A PRELIMINARY FINANCIAL ANALYSIS OF SEMI-INTENSIVE PENAEID SHRIMP FARMING IN SOUTH CAROLINA

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ABSTRACT

A preliminary financial analysis of highland marine shrimp farming in coastal South Carolina was prepared using a microcomputer financial model. This deterministic model was used to analyze the financial performance of a hypothetical 176-acre commercial shrimp farm consisting of two 12-pond units with each pond 7.3 acres (3.0 ha) in water surface. Using 1985 as the first year, the financial analysis included projections of initial capital investment, the payback period, net operating income, and the first 10-year after-tax internal rate of return (IRR) for one crop per year with no nursery system. The expected cultivation approach would include the direct stocking of postlarval Pacific white shrimp, *Penaeus vannamei*, at 50,000/acre (123,5000/ha), water exchange rates averaging 5-10%/day, limited paddlewheel aeration and supplemental feeding with a dry commercial ration (see Stokes, *et al*., 1986). Major base scenario assumptions include land leased at $70/acre ($173/ha), an annual inflation rate of 3%, final harvested size of 18g (36-40/1b headless), a heads-off shrimp market price of $4.00/1b ($8.82/kg), and the initial seed cost of $18/1,000.

Using the base scenario, which includes a 75% annual survival rate to harvest and yield of 935 lbs/acre (1,048 kg/ha) of headless shrimp harvested, the IRR would be 14%. The discounted payback period at 10% would be nearly eight years for the initial investment in equipment and construction. If land is not leased but purchased at an average cost of $2,600/acre ($6,422/ha), the IRR declines to two percent.

When land is leased, the sensitivity analysis indicates that the 10-year projected IRR is more responsive to changes in shrimp (output) prices and annual survival rates than input prices for postlarvae, bulk feed and leasing. In the 65% to 75% survival rate range, the projected IRR averages a 0.8 percentage point change for every one percent change in the survival rate. A one percent change in the shrimp (output) price resulted in a 0.9 percentage point change in the projected IRR. In contrast, the projected IRR changed less than 0.2 percentage points for every one percent change in postlarvae, feed and leasing input prices.

Projected initial investment costs per area, excluding land costs and operating capital, would be slightly lower than those estimated for a 148-acre Texas shrimp farm. Due to economies of scale, the projected IRR for a semi-intensive shrimp farm in South Carolina would be expected to increase with the size of the farm.

Based upon the sensitivity analysis, opportunities to improve shrimp farming profitability will depend upon improved yields, increasing the final harvest size, and/or securing higher shrimp prices. Intensive shrimp culturing techniques indicate that higher yields result in increased gross revenues per area. The grow-out of two crops/season with headstarting nursery systems and polyculture with molluscan species (e.g. *Crassostrea virginica*) may also be commercially feasible techniques for improving the profitability of a shrimp farming enterprise. The commercial feasibility of these techniques and others needs to be investigated.

INTRODUCTION

South Carolina currently has over 69,000 acres of impounded wetlands, representing 14-16% of the total wetlands in the state. Although most of these are managed for waterfowl, up to 20% of the existing impoundments may have some potential for marine shrimp culture (Sandifer and Bauer, 1985). However, current environmental regulations and policies place significant restrictions on alteration (e.g., subdividing into small ponds) of these impoundments for high density (i.e. greater than 20,000 postlarvae/ha) stocking with hatchery-reared postlarvae (Whetstone, n.d.). Moreover, existing environmental regulations make the construction of new wetland impoundments for shrimp culturing very unlikely (Sandifer and Bauer, 1985), and it is unlikely that construction of new impoundments for shrimp farming would be economically practical.

