

WEDNESDAY - NOVEMBER 11, 1970

*Chairman - L. Shafer, St. George Packing Company,
Fort Myers, Florida*

Some Economic Aspects of Pink Shrimp Farming in Florida¹

LEE G. ANDERSON
*Department of Economics
University of Miami*

DURBIN C. TABB
*Rosenstiel School of Marine and Atmospheric Science²
University of Miami
Miami, Florida 33149*

INTRODUCTION

As with most other business ventures, shrimp culture can be operated at different levels of output and with different qualities of final output. A firm or individual interested in investing in shrimp culture would want to know whether he should grow shrimp for bait or for food and what scale of plant he should operate. To get some insights as to the answer to these questions, six types of shrimp culture operations were studied. Since land makes up such a large portion of the initial investment in operations such as these and since shorefront land has such a wide range of prices, each of these six types was studied as to the effect of changes in land prices. The six types studied were: a 100-acre, a 500-acre, and a 1,000-acre operation used to produce shrimp for food (i.e., 36 count which is equivalent to 36 shrimp tails per pound) and also a 100-acre, a 500-acre, and a 1,000-acre operation used to produce bait shrimp. The acreage given here refers to the ponds. About 20% more land will be required in each case for levees and buildings.

The internal rate of return was found for each of the six types at various land prices. The internal rate of return is the interest rate that discounts the annual net cash flow (in this case for the first 15 years of the investment) to an amount in the base period that is equal to the investment. Put another way, it is the rate of compound interest at which the present value of the project investment would have to be invested at the current time to yield the earnings of the project investment over its life.

¹ This study was sponsored by a Sea Grant Institutional Program of the National Science Foundation, Contract Number GH-100.

² Contribution No. 1334 from the Rosenstiel School of Marine and Atmospheric Science, University of Miami.

DATA

Because there are no operations in existence like the ones proposed here, the cost data, especially labor costs, are estimates. It is very difficult to predict exactly the number of man hours that will be needed to run the different types of operations until they have been in use for a period of time. Nevertheless, it is felt that the cost estimates used are fair and do not bias the study in either direction.

The capital investment, which is the same for both a food or a bait shrimp outfit, except for the fact that the latter will require live holding tanks, can be broken into three parts: land, pond construction and hatchery construction. As mentioned earlier various prices for land were used; they were: \$15,000; \$12,500; \$4,100; \$3,500; \$3,000; \$2,500; \$2,000; \$1,500; \$1,000; \$500 and \$250. The first four are actual estimates for suitable acreage in Flagler, Volusia, Brevard and Levy counties respectively.³

Pond construction cost was estimated to be \$850 per each 1 acre pond. After about 10 years 10% of this amount will be required for maintenance purposes. Also, there would be an expenditure of \$0.50 per year per acre for pump expenditure, etc. It also was estimated that the cost of a hatchery capable of handling a 1,000-acre operation was \$82,500. Such a hatchery would normally require \$1,000 a year for such things as utilities and another \$5,000 every 3 years for repairs, painting and replacement of equipment. This figure was also used as the hatchery cost for both the 500- and 100-acre projects because of the indivisibility of such an item. The effect of this will be to underestimate the profitability of the smaller projects, but because of the relative size of this expense in comparison with total investment, it is doubtful that this underestimation would "make or break" a project.

Although capital costs are the same regardless of what type of shrimp is raised, the revenues and operating costs (except for the labor and maintenance cost for the hatchery and the maintenance costs of the ponds) are different.

The revenue for food shrimp was estimated to be \$720 an acre based on the current ex-vessel price of \$0.72 a lb. for one crop of 1,000 lb. of 36 count shrimp per acre.

The revenue for a bait shrimp operation was estimated to be \$1,800 an acre based on a price of \$15 a thousand (a quite conservative estimate) for four crops of 30,000.

