Growth Performance of Tilapia in Earthen Ponds in the Philippines Using the ASA-IM Feed-Based Methodology with Soy-Based Feed Compared to Traditional Culture Methodology

Results of ASA-IM/Soy-in-Aquaculture 2006 Feeding Demonstration

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ABSTRACT

A feeding demonstration was conducted at ZH Aquafarm, San Jose City, Nueva Ecija, Philippines to evaluate the growth of tilapia (*Oreochromis niloticus*) using ASA-IM feed-based pond culture methodologies with soy-based feeds in comparison to traditionally used culture methodologies and feeds. Mono-sex tilapia of size 0.0013 g were stocked in three, 0.1 ha ponds at 25,200 fish per hectare for the ASA-IM feed based demonstration ponds. Mono-sex tilapia of size 0.0007 g were stocked in three, 0.0.1 ha ponds at 52,500 fish per hectare for the traditional methodology of culture used in the area. Tilapia grew from an average of 0.0013 g to 252 g in 102 days and yielded an average of 6,048 kg/ha in the ASA-IM feed-based demonstration ponds. Tilapia in the traditional technology ponds grew from an average of 0.0007 g to 252 g in 132 days and yielded an average of 10,483 kg/ha. Survivals in the ASA-IM ponds averaged 95% while in the traditional ponds the average survivals were 79%. An economic analysis of the project indicated an average 29% overall return on investment (ROI) from the three ASA-IM feed based demonstration ponds, while only an average 16% ROI for the traditional ponds.

INTRODUCTION

The American Soybean Association International Marketing (ASA-IM) Program, under the Soy-in-Aquaculture (SIA) Project and in cooperation with ZH Aquafarm in Barangay Santo Tomas, San Jose City, Nueva Ecija, Philippines, conducted a 132-day feeding demonstration with mono-sex tilapia in earthen ponds. The objective of the project was to demonstrate the improved economic return of culturing tilapia using the ASA-IM feed-based production methodology with extruded, soy-based aquafeeds as compared to traditional culture methods typically used in the area.

MATERIALS AND METHODS

Six ponds of an average size of 0.1-ha at ZH Aquafarm in San Jose City, Nueva Ecija, Philippines, were used for the demonstration. All ponds were dried prior to use and the bottom organic material removed prior to filling. Each pond was filled using borehole water. Preparation for three of the ponds was according to the ASA-IM 80:20 manual "Principles and Practices of 80:20 Pond Fish Farming**",** and for the remaining three ponds using the traditionally used methodology in the area.

Mono-sex, male tilapia fingerlings of size 0.0007-0.0013 g were produced on site, as ZH Aquafarm is primarily a hatchery operation. Tilapia were stocked in the three ASA-IM feed-based demonstration ponds at a density of 25,200 fish per ha, and in the traditional methodology at a density of 52,493 fish per ha. Fish in all ponds were of the same initial age and size class. Production targets were 250 g per fish, or 6,000 kg/ha after a predicted 5% mortality for the ASA-IM feed based pond technique, and about 11,000 kg/ha after a predicted 20% mortality for the traditional ponds.

Tilapia were fed twice per day in the ASA-IM demonstration ponds with an extruded, floating feed formulated to contain 36% crude protein and 7% crude lipid (36/7) for fish under 50 g average size (Tables 1 and 3). A second feed formulated to contain 32% crude protein and 6% crude lipid (32/6) was fed to fish $\geq$50 g average size (Tables 2 and 3). These feeds were least-cost formulated by ASA-IM and contained either 64% (36/7), 53.5% (Feedmill A 32/6) or 57% (Feedmill B 32/6) dehulled soybean meal as a percentage of total feed ingredients. The feeds were produced domestically in the Philippines by Feedmill A and Feedmill B. The three ASA-IM technology ponds were treated as replicates of a single feed treatment, with fish in all ponds fed in an identical fashion at each feeding using the ASA-IM satiation feeding technique. Pond management for the ASA-IM demonstration ponds was based on the ASA-IM 80:20 feed-based pond production model.

