth rate, and survivability Ordonez et al., [10]; Ansah et al., [11] have caused lower production and profitability. To alleviate the crisis, breeding experiments were initiated to develop genetically improved Nile tilapia.Improving disease resistance Houston, [12], Barria et al., [13] and enhancing socio-economic and welfare performance of the related aquaculture systems Dey, [14].

The intensive aquaculture increases the production of fish rearing exotic species. Intensive aquaculture of indigenous species can enhance the indigenous fish production in a particular/limited time. The aquaculture development and increase in per unit volume of water depends after all artificial feed Shaheen et al., [15]. Tilapia (*Oreochromis niloticus)* regarded as an honest converter of organic matter into top quality which will survive in shallow and turbid water conditions Stickney et al., [16]. Aquaculture is a feed based industry with over 60% of the operational cost coming from feed sources alone Pandian et al. 2001 [17].

The use of commercial feed has become a time demanded initiative for the success of cyprinid and tilapia culture under intensive culture conditions particularly rohu along with other carps Abid and Ahmed, [18] and tilapia monosex culture. Chakraborty et al. [19] and Chakraborty [20] conducted research on rearing, spawning and nursing of Pangas in Bangladesh. High-quality aquafeed is essential for optimal growth, feed conversion efficiency, and fish health, promoting increased utilization in the country Das KG [21].

Given the critical role of feed in aquaculture and the increasing demand for high-quality protein sources, this study focuses on evaluating the effects of different feed formulations on the growth performance of *O. niloticus* under intensive culture conditions. By assessing the impact of floating commercial feeds in earthen ponds, the study aims to contribute to a better understanding of feed-based growth optimization strategies in tilapia culture, with broader implications for sustainable aquaculture development.

2. MATERIALS AND METHODS

Study location and pond facilities: The experiment was conducted from July 15, 2021, to December 15, 2021, over a period of five months (150days), with the objective of assessing the effect of floating pellet feed on the growth of GIFT tilapia in nine rectangular earthen culture ponds, each measuring 0.2 hectares. Tilapia fingerlings were sourced from the Government GIFT Tilapia Fish Seed Hatchery at Manjalar Dam, Theni District, Tamil Nadu, and distributed to selected farmers across various villages in Namakkal District. All ponds used in the study were consistent in shape, depth, and basin configuration, and were equipped with standardized water supply facilities. Water depth was maintained at approximately 1.0 meter through regular adjustments with machinery.

2.1 Experimental Design

The experiment was conducted using three treatments: Handmade Feed (P-24%) (T1), TNJFU Floating Fish Feed (P-28.50%) (T2) [22], and Commercial (Growfin) Floating Fish Feed (P-34.53%) (T3), each with three replications. GIFT tilapia fingerlings, with an initial average weight of 3.25 ± 0.13 g, were stocked in each pond at a density of 50,000 fingerlings/ha. The floating feed used in treatments F2 and F3 was sourced from TNJFU and local markets. To promote scientific and intensive pond management practices, both off-campus and on-campus training programs were conducted in the selected villages to raise farmers' awareness. Additionally, critical inputs were provided to encourage the adoption of these technologies.

2.2 Pond Preparation

Initially, the bottoms and sides of the selected ponds were renovated, and all aquatic weeds were removed manually by hand-picking, uprooting, and cutting. To disinfect the water, each pond was treated with lime at a rate of 250 kg/ha. Seven days after liming, experimental

Table 1. proximate analysis of extruded diet type used (on DM basis)

Treatment/Analyzed variable	Crude Protein (%)	Crude Fat (%)	Crude Fiber (%)	Moisture (%)
Handmade Feed (T1)	24 ± 0.2	7 ± 0.3	11.4 ± 0.2	12.6 ± 0.1
TNJFU Floating Fish Feed (T2)	28.50 ± 0.5	5 ± 0.1	5.5 ± 0.3	9.5 ± 0.2
Commercial(Growfin) Floating Fish Feed (T3)	34.53 ± 0.3	6 ± 0.2	3.0 ± 0.1	9.3± 0.1

ponds (Pond-1, Pond-2, and Pond-3) were fertilized with cow dung at 988 kg/ha, urea at 24.7 kg/ha, and TSP at 12.35 kg/ha [23]. The water sources for the experimental ponds were rainfall and deep tube wells. To prevent the entry of predatory fish eggs, spawn, fry, and harmful aquatic insect larvae, a fine mesh (2 mm) nylon net was placed at the inlet of pumped water. Natural food production and water toxicity levels in the experimental ponds were then assessed. Three days before stocking the fry, netting was conducted to remove any small frogs and water bugs from the ponds.