As far as costs are concerned, a complete description of the labor costs can be found in the tables. The food cost for a food shrimp operation was based on 20 lb. of feed (at \$0.0525 per lb.) per acre for 180 days or \$189 an acre. For each crop in a bait shrimp operation, food costs were estimated at 25 lb. per day per acre for 90 days or \$118 an acre. These low food costs are based on a new concept of feeding which will be discussed upon completion of present experiments.

The egg acquisition cost listed in the tables is based on labor and boat charges for the average number of nights fishing necessary to capture enough females to support the acreage assumed. (For example, at the peak of the season it should take two nights to obtain sufficient females for a 1,000-acre operation while at

³ These estimates were given to the authors by the James S. Billings Investment Firm which was recently an agent for a large company interested in beach front property.

TABLE 1
Balance Sheet for 1,000 Acre Food Shrimp Farm

Yr.	Capital		Operating Costs			Total revenue	Net Cash flow	
	Ponds	Hatchery	Land	Labor for ponds management	Labor for hatchery & management			Food
1	\$850,000	\$82,500	Range from \$18,000,000 to \$300,000	\$337,500	\$147,500	\$189,000	\$3,510	Range from -\$18,932,500 to -\$1,232,500
2	500	1,000						40,990
3	500	1,000						40,990
4	500	6,000						35,990
5	500	1,000						40,990
6	500	1,000						40,990
7	500	6,000						35,990
8	500	1,000						40,990
9	500	1,000						40,990
10	85,500	6,000						49,010
11	500	1,000						40,990
12	500	1,000						40,990
13	500	6,000						35,990
14	500	1,000						40,990
15	500	1,000						40,990
16								Range from \$14,400,000 to \$240,000

TABLE 2
Balance Sheet for 500 Acre Food Shrimp Farm

Yr.	Capital		Operating Costs			Total revenue	Net Cash flow		
	Ponds	Hatchery	Land	Labor for ponds	Labor for hatchery & management			Food	Egg acquisition
1	\$425,000	\$82,500	Range from \$9,000,000 to \$150,000	\$245,100	\$123,000	\$94,500	\$2,730	\$360,000	Range from -\$9,507,500 to -\$657,500
2	250	1,000							-\$183,080
3	250	1,000							-\$183,080
4	250	6,000							-\$188,000
5	250	1,000							-\$183,090
6	250	1,000							-\$183,080
7	250	6,000							-\$188,080
8	250	1,000							-\$183,080
9	250	1,000							-\$183,080
10	42,750	6,000							-\$226,080
11	250	1,000							-\$183,080
12	250	1,000							-\$183,080
13	250	6,000							-\$188,080
14	250	1,000							-\$183,080
15	250	1,000							-\$183,080
16									Range from \$7,200,000 to \$120,000

TABLE 3
Balance Sheet for 100 Acre Food Shrimp Farm

Yr.	Capital			Operating Costs			Total revenue	Net Cash flow
	Ponds	Hatchery	Land	Labor for ponds	Labor for hatchery & management	Food		
1	\$85,000	\$82,500	Range from \$1,800,000 to \$30,000					Range from -\$1,967,500 to -\$297,500
2	50	1,000		\$200,700	\$106,000	\$18,900	\$2,340	\$72,000
3	50	1,000						72,000
4	50	6,000						72,000
5	50	1,000						72,000
6	50	1,000						72,000
7	50	6,000						72,000
8	50	1,000						72,000
9	50	1,000						72,000
10	8,550	6,000						72,000
11	50	1,000						72,000
12	50	1,000						72,000
13	50	6,000						72,000
14	50	1,000						72,000
15	50	1,000						72,000
16								72,000
								Range from \$1,440,000 to \$24,000