Tilapia in the traditional ponds were fed three times per day on a set schedule according to feeding tables provided by the feedmill. Except for an initial period when a mash feed was fed to the fingerlings, all feeds used in the traditional ponds were also extruded, floating feeds but with different protein/fat ratios than the ASA-IM demonstration feeds. These feeds were produced by Selecta Feeds Incorporated, Quezon City, Metro Manila, Philippines. Pond management of the traditional ponds included initial applications of manure and lime.

Fish in all ponds were sampled once per month on about the same date each month. At the conclusion of the demonstration, all ponds were completely harvested and all fish weighed and a representative sample (10%) enumerated and weighed. Results were used to estimate fish survival, average fish weight, gross fish production and feed conversion ratio (FCR).

RESULTS

Tilapia in the ASA-IM demonstration ponds were cultured an average of 102 days between 10 June and 27 September 2006 (Table 5). Tilapia grew from an average of 0.0013 g to 252 g in this period and yielded an average production of 6,048 kg/ha for the three ponds (Figure 1; Table 5). Average survival rate was 95% and average FCR was 1.19:1 (Table 5; Figure 2). Overall net profit for the three ASA-IM demonstration ponds was 19,906.75 Philippine Pesos, or about $406.26 United States Dollars using a FOREX of 49PhP/USD$1, with an average return on investment (ROI) of 29% (Tables 6 and 7).

Tilapia in the traditional ponds were cultured an average of 132 days between 10 June and 17 November 2006 (Table 5). Tilapia grew from an average of 0.0007 g to 252 g in this period and yielded an average production of 10,483 kg/ha for the three ponds (Figure 1; Table 5). Average survival rate was 79% and average FCR was 1.48:1 (Table 5; Figure 2). Overall net profit for the three traditional ponds was 21,607.83 PhP or about USD $440.98, using a FOREX of 49PhP/USD$1, with an average return on investment (ROI) of 16% (Tables 6 and 7).

SUMMARY AND CONCLUSIONS

This was the third demonstration by ASA-IM of this type in the Philippines and was again successful in demonstrating the results that can be achieved with the ASA-IM feed-based technology and least-cost, soy-based feeds. However, the results were not as ideal as the previous year's results, likely due to the poor quality initial feeds that were used in the ASA-IM ponds. A dramatic improvement in the project was observed by the farmer when the initial low quality feeds were replaced with feeds from a new cooperating feedmill.

The first production of 36/7 feed (formulated for 36% crude protein and 7% lipid) was analyzed by Feedmill A to have a moisture level of 12.7%. This feed was subsequently re-dried and tested at an independent laboratory and returned the following values:

- Crude Protein 32.38%
- Fat 10.06%
- Moisture 7.54%
- Ash 6.32%
- Crude Fiber 3.90%

The first production of 32/6 feed (formulated for 32% crude protein and 6% lipid) was analyzed by Feedmill A at a moisture level of 10.21%. This feed was tested at an independent laboratory and returned the following values:

- Crude Protein 28.81%

- Fat 8.54%
- Moisture 10.82%
- Ash 6.00%
- Crude Fiber 4.29%

Even adjusting for the feed based on a 10% moisture level, the 36/7 feed produced at this feedmill would have only 31.82% crude protein and the 32/6 would have 29.07% crude protein, a 12.4% and 9% difference from target values.

Circumstances dictated that the initial 36/7 and 32/6 feeds be used for the project until a replacement feed could be produced. This 32/6 replacement feed was produced at a new feedmill (Feedmill B) and returned the following proximate analysis results from an independent lab:

- Crude Protein 31.64%
- Fat 10.37%
- Moisture 9.05%
- Ash 6.83%
- Crude Fiber 3.40%

The values for the new 32/6 feed were closer to the values desired for the feed for this project, although the lipid level was 73% higher than it should have been. One reason for this difference was the way the feedmill itself tested the lipid inclusion, using the solvent extraction method. This is less accurate than the acid hydrolysis method used by the independent laboratory used in this project. A higher lipid level in the feed would affect the DE/DP ratio in the feed.