2.3 Feed Preparation and Feeding

The required quantities of all feed ingredients were mixed by hand to prepare the feed, which was then evenly spread over the surface of the experimental ponds. Supplemental feed was supplied at varying rates and frequencies based on the fish's body weight, with feeding rates decreasing as individual body weights increased. Fish were randomly weighed biweekly, and daily feed rations were adjusted accordingly. A feed testing tray was used to prevent overfeeding. Key water quality parameters, including temperature, dissolved oxygen, and pH, were monitored fortnightly in the early morning before sunrise and in the evening at sunset. Half of the daily ration was provided at 9:00 am, and the remaining half was supplied at 4:00 pm.

The proximate nutritional composition (crude protein, fat, fiber, and moisture) of the feed was analyzed following the standard methods of the Association of Official Analytical Chemists [24]. Crude protein was estimated by measuring the nitrogen content of the ingredient using the micro-Kjeldahl method and calculating the crude protein level by multiplying the nitrogen content by 6.25. Crude lipid was determined by ether extraction method using soxhlet apparatus. Moisture content was measured by placing a sample of known weight in an oven set at 105-110°C until the sample attained a constant weight. The lost weight from the sample was considered the moisture content and the remaining weight dry matter.

2.4 Estimation of Survival Rate and Production of Fishes

This section provides details on the production of GIFT tilapia in the study ponds. Production was calculated by subtracting the average initial fish weight from the recorded weight after five months. The following methods were used to determine growth parameters and feed utilization:

(i) Total Weight Gain per Fish = Final fish weight (g) - Initial fish weight (g) [25].
(ii) Feed Conversion Ratio (FCR) = Total weight of dry feed provided ÷ Total weight gain (Boonyaratpalin, [53]).
(iii) Fish Survival (%) = 100 × (Final total fish count ÷ Initial total fish count) [26].
(iv) Net Yield (NY) = (Final total fish weight - Initial total fish weight) ÷ Pond water volume.

Each calculation was conducted separately for each replication and treatment group.

2.5 Statistical Analysis

Statistical analysis was conducted to assess fish performance across different species combinations. Analysis of Variance (ANOVA) was used to compare mean values for growth, survival, and yield. Mean values were further analyzed using Duncan's Multiple Range Test for detailed comparison [27].

3. RESULTS

3.1 Production Performances

The Initial stocking weight of fish was (3.25±0.13) for T_1, T_2 and T_3. At the end of the experiment, the final mean weights were 539.94 ± 1.29 g for T1, 869.24 ± 4.97 g for T2, and 917.25 ± 3.97 g for T3, showing a significant difference between treatments. This regular monitoring helped identify where the maximum growth occurred across the two different feeding formulations. The survival rate (%) of GIFT tilapia across treatments ranged from 72.00 ± 0.58 to 96.33 ± 0.88, which aligns with the range (70.62% to 93.45%) recorded by Alam et al. [28]. These findings are also consistent with those of Zannatul et al. [29], who reported survival rates of 79% to 92% for monosex fry tilapia reared in hapa. The results show that, the fish feeding floating diet recorded the highest ranges of body weight, body length and daily weight gain highest survival rate was observed in T3, where fish were fed a diet containing 34.53% protein. These results are agreements with the results obtained by Hematzade et al. (2013) with rainbow trout and disagreed with that obtained by Kristiansen and Ferno (2007). R.M. Abou-Zied (2015) weight and weight gain were significantly (P≤0.05) better with extruded floating diet, while lower values were recorded with extruded sinking diet. M. Abid* and M. S. Ahmed [18] reported that the survival rate was 100 % at all feeding levels. In aquaria fish fingerlings fed with 45% low cost based diet showed significantly higher (P<0.05) weight gain(26.17g) in *Labeo rohita*.

Improved growth of fish fed extruded floating diet may be due to the presence of pelleted floating diet above the water surface, which can fish taken and benefit from it as well as the fish movement and activity as a result of rise of the water surface to feed, which works to improve digestion. But the extruded sinking diet on the feeder lose part of them as a result of movement of fish and download to the bottom of pond and mixed with mud and fish not benefit them as well as change the water properties as a result of the accumulation of feed waste analyzed in water causing increased total ammonia concentration in ponds.