TABLE 4
Balance Sheet for 1,000 Acre Bait Shrimp Farm

Yr.	Capital			Operating Costs				Total revenue	Net Cash flow	
	Live holding tank	Ponds	Hatchery	Land	Labor for ponds management	Labor for hatchery & management	Food			Egg acquisition
1	\$60,000	\$850,000	\$82,500	Range from \$18,000,000 to \$300,000	\$507,000	\$147,500	\$472,000	\$14,040	\$1,800,000	Range from -\$18,992,500 to -\$1,292,500
2	500		1,000							1,114,260
3	500		1,000							1,114,260
4	500		6,000							1,109,260
5	500		1,000							1,114,260
6	500		1,000							1,114,260
7	500		6,000							1,109,260
8	500		1,000							1,114,260
9	500		1,000							1,114,260
10	85,500		6,000							1,024,260
11	500		1,000							1,114,260
12	500		1,000							1,114,260
13	500		6,000							1,109,260
14	500		1,000							1,114,260
15	500		1,000							1,114,260
16										Range from \$14,400,000 to \$240,000

TABLE 5
Balance Sheet for 500 Acre Bait Shrimp Farm

Yr.	Capital			Operating Costs				Total revenue	Net Cash flow	
	Live holding tank	Ponds	Hatchery	Land	Labor for ponds	Labor for hatchery & management	Food			Egg acquisition
1	\$30,000	\$425,000	\$82,500	Range from \$9,000,000 to \$150,000	\$359,700	\$123,000	\$236,000	\$10,920	\$900,000	Range from -\$9,537,500 to -\$687,500
2		250	1,000							\$169,230
3		250	1,000							\$169,230
4		250	6,000							\$164,230
5		250	1,000							\$169,230
6		250	1,000							\$169,230
7		250	6,000							\$164,230
8		250	1,000							\$169,230
9		250	1,000							\$169,230
10		42,250	6,000							\$121,230
11		250	1,000							\$169,230
12		250	1,000							\$169,230
13		250	6,000							\$169,230
14		250	1,000							\$164,230
15		250	1,000							\$169,230
16										Range from \$7,200,000 to \$120,000

TABLE 6
Balance Sheet for 100 Acre Bait Shrimp Farm

Yr.	Capital			Operating Costs			Egg acquisition	Total revenue	Net Cash flow
	Live holding tank	Ponds	Hatchery	Land	Labor for ponds management	Labor for hatchery & management			
1	\$6,000	\$85,000	\$82,500	Range from \$1,800,000 to \$30,000					Range from -\$1,973,500 to -\$303,500
2		50	1,000		\$270,900	\$106,000	\$47,200	\$9,360	-\$254,510
3		50	1,000						-\$259,510
4		50	6,000						-\$254,510
5		50	1,000						-\$254,510
6		50	1,000						-\$254,510
7		50	6,000						-\$259,510
8		50	1,000						-\$254,510
9		50	1,000						-\$254,510
10		8,550	6,000						-\$260,010
11		50	1,000						-\$254,510
12		50	1,000						-\$254,510
13		50	1,000						-\$259,510
14		50	6,000						-\$254,510
15		50	1,000						-\$254,510
16									Range from \$1,440,000 to \$24,000

other times it may take as many as five or six nights.) The egg acquisition costs for bait farms of comparable acreages are four times as large as those of comparable sized food shrimp farms.

The balance sheets in Tables 1 through 6 contain summaries of the above information for 1,000-, 500- and 100-acre food and bait shrimp farms respectively. All of the revenues and costs are kept in current prices. Since shrimp prices have been known to grow at a faster rate than normal prices (Cleary, 1969) it was felt that, if anything, such an assumption would bias the study in a downward direction.

The figure in the sixteenth year is the "scrap value" of land figured at 80% of its initial price. The 80% value was chosen because work will be necessary before the land can be used for something else. One might argue, and rightly so, that land of this type will probably increase in value. But since this is a study of shrimp culture and not of land speculation, this aspect was ignored. This consideration should be kept in mind by a firm when considering a certain piece of land for use, however.

The above costs are those of the private investor, but from society's point of view the social cost of such an operation should be considered. That is, how will the ecological balance be affected by altering large amounts of shorefront and marsh land, and what are the social and economic implications of this alteration?