In the previous year the economic returns in terms of net profit and ROI of the ASA-IM ponds were significantly higher (23,918.79 PhP vs. 3750.27 PhP and 64% vs. 4% respectively) than that of the traditional ponds as well as the ASA-IM ponds also having a much shorter production time (109 vs.162 days). As discussed above, this year the quality of the initial feeds used in the ASA-IM projects was tested and found to be below standard, but these feeds had to be used until a replacement feed was produced and shipped to the project site. The time period that the substandard feeds were used was about 46 days, of a 102 day project cycle. This shows the importance of high quality feeds for good productivity and profit.

The cooperating farmer requested a follow-on demonstration at this site that would compare high quality ASA-IM feeds compared to commercially available feeds (both using the ASA-IM technology package) to show the utility of using high quality, least-cost, soy-based feeds to improve production and profitability.

ACKNOWLEGEMENTS

The ASA-IM Soy-in-Aquaculture Project gratefully acknowledges the local ASA-IM Philippines office and the ASA-IM SEA Regional Office for their help and support of this demonstration project.

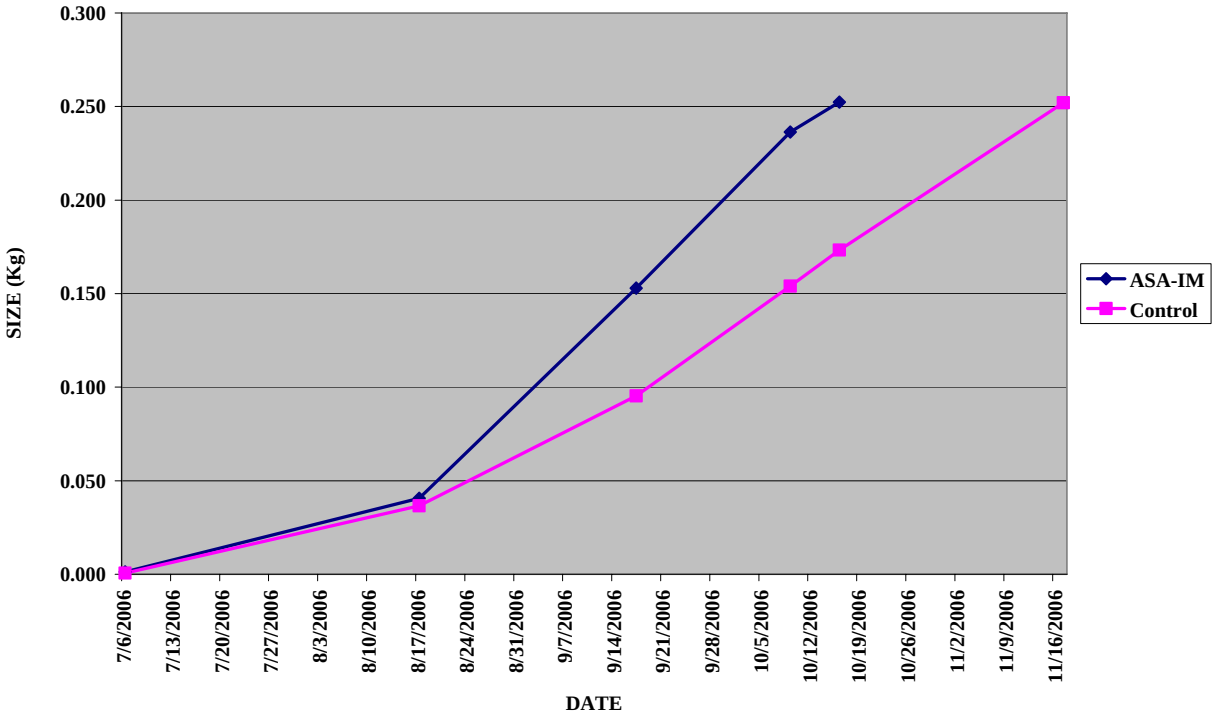

FIGURE 1. Growth curves for tilapia grown in earthen ponds using the ASA-IM feed-based pond production methodology with soy-based feeds compared to traditional culture techniques and feeds in a 132-day culture period in the 2006 ASA-IM SIA Tilapia Demonstration Project at ZH Aquafarm in San Jose City, Nueva Ecija, Philippines. Tilapia grew from an average of 0.0013 g to 252 g in 102 days using the ASA-IM method and from 0.0007 g to 252 g in 132 days using the traditional method.

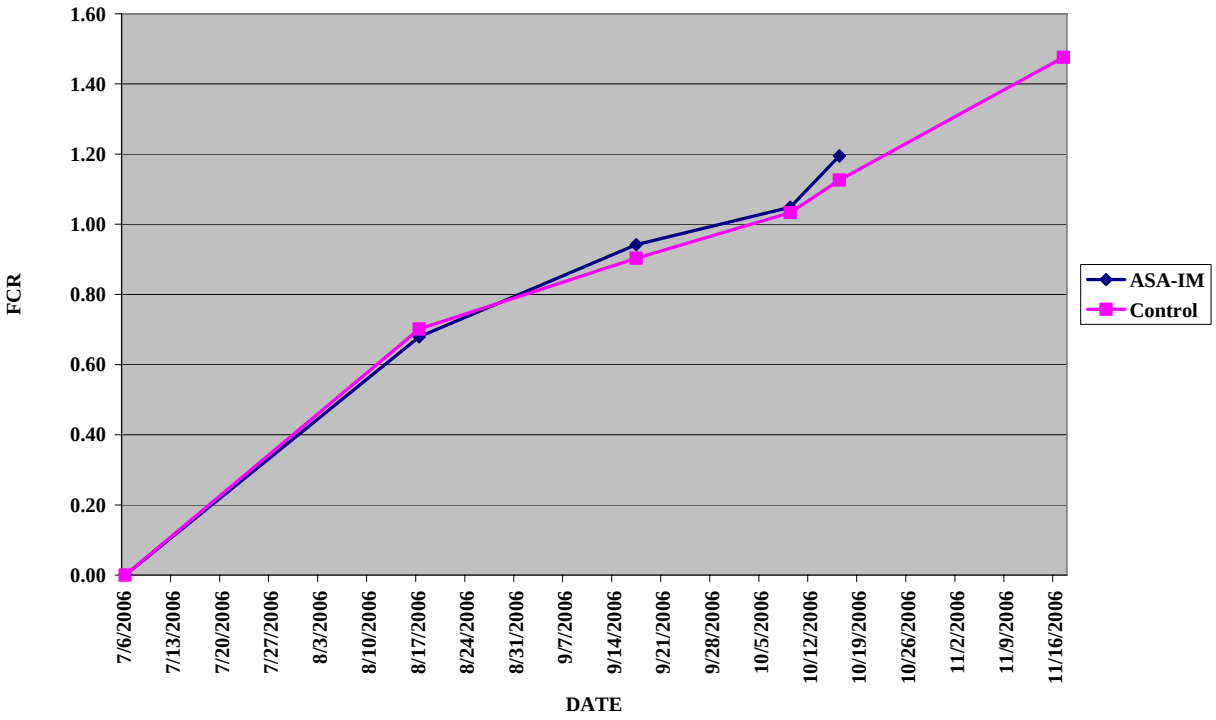

FIGURE 2. FCR curves for tilapia grown in earthen ponds using the ASA-IM feed-based pond production methodology with soy-based feeds compared to traditional culture techniques and feeds in a 132-day culture period in the 2006 ASA-IM SIA Tilapia Demonstration Project at ZH Aquafarm in San Jose City, Nueva Ecija, Philippines. Average FCR using the ASA-IM technology and soy-based feeds was 1.19:1, compared to 1.48:1 with the traditional method and traditional, local feeds.