The feed conversion ratio (FCR) was calculated based on the total feed used during the experiment. The FCR values for sinking and floating feeds were 2.04 ± 0.18 for T1, 1.83 ± 0.20 for T2, and 1.63 ± 0.20 for T3, respectively. At the end of the study, total tilapia production was 7265.59 kg/ha in T3, 6588.88 kg/ha in T2, and 5354.36 kg/ha in T1. Production was highest in T3, followed by T2, with T1 yielding the lowest production.

Table 2. Growth, survival and production performance of *Oreochromis niloticus*

Parameter	Treatments		
	T1	T2	T3
Mean initial weight (g)	3.25±0.13	3.25±0.13	3.25±0.13
Final weight (g)	539.94±1.29[c]	869.24±0.21[b]	917.25±1.24[a]
Growth rate (g)	536.69 ± 0.93	865.99 ± 0.16	914.00 ± 0.42
Survival rate (%)	72 ±0.58[c]	85±0.88[b]	96±0.88[a]
Yield (kg/ha/150days)	5354.36±23.61[c]	6588.88±38.14[b]	7265.45±59.34[a]
Feed conversion ratio (FCR)	2.04 ±0.18[c]	1.83±0.20[b]	1.63 ± 0.20[a]

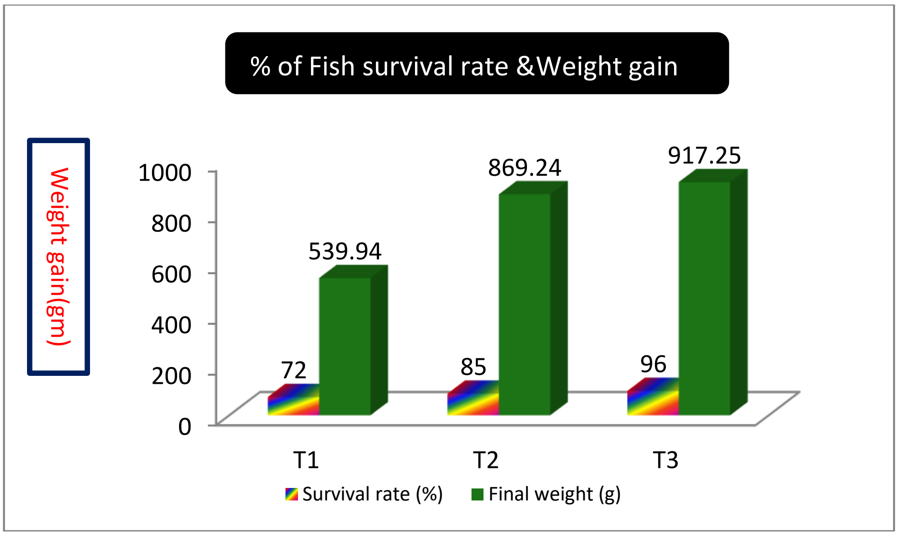

Fig. 1. GIFT tilapia weight gain and percentage of survival rate of different fish float feed

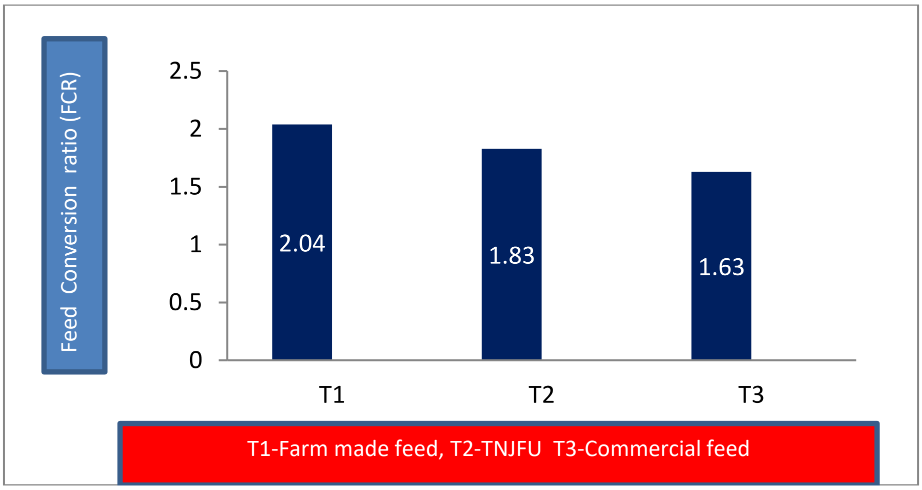

Fig. 2. Feed conversion ratio in Farm made feed (T1), TNJFU(T2) and Commercial floating (T3) feed