RESULTS

Food shrimp is not profitable at any level of operation at any land price. The sum of the net cash flows in Table 1 is only \$468,860 which is smaller than the initial outlay even when the price of land is only \$250 an acre. The net cash flows for both the 500-acre and the 100-acre food shrimp farms are negative.

It may be argued that this gloomy picture is the result of the assumption of one crop of 36 count shrimp per year. This is partly true. Switching to three crops of 110 count (heads off) shrimp which is physically possible will not help, since revenues only increase a small amount but food costs increase by about one-half. (The price per pound of 110 count heads off shrimp is slightly more than one third of that of 36 count and three crops of the smaller shrimp would mean feeding for about 9 or 10 months rather than 6 or 7.) Our current information leads us to believe that two crops of 36 count shrimp are not possible, and even if it were possible it would only be economically significant in the 1,000-acre farm. Two crops would double revenues, but seasonal pond labor, food, and egg acquisition costs would also double. The net cash flows of the 100- and the 500-acre farms will still be negative, while the net cash flows of the 1,000-acre farm will increase by \$358,990. The latter would be profitable under these conditions, but much less so than the comparable sized bait shrimp farm. See Table 7 for a comparison of the relative profitability of the two types of farms.

Since labor costs make up the major portion of operating costs and because of their tentative nature in this study, it is logical to assume that if a one crop food shrimp farm is ever to be profitable, it will come about because labor costs are actually lower than estimated here. That is, a smaller labor force is necessary or lower wages are required, or a combination of the two.

The 100-acre bait shrimp farm has negative cash flows and hence would not be profitable. But the 500- and the 1,000-acre bait shrimp farms have sufficiently large positive cash flows to make them profitable operations. Just how profitable

they are for different prices of land is shown in Table 7. Internal rates of return of less than 5% were not listed since that is the interest commonly available at commercial banks.

TABLE 7
Internal Rate of Return in Percent for Various Prices of Land
of Bait Shrimp Farm

Price/Acre	Rate of Return	
	500 Acres	1000 Acres
\$15,000	> 5	> 5
12,000	> 5	> 5
4,100	> 5	17
3,500	> 5	19
3,000	5	23
2,500	6	27
2,000	7	33
1,500	9	39
1,000	13	51
500	19	69
250	27	93

* The figures in parenthesis are the returns in percent on 1000 acre food shrimp farms producing two crops a year, which is not physically possible at the present time.

CONCLUSIONS

Of the six types of operations studied, only two, the 1,000-acre and the 500-acre bait shrimp operations appeared to be profitable and they were profitable indeed at low land prices.

As one would expect from the cost data there are economies of scale. It would be interesting to expand the present work to see how far these increasing returns go. That is, how much bigger (or smaller, for that matter) than 1,000 acres should the optimum farm be.

It must be remembered that returns here are gross of any taxes, and so when comparing this project to other possible investments a comparison should be made on gross rates of return. The corporate income tax of 52% will not necessarily cut the returns in half, however, because most of the write-off of the capital will be in the early years which has the effect of shifting taxes to the later years where they will be paid with dollars that are more highly discounted.

EFFECTS OF SHRIMP FARMING ON THE PRICE OF SHRIMP

It is well known that as more units of a product are put on the market, the price of the product decreases. The relationship between this change in output and the change in price is called the elasticity of demand, which is the percentage change in output divided by the percentage change in price. The Bureau of Commercial Fisheries has estimated the ex-vessel price elasticity of food shrimp to be -0.3099 (Anon., 1970, p.22), which means that by increasing the output by 0.3099% the price would fall by 1%. In 1968 total consumption of food shrimp in the U.S. was 474 million pounds (Anon., 1970, p.24),