Besides the development of commercial shrimp cultivation with existing impoundments, current research at the Waddell Mariculture Center (WMC) near Bluffton, South Carolina, indicates that yields of 2,210 lbs/acres (2,480 kg/ha) (whole animals) can be obtained with semi-intensive stocking densities in highland ponds (Stokes, et al., 1986). (In this report, any initial postlarvae (PL) stocking density in a grow-out pond between 20,000 PL/acre and 100,000 PL/acre will be considered "semi-intensive"). In addition to the shrimp culturing technology being developed at the WMC, other factors may be conducive to the development of highland shrimp farming in coastal South Carolina, including the availability of undeveloped or agricultural land near brackish water sources (e.g. creeks and waterways), a regulatory environment that is relatively conducive to aquaculture development, and a shrimp market distribution infrastructure (e.g. freezers, packing houses, etc.) associated with South Carolina's shrimp trawler fishery.

The purpose of this report was to prepare a preliminary financial analysis of semi-intensive shrimp culture in coastal South Carolina in anticipation of basic information needs by the private sector. Since the major users of this report are expected to be aquaculture entrepreneurs and private investors, the analysis emphasizes the measurement of return on investment (i.e., the internal rate of return). Moreover, information from financial sensitivity analyses can be useful in identifying controllable costs which might be reduced via research. The results of this analysis are compared to other studies, but no attempt has been made to evaluate the desirability of semi-intensive shrimp farming in South Carolina. The desirability of investing time, money and other resources in any commercial enterprise depends upon many factors (e.g., investment alternatives, life-style preferences, etc.). In addition, the hypothetical shrimp farm used in this report may not constitute the optimal design, and the specifications provided are not intended to be utilized as an actual design model.

ASSUMPTIONS AND METHODS

Hypothetical Facility

The shrimp farm analyzed consists of two, 12-pond units with each pond averaging 2.97 ha (7.35 acres) of surface water (Fig. 1). Each pond would have a dimension of approximately 244 m (800 ft.) by 122 m (400 ft.) with an average water depth of 3.8 ft. This hypothetical design includes levees with the following specifications: the perimeter diversion canal has 1.5:1 side slopes on the back side (dry side) and 2.5:1 side slopes on the front side (wet side) with a six foot top (crown). The interior dikes have 2.5:1 side slopes and both sides have 12 foot tops to accommodate travel. The pond bottom has a gentle slope of 0.2 ft./100 ft. to facilitate drainage toward the harvest basin.

This hypothetical water system would include two 60 horsepower axial flow pump units capable of delivering 10,000 gpm based on a total dynamic head of 17 ft. The water would be derived from an estuarine creek and pumped into a settling basin and then gravity-fed into distribution canals. Flashboard risers would be used in both the intake pipe and harvest basins in each pond. The lateral drainage canals are designed for a 10% water exchange per 18 hours with drainage pipes capable of draining each pond within 24 hours.

Production Techniques and Yields

Production techniques are based upon those reported by Stokes, et al., (1986) at the Waddell Mariculture Center near Bluffton, South Carolina, using hatchery-reared postlarvae (PL) of the Pacific Ocean white shrimp species, *Penaeus vannamei*. Survival rates exceeding 90% in 0.1, 0.25 and 0.5 ha experimental ponds and harvest yields averaging 2,210 lb/acre (2,477 kg/ha) of whole animals were reported (Stokes, et al., 1986) from an initial stocking density of 120,000 PL/ha (48,583 PL/acre). Pond management practices included flushing and paddlewheel aeration as needed. Supplemental feeding of a dry commercial ration was done with a feed conversion ratio starting at 2.5:1 and declining to

