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Economic analysis of an integrated milkfish broodstock and hatchery operation

SEAFDEC/AQD Associate Scientist Renato Agbayani and colleagues determined the economic viability of an integrated milkfish broodstock and hatchery. They also noted the critical technical areas in its operation and recommended measures that would improve the profitability to levels attractive to private hatchery operators.

The economic analysis was prepared based on technical data obtained from experimental results of SEAFDEC/AQD:

- Number of mature female milkfish, 50 fish/cage
- Fecundity/kg per spawning of fish, 300 000 eggs
- Number of spawning/fish per year, three
- Fertilization rate, 85%
- Egg collection rate, 95%
- Hatching rate, 59%
- Survival rate in the hatchery, 30%
- Stocking density in the hatchery, 30 eggs/liter.

A 15-year development plan was prepared. The plan had the first 4 years of operation devoted to broodstock development, and one 10-m dia. floating cage was to be constructed each year. Every cage was to be stocked with 100 milkfish, each fish weighing about 250 g. In anticipation of the maturation and spawning of milkfish in the fifth year, the first hatchery facility was to be constructed during the fourth year and every year thereafter up to the fifteenth year to accommodate all the eggs produced in the floating cages. Table 1 shows the projected milkfish egg production for 15 years based on technical data. Spawning season is from May to October, with September as the peak period.

Projected cash flows for four cages of milkfish broodstock were computed for the entire 15 years. Table 2 shows the projected cash flows for the first 4 years for Cage 1. The initial infrastructure, e.g., guard house, caretaker's house and pump boat, are common costs for the four cages but are reflected in the cash flow of Cage 1.

The projected cash flow of the hatchery operation was computed from Year 4 to Year 15. The capital outlay for the initial hatchery facilities in Year 4 totalled ₱8,670,254 and the operating expenses in Year 5 reached ₱1 583 652. (Operating a milkfish hatchery is discussed in *Aqua Farm News*, Vol. VIII, No. 3, May-June 1990.)

The 15-year cash flow for an integrated milkfish broodstock and hatchery operation is shown in Table 3. Positive cash flow started in Year 8, after an investment of about ₱45 million.

The economic analysis using discounted cash flow at a discount rate of 8%, showed that net present value (NPV) was negative from Year 5 to Year 15 and internal rate of return (IRR) was likewise negative from Year 5 to Year 14. In Year 15, IRR registered a positive 4%. Despite the negative economic indicators, the IRR and NPV showed upward trends starting in the sixth and seventh years, respectively.

The seemingly poor economic indicators were due to:

- High investment in the hatchery facilities, especially in concrete tanks and life-support equipment; the high ratio of algal and rotifer tanks to larval rearing tanks (6:1) resulted in high expenditures on tanks; and
- Low utilization of hatchery facilities because of the short seasonal spawning which is only 6 months (May to October); the estimated capacity utilization is only about 30% over a period of 1 year.

Government subsidy

The ₱45 million initial investment for an integrated broodstock-hatchery system which starts paying off after six years is no doubt unattractive to the private sector. The NBBP (see preceding sections) is a public investment in the milkfish industry with such a capitalization.

When the government invests in a project which benefits a particular sector of society -- in this case milkfish growers -- the unrecovered

Table 1. Projected milkfish egg production

	Year 5	Year 6	Year 7	Year 8
Quantity of spawners	50	100	150	200
Fecundity/kg of fish	300 000	300 000	300 000	300 000
Average weight of fish (kg)	3.00	3.13	3.25	3.38
Fertilization rate	0.85	0.85	0.85	0.85
Number of spawning/fish per year	3	3	3	3
Quantity of fertilized eggs	114 750 000	239 062 000	372 937 500	516 375 000
Collection rate	0.95	0.95	0.95	0.95
Quantity of collected eggs	109 012 000	227 109 375	354 290 625	490 556 250
Hatching rate	0.59	0.59	0.59	0.59
Quantity of hatched eggs	64 317 375	133 994 531	209 031 469	289 428 188