TABLE 1. Formula provided to Feedmill A for the ASA-IM 36/7, soymeal-based feed used in the 2006 ASA-IM SIA Tilapia Demonstration Project at ZH Aquafarm in San Jose City, Nueva Ecija, Philippines. The feed was fed in a 2-mm size.

36/7[1] Fingerling Feed*
2006 Philippine Tilapia Feeding Demonstrations

Ingredient	% Inclusion Rate
Soybean Meal - 48%	64.00
Wheat, HRW 13.6%	20.00
DDGS 27/10	8.00
Fish Oil	4.50
Calcium phosphate 21%	2.25
Vitamin Premix F-2	0.50
Mineral Premix F-1	0.25
DL-Methionine 99%	0.27
Mold Inhibitor	0.10
Choline Chloride 50%	0.09
Stay C - 35%	0.03
Antioxidant 125g/mt	0.01
Total	**100.00**

*For fingerling fish weighing between 3 grams and 50 grams

[1]The numerical component of the feed description refers to the percentage of protein and fat, respectively, in the ration, i.e. 36/7 indicates 36% crude protein and 7% crude fat.

TABLE 2. Formula provided to Feedmill A for the ASA-IM 32/6, soymeal-based feed used in the 2006 ASA-IM SIA Tilapia Demonstration Project at ZH Aquafarm in San Jose City, Nueva Ecija, Philippines. The feed was fed in 3-mm pellet sizes.

32/6[1] Growout Aquafeed*
2006 Philippine Tilapia Feeding Demonstrations

Ingredient	% Inclusion Rate
Soybean Meal - 48% IFN	53.50
Wheat, HRW 13.6%	25.75
DDGS 27/10	14.00
Fish Oil	3.00
Calcium phosphate 21%	2.63
Vitamin Premix F-2	0.50
Mineral Premix F-1	0.25
Choline Chloride 50%	0.11
Mold Inhibitor	0.10
DL-Methionine 99%	0.12
Stay C - 35%	0.03
Antioxidant 125g/mt	0.01
Total	**100.00**

*For fish ≥50 g

[1]The numerical component of the feed description refers to the percentage of protein and fat, respectively, in the ration, i.e. 32/6 indicates 32% crude protein and 6% crude fat.

TABLE 3. Formula provided to Feedmill B for the ASA-IM 32/6, soymeal-based feed used in the 2006 ASA-IM SIA Tilapia Demonstration Project at ZH Aquafarm in San Jose City, Nueva Ecija, Philippines. The feed was fed in 3-mm and 4-mm pellet sizes.

32/6[1] Growout Aquafeed*
2006 Philippine Tilapia Feeding Demonstrations

Ingredient	% Inclusion Rate
Soybean Meal - 45.5%	57.00
Wheat, Feed Flour - 12%	30.40
Fish, Menhadn 62/9.5	5.00
Fish Oil, Unspec.	2.56
Calcium phos. mono - 21%	2.05
Soy Oil	2.04
Vit. PMX-F1	0.50
Min. PMX F-2	0.25
Choline Chloride 50%	0.10
Soy Lecithin	0.05
Stay C - 35%	0.03
Ethoxyquin - 100%	0.02
Total	**100.00**

*For fish ≥50 g

[1]The numerical component of the feed description refers to the percentage of protein and fat, respectively, in the ration, i.e. 32/6 indicates 32% crude protein and 6% crude fat.

TABLE 4. Vitamin and mineral premix formulas produced by Progressive Laboratories and provided to Feedmill A and Feedmill B for the ASA-IM 36/7 and 32/6, soymeal-based feed used in the 2006 ASA-IM SIA Tilapia Demonstration Project at ZH Aquafarm in San Jose City, Nueva Ecija, Philippines.