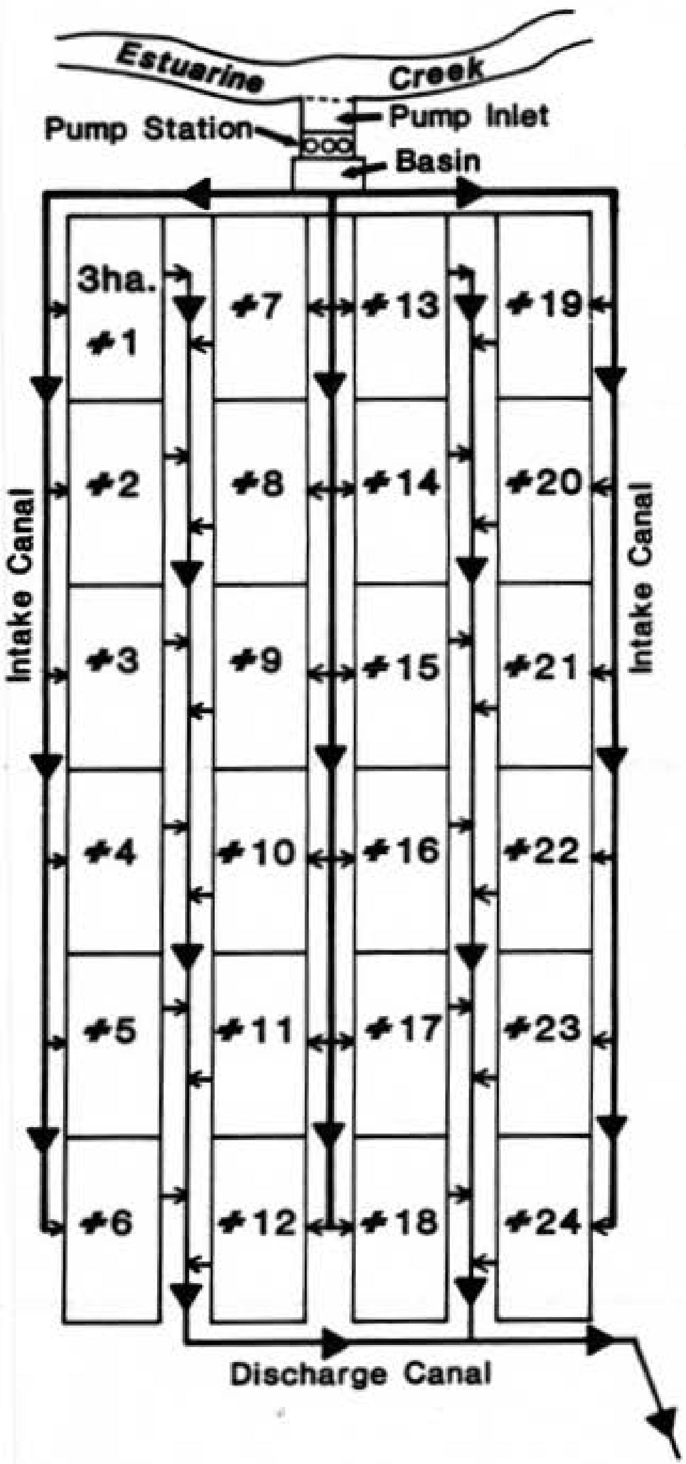

Fig. 1. Schematic layout of a 176-acre (72-ha) hypothetical marine shrimp farm in South Carolina.

2.1:1. Hirono (1984) has reported an annual aggregate survival rate of 84% for an Ecuadorian shrimp farm using a nursery system but no aeration. We estimate that a semi-intensive commercial shrimp farm as described in this report should be able to average a survival rate of 75% using an aeration system and supplemental feeding.

The headless yield is assumed to be about 63% of the whole weight, which is the headless yield used by the U.S. Department of Commerce for converting whole shrimp to raw, shell-on headless shrimp (Thompson, 1984). The final headless market size of the shrimp was assumed to be relatively uniform at the 36-40 shrimp "tails" per pound market class as reported by Stokes, et al., 1986.

Financial Analysis and Cost Estimates

Costs were estimated from several sources, including average statewide costs (U.S.D.A., 1985), used equipment dealers, equipment manufacturers and other aquaculture enterprises in the U.S.A. Assuming an overall pump efficiency of 66%, the electrical power consumption per pump was estimated to be 53 kilowatts with pump operation time at 10 hrs/day for 130 days, including the initial filling of the ponds. Electricity consumption for paddlewheel aerators was set at 2.4 kwh per paddlewheel for 120 days operating 12-hrs./day. Based upon the discussion with power companies in the coastal area during 1985, a rate of $0.07 per kwh was estimated.