	Year 9	Year 10	Year 11	Year 12
Quantity of spawners	200	200	200	200
Fecundity/kg of fish	300 000	300 000	300 000	300 000
Average weight of fish (kg)	3.63	3.88	4.13	4.38
Fertilization rate	0.85	0.85	0.85	3
Quantity of fertilized eggs	554 625 000	592 875 000	631 125 000	669 375 000
Collection rate	0.95	0.95	0.95	0.95
Quantity of collected eggs	526 893 750	563 231 250	599 568 750	635 906 250
Hatching rate	0.59	0.59	0.59	0.59
Quantity of hatched eggs	310 867 313	332 306 438	353 745 563	375 184 688

	Year 13	Year 14	Year 15
Quantity of spawners	200	200	200
Fecundity/kg of fish	300 000	300 000	300 000
Average weight of fish (kg)	4.63	4.88	5.13
Fertilization rate	0.85	0.85	085
Number of spawning/fish per year	3	3	3
Quantity of fertilized eggs	707 625 000	745 875 000	784 125 000
Collection rate	0.95	0.95	0.95
Quantity of collected eggs	672 243 750	708 581 250	744 918 750
Hatching rate	0.59	0.59	0.59
Quantity of hatching eggs	396 623 813	418 062 938	439 502 063

cost is subsidized by other sectors of society. The government, however, can recover the cost of a project by improving the project's economic efficiency through sustained research and development efforts. An alternative action of the government in the case of the NBBP is to concentrate on egg production while maintaining pilot-scale hatcheries in selected sites for research, training and extension purposes, as is presently done. The fertilized eggs can be sold to private hatchery operators who are presently in shrimp (*Penaeus monodon*) fry production but can switch to milkfish as an alternative crop.

The cost efficiency aspect of the milkfish broodstock operation merits further discussion. During the first year, the cost of eggs ranged from ₱4,800 to ₱13,100/million, a very high figure compared to the market price of shrimp nauplii which cost between ₱2,500 to ₱3,500/million. The cost of milkfish eggs decreased during the fourth year of hatchery operation when incremental revenues became greater than the incremental costs. Costs level off from ₱1,900 to ₱2,400/million eggs. The cost of feeds was estimated to be about 46% of total cost over a 15-year period. The cost of rearing a 5-year old

Table 2. Cash flow projection of one unit floating cage milkfish broodstock for 4 years

Items	Year 1	Year 2	Year 3	Year 4
Capital outlay				
Infrastructure				
Floating cage	12 000			
Guard house[1]	5 000			
Caretaker's house and bodega[2]	50 000			
Egg collector				7 000
Equipment				
Pump boat	30 000			
Weighing scales	3 000		3 300	
Thermometers	300		330	
Refractometer	5 000			
Dissecting set	1 000			
Skin diving gear	2 000		2 000	
Subtotal	108 300		5 830	7 000
Operating expenses				
Fish stock	1 000	1 050	1 103	1 158
Feeds	2 549	5 578	10 545	76 687
Chemicals	5 000		5 500	
Nets	15 000		16 500	
Twines, ropes, etc	15 000		16 500	
Gas, oil and grease	15 000	15 750	16 538	17 364
Salaries				
Technician	24 000	24 000	26 400	26 400
Aide	12 000	25 200	39 690	13 200
Repairs and maintenance	5 415	5 415	5 707	6 057
Miscellaneous	5 000	5 000	5 000	5 000
Subtotal	99 964	80 943	142 379	144 707
Total cost per year/cage	208 264	80 943	148 209	151 707

[1]Off-shore; [2]on-shore.

milkfish broodstock weighing about 3 kg is about ₱8,000, using 1988 prices as the base.

The shrimp hatchery operators in the Philippines are encouraged to go into milkfish fry production as an alternative to shrimp fry in view of the latter's decreasing price. The government-operated milkfish broodstock stations can initially sell the milkfish eggs at a subsidized price to private hatcheries to encourage the private operators.