Vitamin Premix PMX-F2[1]

Nutrient	Unit	As fed
Vitamin A	IU/kg	1200000
Vitamin D3	IU/kg	200000
Vitamin E	IU/kg	20000
Biotin	mg/kg	40
Folic acid	mg/kg	1800
Niacin	mg/kg	40000
Pantothenate	mg/kg	20000
Pyridoxine (B6)	mg/kg	5000
Riboflavin (B2)	mg/kg	8000
Thiamin (B1)	mg/kg	8000
Vitamin B12	mcg/kg	2000
Ethoxyquin	mg/kg	500

Mineral Premix PMX-F1[1]

Nutrient	Unit	As fed
Iron	ppm	40000
Manganese	ppm	10000
Copper	ppm	4000
Zinc	ppm	40000
Iodine	ppm	1800
Cobalt	ppm	20
Selenium	ppm	200

[1]Premix ingredient quantities are per kg of premix.

TABLE 5. Results of the 2006 ASA-IM SIA Tilapia Demonstration Project at ZH Aquafarm in San Jose City, Nueva Ecija, Philippines, that demonstrated growth performance of tilapia using the ASA-IM feed-based production methodology with soy-based feeds compared to traditional methods and local feeds.

Pond No.	Pond type	Pond size	Stocking size (g) of tilapia	Stocking rate (fish/ha)	No. days cultured	Harvest weight (g)	Gross Production (kg/ha)	Survival (%)	FCR
A1	Traditional	0.1	0.7	52,500	134	248	10,050	77	1.58
A2	Traditional	0.1	0.7	52,500	132	252	10,400	79	1.48
A3	Traditional	0.1	0.7	52,500	130	256	11,000	82	1.37
Mean		**0.1**	**0.7**	**52,500**	**132**	**252**	**10,483**	**79**	**1.48**
A4	ASA-IM	0.1	1.3	25,200	103	242	5,570	91	1.29
A5	ASA-IM	0.1	1.3	25,200	102	266	6,310	94	1.14
A6	ASA-IM	0.1	1.3	25,200	102	249	6,265	100	1.15
Mean		**0.1**	**1.3**	**25,200**	**102**	**252**	**6,048**	**95**	**1.19**

TABLE 6. Economic results for the ASA-IM demonstration ponds of the 2006 ASA-IM SIA Tilapia Demonstration Project at ZH Aquafarm in San Jose City, Nueva Ecija, Philippines, that demonstrated growth performance of tilapia using the ASA-IM feed-based production methodology with soy-based feeds compared to the traditional methodology.

Item	Basis	Pond A4	Pond A5	Pond A6	Totals
Pond size	m2	1,000.00	1,000.00	1,000.00	3,000.00
Total stocked	pcs	2,520	2,520	2,520	7,560
Stocking rate	per m2	2.52	2.52	2.52	2.52
Surviving fish	pcs	2,302	2,372	2,516	2,397
Survival	%	91%	94%	100%	95%
FCR	(ratio)	1.29	1.14	1.14	1.19
Feed cost S-35	Php/kg	23.20	23.20	23.20	23.20
Feed cost 36/7	Php/kg	25.21	25.21	25.21	25.21
Feed cost 32/6	Php/kg	23.81	23.81	23.81	23.81
Feed S-35	kg	5.16	5.16	5.16	5.16
Feed 36/7	kg	67.75	67.75	67.75	203.25
Feed 32/6	kg	643.50	643.50	643.50	1,930.50
Total Feed	kg	716.41	716.41	716.41	2,149.23
Pumping cost	Php	1,288.00	1,288.00	1,288.00	3,864.00
Harvest size	kg	0.242	0.266	0.249	0.252
Sales price	Php/kg	52.00	52.00	52.00	52.00
Fry price	Php/pc	0.48	0.48	0.48	0.48
Total fry	pcs	2,520	2,520	2,520	7,560.00
Time of culture	months	3.40	3.40	3.40	3.40
Cost of labor	Php/month	583.33	583.33	583.33	1,749.99
Final biomass	kg	557.000	631.000	626.500	1,814.50
Paid sales	kg	529.00	599.00	595.50	1,723.50
Gross profit	Php	27,508.00	31,148.00	30,966.00	89,622.00
Feed cost	Php	17,149.42	17,149.42	17,149.42	51,448.27
Pumping cost	Php	1,288.00	1,288.00	1,288.00	3,864.00
Hired Labor for Harvest	Php	1,250.00	1,250.00	1,250.00	3,750.00
Diesel and tractor	Php	370.67	370.67	370.67	1,112.01
Labor cost	Php	1,983.32	1,983.32	1,983.32	5,949.97
Fry cost	Php	1,197.00	1,197.00	1,197.00	3,591.00
All Costs	Php	23,238.42	23,238.42	23,238.42	69,715.25
Net profit	Php	4,269.58	7,909.58	7,727.58	19,906.75
ROI		18%	34%	33%	29%