Total salary figure for a manager and two technicians in the first year was set at $74,100, which includes 20% for payroll taxes and insurance. Seasonal labor associated with pond management, feeding and harvesting was estimated at 720 man-days (5,760 hours at $5.00/hr). Shrimp packing costs, which usually involve the deheading and packaging, were set at $0.30/lb. (heads-off yield).

Construction costs are based upon estimates of water control systems materials (Appendix A), levee construction, excavation, and pump inlet construction. It was assumed that soil conditions would be acceptable for constructing the levees from the material excavated from the canals and pond bottoms. Consequently, earth moving costs were based upon an estimated 330,400 cubic yards at a cost of $1.00/yd^3.

Other materials and equipment not directly associated with the pond system included feed blower, feed storage bins, tractor, paddlewheel aerators (one/pond), and a harvesting trailer with a fish pump (Appendix A). The feed storage bins are necessary to store bulk quantities of dry commercial ration, especially during the last three months of grow-out when weekly feed requirements for a 176-acre system could exceed 35,000 lbs. A harvesting trailer with a fish pump capable of pumping out a harvest basin was included to reduce harvesting time and labor costs.

Projected income statements were generated on a microcomputer software, Advanced VisiCalc, using an Apple IIe microcomputer. The discounted cash flow analysis used in calculating the internal rate of return (IRR) was calculated with the initial capital investment occurring at the beginning of the period and series of cash flows occurring at end of each period (Table 1). Any new or other capital improvements occurring after the initial investment are treated as cash disbursements occurring at the end of the period. Depreciated equipment was given no market value when replaced.

Equipment, pond construction and other capital expenditures were treated as 5, 10 or 19 year properties based upon current Internal Revenue Service depreciation rules under the Accelerated Cost Recovery System (ACRS) (Table 1). No investment tax credit (ITC) treatment was used. Moreover, the Tax Reform Act of 1986 repealed the ITC for property placed in service after 1985. The average marginal tax rate was set at 30% even though tax rates for incorporated businesses can be lower or higher depending upon net income. In general, the various tax treatments used in this analysis were conservative and are not intended to represent the optimal treatment under current state and federal tax codes in 1985.

Base Scenario

The base scenario for this analysis was predicated on optimal management conditions with declining PL input prices and constant (not inflated) shrimp prices (Table 2). Discussions with penaeid hatchery managers in the U.S.A. and Latin America indicate an

Table 1 . Major financial analysis assumptions for a hypthetical semi-intensive marine shrimp farm in South Carolina.

Financial Analysis Assumptions

Depreciation Treatment: Accelerated Cost Recovery System, 5,10 and 19 year properties

Income Tax Rate: 30%

Type of Capital: 100% equity

Investment Tax Credit: None

Cash Flow in IRR & NPV: Initial investment at beginning of first year and cash flows (future returns) occur at the end of each year.

Inflation Rate: Three percent annually compounded

Land Leasing Cost: $70/acre ($173/ha)

Table 2. Major operating assumptions and base scenario for a hypothetical semi-intensive marine shrimp farm in South Carolina.

Major Operating Assumptions

Species: *Penaeus vannamei*

Stocking Density: 50,000/acre(PL_5 - PL_{10}) (123,500/ha)

Harvested Size: 18g (36-40/lb "tails")

Average Tail Yield: 63%

Feeding Ratio: 2.5 declining .1 per year to 2.1

Base Scenario

Survival Rate: 75% (PL grow-out)

Headless Yield: 1st Year: 875 lbs/acre (981 kg/ha)
2nd Year: 910 lbs/acre (1,020 kg/ha)
3rd-10th Year: 935 lbs/acre (1,048 kg/ha)

PL Cost: $18/1,000 declining 10%/yr. with a minimum of $12/1,000

Feed Price: $0.20/lb.($0.44/ha)

Packing & Heading Price: $0.30/lb ($0.66/kg)

Electricity: $0.07/kwh

Shrimp (headless) Price: $4.00/lb ($8.82/kg)

expectation that PL prices for *P. vannamei* will decline during the next 10 years as the number of commercial hatcheries expands. In addition, the market (output) price (heads-off) of the cultured shrimp in this hypothetical enterprise was set at $4.00/lb ($8.82/kg). Although this price is $0.53/lb higher than the average South Carolina exvessel price for 36-40 count white shrimp in October, 1985 (SCWMRD, 1985), current experience indicates that white shrimp cultured in the U.S.A. is usually sold for prices significantly higher than that received for trawler caught shrimp. This price differential may be due to several factors, including direct wholesale purchases by large buyers (e.g. supermarkets) and quality preferences for farmed shrimp (Hollin and Griffin, 1985).