The investment requirement needed to put up a small-scale milkfish hatchery is estimated at ₱316,724. The working capital required is ₱36,624 which is good for two runs. The rest is spent on capital structures and equipment. The annual depreciation is ₱30 360, computed by a straight-line method based on the estimated economic lives of the various items of equipment and structures.

The cost-and-return analysis of a private milkfish hatchery can be based on the following production efficiencies:

- Hatching rate, 59%
- Survival rate, 30%
- Stocking density, 30 egg/l

The cost of eggs was placed at ₱2,100/million which was the leveling-off cost. The cost of inputs and milkfish fry was based on the prevailing market prices in 1989 in the province of Iloilo. The ROI is 63% and the payback period is 1.47 years. Feeds (*Artemia*) cost 9% and fertilized milkfish eggs cost 23% of total operating costs. There was a dramatic increase in the price of milkfish fry from ₱0.14 in 1988 to as high

Table 3. Cash flow projection for an integrated milkfish broodstock and hatchery project

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Cash outflow[1]						
Broodstock	208 264	172 389	282 011	378 377	457 804	718 661
Hatchery	0	0	0	8 670 254	10 116 186	12 853 459
Total	208 264	172 389	282 011	9 048 631	10 573 989	13 572 120
Revenue	0	0	0	0	2 199 654	4 811 744
Net cash flow	(208 264)	(172 389)	(282 011)	(9 048 631)	(8 374 335)	(8 760 376)

	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
Cash outflow[1]						
Broodstock	808 246	832 313	977 823	990 823	1 233 038	1 207 765
Hatchery	15 872 259	9 494 494	9 788 120	10 316 319	11 794 723	11 526 545
Total	16 680 506	10 326 807	10 765 943	11 306 593	13 027 761	12 734 310
Revenue	7 881 636	11 458 686	12 922 852	14 504 787	16 212 609	18 054 951
Net cash flow	(8 798 870)	(1 131 897)	(2 156 909)	(3 198 194)	(3 184 848)	(5 320 640)

	Year 13	Year 14	Year 15
Cash outflow[1]			
Broodstock	1 333 964	1 429 413	1 571 518
Hatchery	12 669 615	13 881 656	1 982 633
Total	14 003 579	15 311 169	3 554 151
Revenue	20 040 995	22 180 507	24 483 867
Net cash flow	6 037 416	6 869 338	20 929 716

[1]Capital outlay and operating expenses.

as ₱0.70 in 1989. A conservative price of P0.45/fry was used in the cost-and-return analysis. There was not enough fry to supply the needs of brackishwater ponds estimated to be about 80% of a total of 207,000 hectares. Similarly, the ex-pond prices of table-size milkfish also rose dramatically by a minimum of 50% in 1989 as compared to the 1987 prices.

Comparatively, the estimated ROI of a small-scale shrimp hatchery in 1986 was 90% but had deteriorated to a low 15-20% in 1989. About 50% of the small-scale hatcheries located in southern Iloilo experienced losses and stopped operation due to cutthroat competition.

If the survival rate improves from 30% to 40%, the ROI increases from 64% to 94%. At this level of profitability, the present shrimp hatchery operators will be encouraged to consider milkfish as an alternative crop. The break-even survival rate is 9%. The break-even price is P0.13/fry.

Recommendations

NBBP should concentrate on egg production and sell the milkfish eggs at a subsidized price to attract hatchery operators, and tap potential export markets for fry. (The government decided to privatize the NBBP stations. - *Ed.*)

SEAFDEC/AQD, on the other hand, should pursue research on: induced spawning during off-season to take advantage of higher prices and optimize hatchery utilization; improvement of production efficiency rates (egg and fry survival and egg hatching rate, higher stocking densities); and reduction of the number of tanks to reduce investment in life-support facilities.

Source: R Agbayani, N Lopez, R Tumaliuan, and G Berjamin. 1991. *Economic analysis of an integrated milkfish broodstock and hatchery operation as a public enterprise.* **Aquaculture** 99: 235-248.