TABLE 8
Labor Cost for Hatchery and Management

Personnel	Unit Cost	1000 Acres		500 Acres		100 Acres	
		Number	Cost	Number	Cost	Number	Cost
Hatchery							
Technicians	\$ 7,500	3	\$22,500	2	\$15,000	2	\$15,000
Supervisors	\$18,000	1	\$18,000	1	\$18,000	1	\$18,000
Mechanics	\$11,000	2	\$22,000	2	\$22,000	2	\$22,000
Maintenance							
Men	\$ 7,500	1	\$ 7,500	1	\$ 7,500	1	\$ 7,500
Labor							
Sub-Total			\$70,000		\$62,500		\$62,500
Secretaries	\$ 6,500	1	\$ 6,500	1	\$ 6,500	1	\$ 6,500
	\$ 5,000	2	\$10,000	1	\$ 5,000		
Sr. Manager	\$25,000	1	\$25,000	1	\$25,000	1	\$25,000
Jr. Manager	\$12,000	3	\$36,000	2	\$24,000	1	\$12,000
Management							
Sub-Total			\$77,500		\$60,500		\$43,500
TOTAL COSTS			\$147,500		\$123,000		\$106,000

therefore, it would take an increase of about 1.4 million pounds to cause a decrease in price of 1%. Thus, since a 1,000-acre food shrimp farm produces 1 million lb., output will affect price. This puts food shrimp production in even a worse light, if many large farms are anticipated.

To the best of our knowledge, there is no estimate of the price elasticity of demand for bait shrimp, although one would expect that it would be higher than that of food shrimp, since there are fewer substitutes for the former. The total output of bait shrimp in 1968, in Florida was 96.4 million⁴ which means that one 1,000-acre farm would increase output by 120%.

This is a large amount indeed, but it is felt that since the wholesale price of shrimp runs as high as \$25.00 per thousand, and a figure of \$15.00 a thousand was used in this study, the results, shown here, are valid for *one* farm at least.

TABLE 9
Labor Cost for Ponds in Food Shrimp Operation

Personnel	Unit Cost	1000 Acres		500 Acres		100 Acres	
		Number	Cost	Number	Cost	Number	Cost
Permanent							
Skilled	\$ 7,500 yr.	20	\$150,000	15	\$112,500	15	\$112,500
Seasonal							
(6 mos.)	\$ 350/mo.	70	\$147,000	45	\$ 96,600	27	\$ 56,700
Seasonal							
Foreman	\$ 750/mo.	5	\$ 22,500	4	\$ 18,000	3	\$ 13,500
Supervisor	\$18,000/yr.	1	\$ 18,000	1	\$ 18,000	1	\$ 18,000
TOTAL COSTS			\$337,500		\$245,100		\$200,700

⁴Source: Lloyd Johnson, Marketing Specialist, Bureau of Commercial Fisheries, Miami, Florida

The effects of such a large increase in supply on the price and other conditions in the bait shrimp market should be investigated more closely.

TABLE 10
Labor Cost for Ponds in Bait Shrimp Operation

Personnel	1000 Acres		500 Acres		100 Acres		
	Unit Cost	Number	Cost	Number	Cost	Number	Cost
Permanent Skilled	\$ 7,500	20	\$150,000	15	\$112,500	15	\$112,500
Permanent Unskilled	\$ 4,200	70	\$294,000	46	\$193,200	27	\$113,400
Foreman	\$ 9,000	5	\$ 45,000	4	\$ 36,000	3	\$ 27,000
Supervisor	\$18,000/yr.	1	\$ 18,000	1	\$ 18,000	1	\$ 18,000
TOTAL COSTS			\$507,000		\$359,700		\$270,900

LITERATURE CITED

Anon.

1970. Basic economic indicators: shrimp. Division of Economic Research, Bureau of Commercial Fisheries, Working Paper No. 57, p.22 and p.24.

Cleary, D. P.

1969. Demand and price structure for shrimp. Division of Economic Research, Bureau of Commercial Fisheries, Working Paper No. 15, p.6.