RESULTS

Initial Capital Investment

The initial capital for the construction and first year operation of a semi-intensive shrimp farm was estimated (Table 3). The construction of levees and canals ("Pond Construction") comprised 29% of the initial investment (Table 3). Collectively, construction and equipment costs comprised about 59% of the initial investment. Projected operating capital for salaries, wages, PL purchases, feed and other operating expenses constituted 41% of the initial investment.

Projected construction cost for a pond system (excluding pumps) is $2,780/acre (Table 3). The initial investment for all construction and equipment is $3,850/acre (Table 3).

Projected Annual Income

For the base scenario (see Table 2), PL and feed expenses (Table 4) are projected to constitute 27% and 21%, respectively, of total operating expenses in the first year of operation. With the projected decline in PL cost (see Table 2), PL expenses would decline to 20% of total expenses by the sixth year (Table 4). Other major cash operating expenses include salaries, wages and electricity.

Table 3. Summary of estimated initial investment (excluding land cost) for a 176-acre hypothetical marine shrimp farm constructed in South Carolina.

Item	Total (x $1,000)	$/acre (Water Surface)	$/ha (Water Surface)
Pond Construction (330,400 yd^3 @ $1.00/yd^3$)	$330.4	$1,880	$4,630
Land Smoothing (230 A @ $420/A)	96.3	550	1,350
Water Control System	62.4	350	870
Total Pond System Cost*:	$489.1	$2,780	$6,850
Sea Water Pumps, 2	34.0	190	480
Paddlewheel Aerators, 26	27.3	150	380
Harvesting Trailer & Pump	15.0	90	210
Office Trailer	15.0	90	210
Other Equipment & Construction	97.3	550	1,360
Subtotal	$677.7	$3,850	$9,440
Operating Capital**	$464.5	$2,640	$6,500
Total Initial Investment in Year One	$1,142.2	$6,490	$15,990
Additional Investment in Year Six***	$64.0	$360	$900

*Cost of pond construction, land smoothing and water control system.

**Includes cash for required deposits and cash reserve.

***Pump inlet reconstruction, truck, paddlewheels and other equipment.

Table 4. Projected income statement for a hypothetical 176-acre semi-intensive marine shrimp farm in coastal South Carolina.

176-Acre Semi-Intensive Marine Shrimp Farm in South Carolina
Ten (10)-Year Projected Income Statement
Years Projected

