Reduction of Feed Rations below Satiation Levels in Tilapia Pond Production

Ninth Work Plan, Feeds and Fertilizers Research 3 (9FFR3)
Final Report

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Abstract

The goal of this study was to evaluate feeding strategies that could be used to reduce tilapia grow-out costs. Growth, yield, and survival of tilapia fed daily were compared at 100 and 67% of experimentally determined satiation. Analysis of growth performance parameters demonstrated that the reduction of rations to 67% of satiation had no effect on growth or yield, suggesting that this approach may be useful to farmers wishing to reduce costs without compromising sales.

Introduction

The use of supplemental feed in addition to fertilization has improved tilapia yields economically. The availability of many types of commercial feeds has made it even more convenient for tilapia farmers to provide feed to their fish. But while feeding ensures rapid growth of fish, feed costs often demand 60 to 70% of the total production cost.

Feeding strategy can affect the profitability of a tilapia production operation. Good feeding procedures must be developed to minimize feed wastage and deterioration of water quality. In a tilapia feeding experiment in Thailand under the Pond Dynamics/Aquaculture Collaborative Research Support Program (PD/A CRSP), results showed that feeding at 50% satiation ration, coupled with fertilization, gave comparable growth and yield to full satiation and provided better water quality (Diana et al., 1994).

The amount of feeds provided is usually determined as some percentage of the body weight of the culture animals. In culture conditions where some natural food is available, 3 to 5% of the total weight of a crop is a reasonable rule of thumb for providing pellet food to finfish (Avault, 1996; Nwanna and Bolarinwa, 2001). Another feeding practice is to provide all the food the fish will consume to ensure that all individuals obtain sufficient nutrition during the grow-out period. However, this latter practice can be costly and may create water quality problems.

This study was undertaken to demonstrate efficient supplemental feeding strategies for tilapia production in fertilized ponds. Specifically, the study aimed to evaluate growth, yield, and survival of tilapia fed daily at 100 and 67% of experimentally determined satiation. This experiment, conducted in cooperation with farmers in the central area of Luzon Island, also served to test the applicability of a reduced-feeding strategy under commercial tilapia aquaculture conditions in the Philippines.

Methods and Materials

Nine tilapia farmers participated in this trial. At each participating farm site, two ponds were assigned one of each of the two treatments—feed ration at 100 and 67% of experimentally determined satiation levels. The determination of satiation requirements was made once a week on each farm by the project staff. The fish were given prepared feeds consisting of 67% rice bran and 33% fish meal (crude protein = 28.6%).

The pond size ranged from 0.1178 to 0.40 ha. The ponds were stocked with sex-reversed Nile tilapia (*Oreochromis niloticus*) of the Genetically Improved Farm Tilapia (GIFT) strain. This strain is genetically selected for rapid growth and presently distributed by the GIFT Foundation International, Incorporated. Fingerlings with mean weight of 0.05 g were used at a stocking rate of 4 fish m^{-2}.

All ponds were fertilized weekly with urea and ammonium phosphate at a rate of 28 kg N and 5.6 kg P ha^{-1} wk^{-1}. Water depth was maintained at 1 m.

Water quality parameters were monitored monthly in all ponds. The water was analyzed for dissolved oxygen, pH, total

alkalinity, total ammonia, and soluble reactive phosphorus. Analyses were done according to standard methods (PD/A CRSP, 1992).

A sample of 50 fish was obtained from each pond every month to measure average weights of the fish. After 120 days the ponds were harvested by seining and then complete draining. Total number of fish was counted and bulk-weighed. Final mean weight, daily weight gain, gross yields, and survival rates were calculated. The total amount of feed given in each treatment was also estimated at the end of the study. Growth performance was analyzed statistically by t-tests.

RESULTS

Growth Performance

Growth performance data are presented in Table 1. Initial stocking weight of the fish was similar in all farm sites. At harvest there were no significant differences observed in the final mean weights, daily weight gains, fish yields, extrapolated gross yields, and survival between the two satiation levels tested ($P > 0.05$).

Mean body weights measured at monthly intervals are shown in Figure 1. A higher mean final body weight of fish was observed in the 67% satiation than in the 100% satiation; however, the difference was not significantly different ($P > 0.05$). A better feed conversion ratio was obtained in the fish fed at reduced satiation level (2.38) than in those fed at full satiation (3.40).

Table 1. Mean values ± standard deviation of on-farm growth performance of Nile tilapia at 100 and 67% satiation levels.