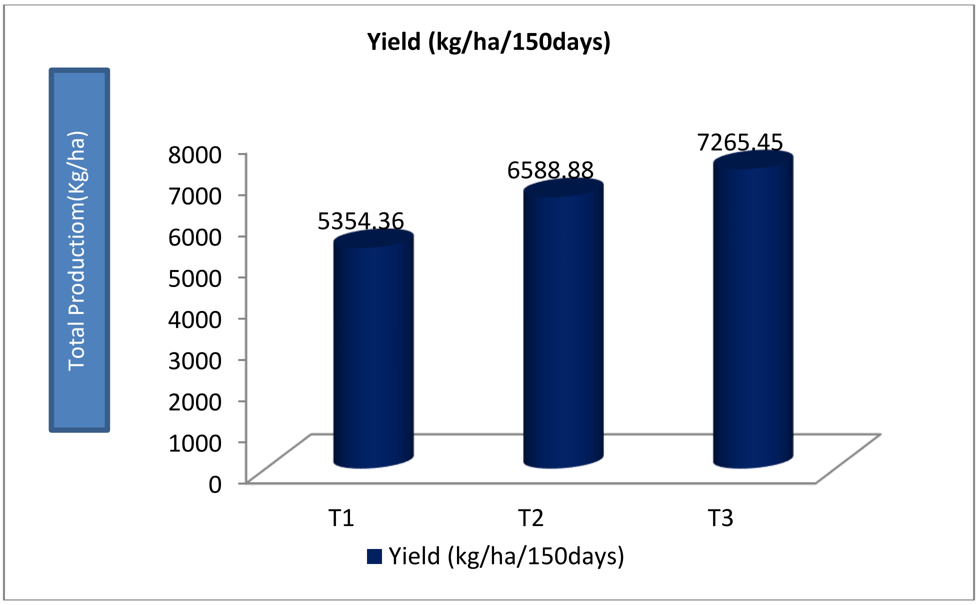

Fig. 3. Total production of tilapia in the Three treatments (T 1, T2 and T3)

3.2 Water Parameters

Tilapia can tolerate dissolved oxygen concentrations as low as 0.1 mg/l (Balarin JD and Hatton JP, 1979). Dissolved oxygen is a critical water quality parameter that influences fish growth and survival. Reduced oxygen levels negatively affect growth, reproduction, and other biological processes in fish, and extremely low concentrations can be lethal. In this study, the average dissolved oxygen concentration in T1 was 4.57 ± 0.79 mg/l in the morning and 5.10 ± 0.82 mg/l in the evening. Higher dissolved oxygen levels were recorded in the experimental tanks due to the installation of aerators.

Other water quality parameters, such as transparency and hardness, did not show significant trends across treatments during the culture period (Table 3). The total ammonia nitrogen content ranged from 0.53 to 0.67 mg/l without significant variation among treatments. Nitrite and nitrate levels also showed no marked differences between treatments. Abdelhamid M. Abdelhamid et al. [30] repot that the unionized ammonia and nitrite levels in the present study remained within safe limits; hence, no remarkable mortality was recorded and no signs of stress were observed. Maximum values of 0.11 mg/L for ammonia and 0.26 mg/L for nitrite were far below the toxic levels. Overall, most

Table 3. Ranges of water quality parameters of different experimental ponds during the culture period under three treatments

Parameters	Treatments		
	TO1	**TO2**	**TO3**
pH	7.8 ± 0.6	8.15±0.7	8.11 ± 0.5
Transparency (cm)	43.85±1.5	36.8±1.2	35.45 ± 1.4
Temperature (0^C)	28.86 ± 1.4	28.6 ± 1.1	29.2 ± 1.3
Dissolved Oxygen (mg /l)	5.3 ± 0.3	6.0 ± 0.4	6.2 ± 0.3
Alkalinity (mg / l)	97.22 ± 0.071	109.6 ± 0.11	114.0 ± 0.09
Hardness (mg / l)	110.4-137.2	113.2-143.8	110.0-136.0
Ammonia (mg / l)	0.67 ± 0.017	0.53 ± 0.012	0.59 ± 0.012
Nitrate (mg / l)	0.562 ± 0.82	0.240 ± 0.58	0.250 ± 0.82
Nitrite (mg / l)	0.25 ± 0.038	0.23 ± 0.038	0.27 ± 0.027
Phosphate (mg / l)	0.26 ± 0.22	0.21 ± 0.15	0.24 ± 0.07