PROJECTED SHRIMP YIELDS PER ACRE:	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
Yield/acre, Heads-off Pounds:	875	910	935	935	935	935	935	935	935	935
Yield/acre, Heads-on Pounds:	0	0	0	0	0	0	0	0	0	0
SALES:					(In Thousands)					
Shrimp	$ 617.5	644.0	661.6	661.6	661.6	661.6	661.6	661.6	661.6	661.6
Other										
TOTAL SALES:	$ 617.5	644.0	661.6	661.6	661.6	661.6	661.6	661.6	661.6	661.6
DIRECT OPERATING EXPENSES:					(In Thousands)					
Post larvae	$158.8	$142.9	$128.6	$115.7	$105.8	$105.8	$105.8	$105.8	$105.8	$105.8
Fertilizer	1.8	1.8	1.9	1.9	2.0	2.1	2.1	2.2	2.2	2.3
Feed	122.5	122.7	120.8	110.3	110.3	110.3	110.3	110.3	110.3	110.3
Shrimp Packing	46.3	47.7	49.1	50.6	52.1	53.7	55.3	57.0	58.7	60.4
TOTAL:	$329.4	$315.1	$300.4	$278.5	$270.2	$271.9	$273.5	$275.2	$277.0	$278.8
OTHER EXPENSES:					(In Thousands)					
Salaries, Manager & Technicians	$74.1	$76.3	$78.6	$81.0	$83.4	$85.9	$88.5	$91.1	$93.9	$96.7
Electricity	19.4	20.0	20.6	21.2	21.8	22.5	23.2	23.9	24.6	25.3
Wage Labor	28.8	29.7	30.6	31.5	32.4	33.4	34.4	35.4	36.5	37.6
Land Leasing	16.1	16.5	17.0	17.5	18.1	18.6	19.2	19.7	20.3	20.9
Depreciation	73.7	89.4	83.2	79.8	77.3	36.0	38.2	35.4	33.3	33.3
Insurance	6.0	6.2	6.4	6.6	6.8	7.0	7.2	7.4	7.6	7.8
Professional Fees	10.0	4.1	4.2	4.4	4.5	4.6	4.8	4.9	5.1	5.2
Licenses & Taxes	5.0	5.2	5.3	5.5	5.6	5.8	6.0	6.1	6.3	6.5
Vehicle	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0
Miscellaneous Expenses	8.0	4.1	4.2	4.4	4.5	4.6	4.8	4.9	5.1	5.2
Pond & Other Maintenance	11.1	13.8	14.2	14.6	15.1	15.5	16.0	16.5	17.0	17.5
TOTAL	$255.2	$268.4	$267.6	$269.8	$272.9	$237.6	$245.7	$249.2	$253.5	$260.1
TOTAL OPERATING EXPENSES:	$584.6	$583.5	$568.0	$548.3	$543.1	$509.4	$519.3	$524.4	$530.5	$538.9
NET OPERATING INCOME:	$33.0	$60.5	$93.6	$113.3	$118.5	$152.2	$142.4	$137.2	$131.1	$122.7
INCOME TAXES 30% of above:	$9.9	$18.2	$28.1	$34.0	$35.6	$45.7	$42.7	$41.2	$39.3	$36.8
INCOME AFTER TAXES	$23.1	$42.4	$65.5	$79.3	$83.0	$106.6	$99.7	$96.0	$91.8	$85.9

Under the base scenario, the projected total operating expenses would reach a minimum in Year Six (Fig. 2). Projected operating expenses would begin increasing after the sixth year (Fig. 2), generally due to the expected effects of moderate inflation on salaries, packing and other expenses.

Projected total operating expenses per acre follow the above pattern, reaching a minimum of $2,890/acre ($7,140/ha) in Year Six (Fig. 3), preceded by a maximum in Year One, $3,320/acre ($8,200/ha). Total operating expenses per pound of headless shrimp cultured attained a maximum in Year One and a minimum in Year Six (Fig. 4). Net operating income is projected to reach a minimum in the first year of operation and a maximum in Year Six (Fig. 2). Net operating income per acre