Performance	Satiation Level	
	100%	*67%*
Initial Mean Weight (g fish^{-1})	0.05	0.05
Final Mean Weight (g fish^{-1})	149 ± 45	154 ± 26
Mean Daily Weight Gain (g fish^{-1} d^{-1})	1.70 ± 1.0	1.76 ± 0.87
Gross Yield (kg pond^{-1})	202 ± 116	211 ± 104
Extrapolated Gross Fish Yield (kg ha^{-1})	3,135 ± 1,149	3,576 ± 1,258
Survival (%)	57 ± 22	65 ± 20
Feed Conversion Ratio	3.40 ± 1.60	2.38 ± 110

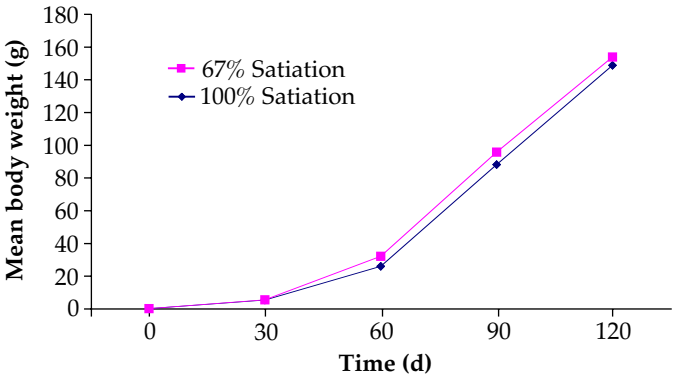

Figure 1. Mean body weight of Nile tilapia in the 100 and 67% satiation rations.

The total feed given to the full satiation treatment was 9,396 kg ha^{-1} as opposed to 7,801 kg ha^{-1} in the reduced ration. This reduction in the amount of feed resulted in $399 savings in terms of feed costs (Table 2). The survival rate can be considered moderate, but there was also no evidence that this was treatment-related. Mortality could be due to handling stress at stocking and during regular sampling of the fish.

ANTICIPATED BENEFITS

This is the second experiment concluded under the current work plan in which a demonstrable reduction in operating costs is not accompanied by a reduction in fish yields. Farmers have adopted the methods demonstrated in the first part of our project (9FFR4, "Timing of the onset of supplemental feeding of Nile tilapia (*Oreochromis niloticus*) in ponds") and will in all likelihood find the reduction of the ration to provide another viable cost-reduction option for them. The pattern that is developing is one of a number of methods being made available to minimize the cost of feeding tilapia grown in ponds in the Philippines. It seems likely that many conscientious farmers are reluctant to compromise their feeding schedules in the interest of growing fish rapidly and keeping them as healthy as possible. Our results indicate that reducing feeding rates, either by delaying the introduction of feeds (9FFR4) or by feeding less than the amount required for satiation (this investigation), does not cause any statistically detectable difference in pond yields or fish quality. We would predict that farmers will find this welcome and reassuring news. We anticipate that a significant number of tilapia farmers in Central Luzon will adopt and to some extent adapt this technique for their own applications, realizing some cost savings in the process.

ACKNOWLEDGMENTS

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Table 2. Cost and return of tilapia production per hectare using 100 and 67% satiation (in US$).

Item	Satiation Level	
	100%	*67%*
GROSS RETURN	3,919	4,470
COST		
Tilapia Fingerlings	420	420
Fertilizers	150	148
Feeds	2,349	1,950
NET RETURN	1,000	1,952

Note: Mean values for water quality parameters measured during the study were found within the acceptable ranges for tilapia culture (Table 3). No significant differences were found between the mean values of water quality parameters between the two treatments across the farms tested ($P > 0.05$).

Table 3. Mean values for water quality parameters measured monthly over a 120-day culture period in ponds fed at 100% (Pond A) and 67% (Pond B) satiation levels in the nine farm sites.

Farm	Pond	Secchi Disk Visibility (cm)	DO (mg l^{-1})	Temperature (°C)	pH	Alkalinity (mg l^{-1})	Ammonia (mg l^{-1})	Phosphorus (mg l^{-1})
1	A	17.8	6.2	25.6	8.5	167.2	0.21	0.55
	B	19.8	6.3	27.7	8.2	172.6	0.28	0.57
2	A	27.8	5.5	28.6	8.3	192.8	0.17	0.42
	B	24.8	10.4	29.3	8.7	179.4	0.16	0.34
3	A	27.4	11.9	28.9	9.0	87.4	0.19	0.20
	B	24.2	11.1	28.6	9.1	117.6	0.24	0.16
4	A	13.4	7.7	27.6	9.1	158.0	0.21	0.50
	B	17.8	6.2	27.7	8.8	137.0	0.22	0.38
5	A	45.2	7.7	28.6	8.6	193.8	0.22	0.42
	B	32.0	8.4	28.4	8.4	167.6	0.16	0.33
6	A	37.0	9.8	27.6	8.6	289.4	0.09	0.39
	B	39.8	10.3	27.6	8.6	256.2	0.08	0.32
7	A	28.4	10.3	29.9	8.7	99.2	0.12	0.32
	B	28.8	11.3	30.2	8.8	105.0	0.10	0.30
8	A	27.2	8.0	25.8	8.7	169.6	0.19	0.34
	B	40.4	6.4	26.8	8.6	166.4	0.15	0.36
9	A	24.6	10.8	30.4	8.6	178.2	0.16	0.43
	B	28.0	10.4	30.1	8.7	164.6	0.11	0.30

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