TABLE 7. Economic results for the traditional ponds of the 2006 ASA-IM SIA Tilapia Demonstration Project at ZH Aquafarm in San Jose City, Nueva Ecija, Philippines, that demonstrated growth performance of tilapia using the ASA-IM feed-based production methodology with soy-based feeds compared to the traditional methodology.

Item	Basis	Pond A1	Pond A2	Pond A3	Totals
Pond size	**m2**	1,000.00	1,000.00	1,000.00	**3,000.00**
Total stocked	**pcs**	5250	5250	5250	**15750**
Stocking rate	**per m2**	5.25	5.25	5.25	**5.25**
Surviving fish	**pcs**	4,052	4,127	4,297	**12476**
Survival	**%**	77%	79%	82%	**79%**
FCR	**(ratio)**	1.57	1.48	1.36	**1.47**
Feed price starter	**Php/kg**	23.20	23.20	23.20	**23.20**
Feed price juvenile	**Php/kg**	22.20	22.20	22.20	**22.20**
Feed price adult	**Php/kg**	22.20	22.20	22.20	**22.20**
Feed starter	**kg**	5.60	5.60	5.60	**16.80**
Feed juvenile	**kg**	137.60	137.60	137.60	**412.80**
Feed adult	**kg**	1,436.00	1,396.00	1,356.00	**4188.00**
Total Feed	**kg**	1,579.20	1,539.20	1,499.20	**4,617.60**
Pumping cost	**Php**	4,470.00	4,470.00	4,470.00	**4,470.00**
Harvest size	**kg**	0.248	0.252	0.256	**0.252**
Sales price	**Php/kg**	53.00	53.00	53.00	**53.00**
Fry price	**Php/pc**	0.48	0.48	0.48	**0.48**
Total fry	**pcs**	5,250	5,250	5,250	**5,250**
Time of culture	**months**	4.40	4.33	4.27	**4.33**
Cost of labor	**total**	4,385.80	4,385.80	4,385.80	**13,157.40**
Cost of Chicken Manure	**total**	60.00	60.00	60.00	**180.00**
Final biomass	**kg**	1,005.00	1,040.00	1,100.00	**3,145.00**
Paid sales	**kg**	955.00	988.00	1,045.00	**2,988.00**
Gross profit	**Php**	50,615.00	52,364.00	55,385.00	**158,364.00**
Feed cost	**Php**	35,063.84	34,175.84	33,287.84	**102,527.52**
Pumping cost	**Php**	4,470.00	4,470.00	4,470.00	**13,410.00**
Manure	**Php**	60.00	60.00	60.00	**180.00**
Labor cost	**Php**	4,385.80	4,385.80	4,385.80	**13,157.40**
Fry cost	**Php**	2,493.75	2,493.75	2,493.75	**7,481.25**
All costs	**Php**	46,473.39	45,585.39	44,697.39	**136,756.17**
Net profit	**Php**	**4,141.61**	**6,778.61**	**10,687.61**	**21,607.83**
ROI		9%	15%	24%	**16%**