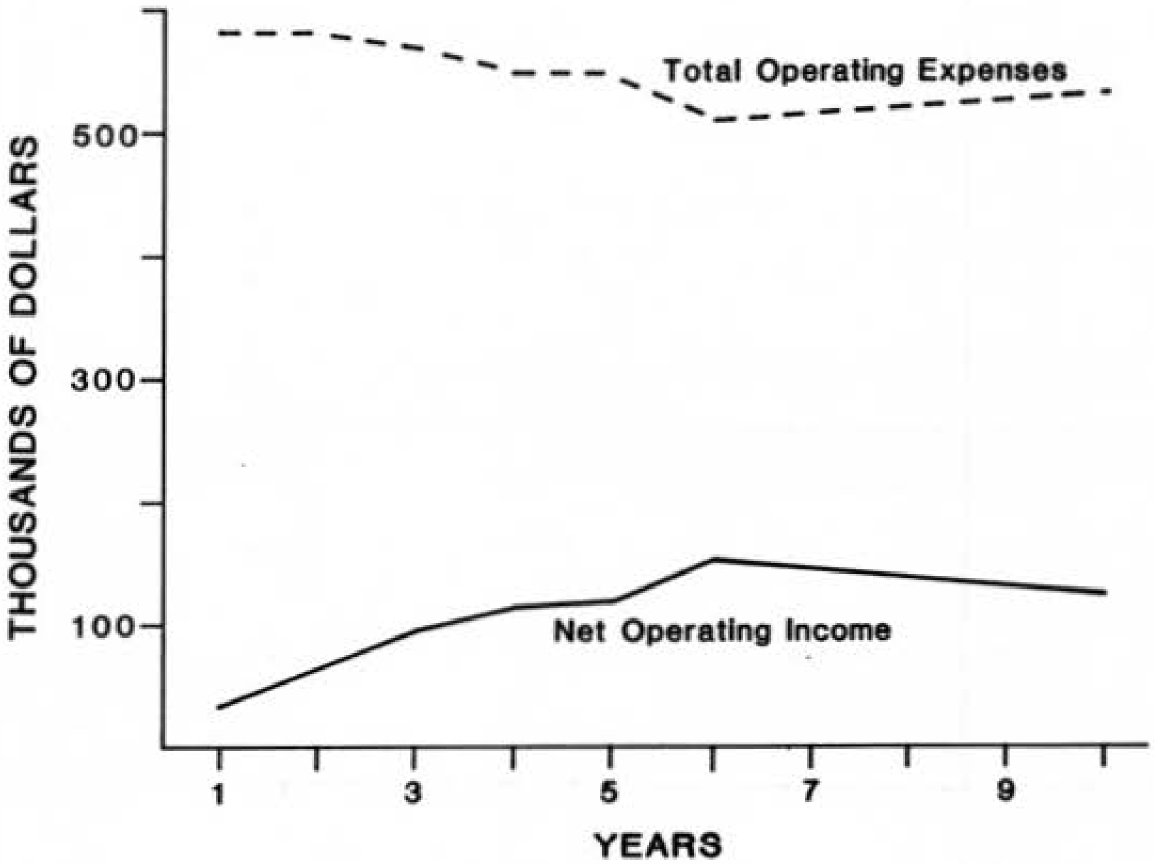

Fig. 2. Projected annual total expenses and net income before taxes (base scenario) for a hypothetical 176-acre semi-intensive marine shrimp farm in coastal South Carolina.

follows the same pattern (Fig. 3). Net operating income per pound harvested (heads-off) peaks in Year Six at \$0.92/lb (\$2.03/kg) and declines to \$0.74/lb (\$1.63/kg) by Year Ten (Fig. 4).

Projected Payback Periods

The payback period (PP) and the discounted payback periods (DPP) for the base scenario and variations in selected variables were projected (Table 5). The projected PP for the base scenario is nearly six years and the DPP at 10% is 7.7 years (Table 5). At lower survival rates or shrimp prices compared to the base scenario, the PP and DPP increase (Table 5). A one percentage point decrease in the survival rate in the 75% to 70% range will result in a 0.3 year increase in the projected DPP when discounted at 10% (Table 5). In contrast, a one percentage point increase in the survival rate in the 75% to 80% range will result in nearly 0.4 year decrease in the projected DPP (Table 5).

Sensitivity Analysis

Using the IRR as a measure of profitability, the effects of one-variable changes on the base scenario were examined (Table 6). Projected input prices for PL and bulk feed were varied (Tables 7 and 8). The projected feed conversion ratio was also varied (Table 8). A one percent change in PL prices results in only a 0.1 percentage point change in the projected IRR (Table 6). If PL prices start at \$18/1,000, but are decreased five percent per year instead of 10%, the IRR