Table 4. Comparative economic analysis of GIFT tilapia Grow out pond during 150 days in rearing system of three different treatments

Cost Rs/ (ha)	TO1	To2	TO3
Liming and Fertilizer cost (Rs)	1150	970	980
Fish fingerlings cost (Rs)	8000	8000	8000
Pond operational cost (Rs)	3500	3500	3500
Feed cost (Rs)	132500	127850	123460
Total cost (Rs)	145150±245	140320 **±**312	136160 ±213
Sale (Rs)	296200±342^a	335400±234^a	339900±234^a
Net benefit (Rs)	81050 ±123a	1195080±67 a	203740 ±76 a
Cost benefit ratio (Rs)	1:1.04	1:1.39	1:1.49

water quality parameters in the ponds and tanks remained within the suitable range for tilapia culture, likely due to the management measures, including regular liming, fertilization, and water exchange.

3.3 Economic Analysis

The mean cost-benefit ratio (CBR) ranged from 1:1.04 to 1:1.49. The lowest yield was recorded in treatment T1, while the highest yield was observed in treatment T3. The total costs were Rupees 145,150 for T1, Rupees 140,320 for T2, and Rupees 136,160 for T3. The net benefits were Rupees 81,050 for T1, Rupees 19,580 for T2, and Rupees 203,740 for T3 (Table 4).

4. DISCUSSION

4.1 Production and Feed Conversion Ratio

The present study demonstrated that feeding GIFT tilapia with floating fish feed in monoculture resulted in significantly higher body weight gains and net fish yield across all locations. Tilapia grew rapidly, achieving average sizes of 833.8 g and 888.4 g, respectively, during the five-month culture period. This enhanced growth can likely be attributed to the genetic potential of the GIFT strain combined with the use of floating pellets, which are more suitable for tilapia as surface feeders. The floating pellets provide a competitive advantage over farm-made feed in terms of consumption and growth utilization. Soltan [31] noted that while sinking pellets are effective, they are more prone to wastage and disintegration. Furthermore, McGinty and Rakocy [32] emphasized the importance of multiple daily feedings, which are necessary to meet the fish's growth requirements, especially during early growth stages. In line with this, Ofori et al. [33] recommended a crude protein content of 28–32% for pelleted fish feed. Floating feed, though more expensive, enables more accurate feed management, whereas sinking pellets require careful monitoring to avoid wastage [31] El-Gendy, M.O, [5] observed the average body weight for the third level (30% protein) was higher than other levels. The analysis of variance of these results indicates that, the differences among different levels were significant ($P<0.05$). Eyo JE. [34], Aizama,et al., [35] reported that all lipid enriched diets had significantly different weight gain ($p < 0.05$), specific growth rate ($p < 0.05$) and survival rate ($p < 0.05$) than the control diet. Although lipid enhanced diets were better than those without lipid in *C. gariepinus*, animal lipid enriched diets had better acceptability index, weight gain, specific growth rate and survival than plant lipid fortified diets.

In this study, the tilapia production was 7265.45 kg/ha/150 days, 6588.88 kg/ha/150 days, and 5354.36 kg/ha/150 days for treatments T3, T2, and T1, respectively. These yields surpass the 4000-6000 kg/ha/120-180 days range observed by Hussain [36] and Md. Istiaque Hossain [37] were observed monosex tilapia was 7247.47 kg/ha/95 days, 6288.42 kg/ha/95 days, 5355.85 kg/ha/95 days, 5064.88 kg/ha/95 days for T1, T2, T3, and T4 in semi-intensive culture systems. This higher production can be attributed to superior feed quality and well-managed feeding practices. Similar findings were reported by Murty et al. [38] and Yadava et al. [39] who also highlighted the importance of feeding management in tilapia culture.

The production of monosex tilapia was 7247.47 kg/ha/95 days, 6288.42 kg/ha/95 days, 5355.85 kg/ha/95 days, 5064.88 kg/ha/95 days for T1, T2, T3, and T4, respectively. This production from 95 days is more satisfactory than that of 4000- 6000 kg/ha/120-180 days as recorded by Hussain [36] in the semi-intensive culture system in freshwater ponds.

The FCR was lowest for the commercial floating feed (T3), indicating better feed efficiency compared to farm-made feed. The contribution of natural plankton, which is more prominent at lower stocking densities, may also have played a role in improving feed conversion [40]. The highest survival rate in the present study was 96%, significantly higher than the 75.55-90.37% survival reported by Ahmed et al. [41] for tilapia in freshwater systems. The survival rates GIFT tilapia were 96%, (T3), 85% (T2), and 72% (T1) respectively with the highest survival achieved in T3. These values are in the normal ranges as indicated by Abou-Zied [42] and Hussain MG *et al*. [43] who reported values of tilapia survival rate ranged between 87.23 and 95%. These results suggest that tilapia culture can be successfully implemented in open pond systems in India, where land and water resources are increasingly scarce.

4.2 Water Parameters

Water temperature is a crucial factor for tilapia growth, with the optimal range being between 26°C and 32°C [44]. Battes K *et.al*. [45] reported that water temperature plays a vital role in regulating the metabolic process of fish. As the body temperature of fish is influenced by the water temperature, proper management of water temperature is essential for maximizing growth, reproduction, and other biological activities. In this study, the water temperature in the experimental ponds remained within the suitable range for tilapia culture. Tilapia can tolerate dissolved oxygen concentrations as low as 0.1 mg/l [46] but reduced oxygen levels can adversely affect their growth and survival. In this study, the mean dissolved oxygen levels in T1 were 6.57±0.79 mg/l in the morning and 6.64±0.82 mg/l in the evening. The higher oxygen concentrations in the experimental tanks were likely due to the aerator installation, which ensured adequate oxygenation. The water quality parameters, such as transparency and hardness, did not show significant variation among the treatments. Total ammonia nitrogen, nitrite, and nitrate levels remained within acceptable limits, ensuring suitable conditions for tilapia growth. Regular management practices, including liming, fertilization, and water exchange, likely contributed to maintaining optimal water quality throughout the culture period.

Microalgae are rich in biochemical constituents needed by fish. Nonetheless, some microalgae species accumulate heavy metals from their environments Lum et al., [47], which can consequently affect fish growth. Moreover, industrial scale microalgal production is still limited by several factors such as contamination issues, high production costs, and excretion of industrial wastes and effluents.

Nhuong Tran *et.al* [48] reported that the propensity score matching analysis confirmed GIFT had a faster specific growth rate than non-GIFT in both monoculture and polyculture systems, with 3.3% and 3.1% body weight per day for GIFT and 2.6% and 2.4% body weight per day for non-GIFT in monoculture and polyculture.

4.3 Economic Analysis

The cost-benefit ratio (CBR) was highest for T3 (1:1.49), followed by T2 (1:1.39), and lowest for T1 (1:1.04). These differences in CBR reflect variations in production costs and market returns from harvested fish. The findings align with those of Bob-Manuel and Erondu [49] who reported CBR values of 1.60-2.03 for Nile tilapia, and Ali et al. [50] who recorded a CBR of 2.60 Tk. Economic analysis indicated that treatment T3 was the most profitable, highlighting the importance of feed quality in determining the profitability of tilapia farming. The profitability and sustainability of tilapia farming are closely linked to the quality and cost-effectiveness of the feed used. The results from this study underline the need for high-quality, cost-efficient feed production to ensure the growth and long-term sustainability of tilapia aquaculture. This is consistent with findings by Firew Admasu [51] and the ISU [52] emphasizing the crucial role of feed in aquaculture systems [53].

5. CONCLUSION

The present study results and economical evaluation demonstrated that fish biomass growth varied across treatments, influenced by the type of feed applied. GIFT tilapia showed a positive growth response to floating feed diet with higher protein levels (34.53.%), with the highest growth rate observed in T3 and was best in terms of economic efficiency compared to other treatments. Further T3 treatment showed with optimum water stability and less water pollution, less bottom settling of unconsumed feed resulting in less organic load in the pond compared to other treatments. Handmade Feed (T1) absorbed more moisture by the fourth month of storage. Crude protein, lipid, fibre and ash content in farm-made feed was stable during the first 2 months of feed storage but after 3 months, protein and lipid decreased while the ash and fibre increased. In culmination to above the reduced feed conversion ratio (FCR) will aid farmers reduce cost of feed on farm.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

I .S. Paulpandi hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

ACKNOWLEDGEMENT

Authors would like to thank TANUVAS, Chennai for technical guidance and ICAR, ATARI, Hyderabad for funding to carry out the On Farm trial (OFT) successfully at Namakkal district, Tamil Nadu.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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