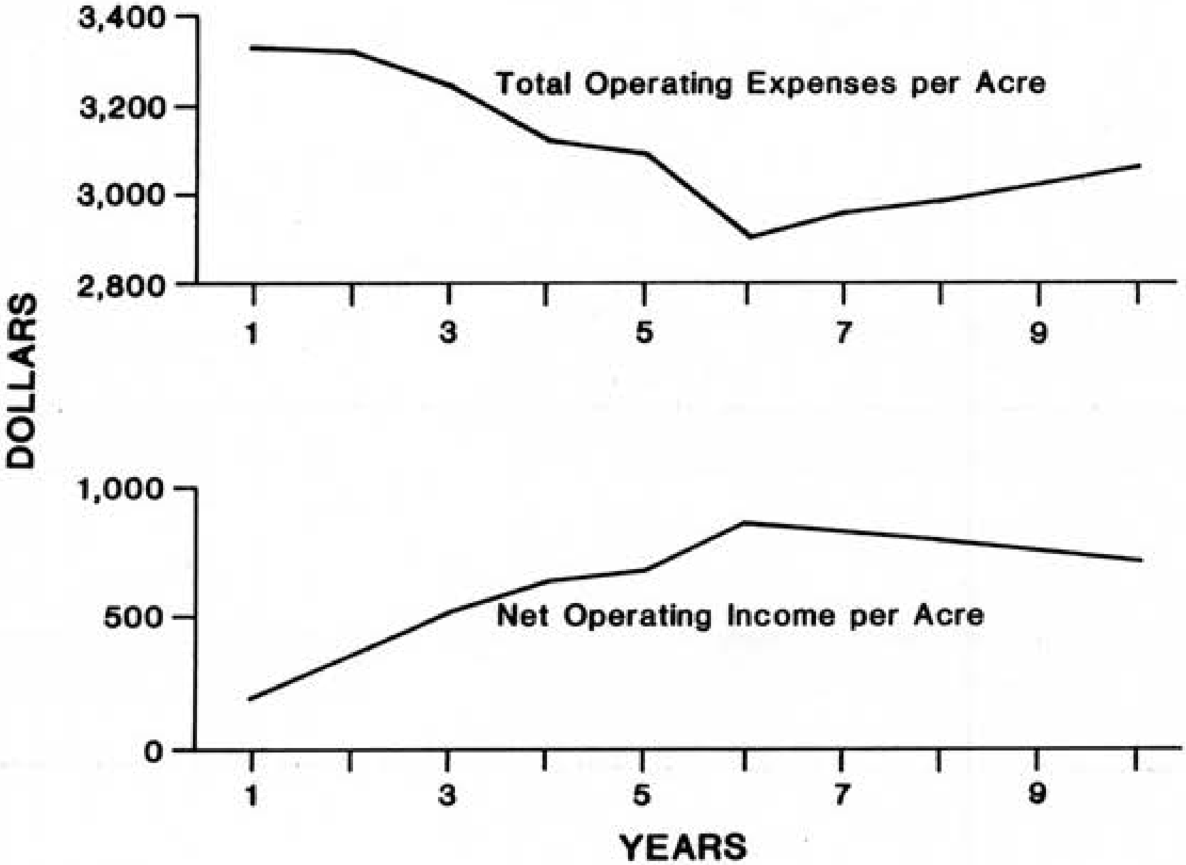

Fig. 3. Projected annual total cost per acre and net income before taxes per acre and net income before taxes per acre (base scenario) for a hypothetical 176-acre semi-intensive marine shrimp farm in coastal South Carolina.

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declines about 1.5 percentage points (Table 7). The projected IRR changes about 0.2 percentage points for every one percent change in feed costs (Table 6).

The projected survival rate and output (market) price for headless shrimp were also altered relative to the base scenario (Table 9 and Table 10). The projected IRR changes nearly one percentage point for every one percent change in shrimp price. In the 75% to 65% survival rate range (Table 10), the projected IRR declines nearly 0.8 percentage points for every one percent decrease in the survival rate. An increase in the survival rate to the 80% and 85% level increases the projected IRR 4.3 and 8.4 percentage points, respectively (Table 10).

The projected IRR averages only about a 0.02 percentage point change for every percent change in the leasing cost of land (Table 6). In contrast, if the land is purchased and not leased, the projected 10-year IRR undergoes a major decline (Table 11). The projected IRR in the $3,800/acre to $2,200/acre purchase price range never exceeds four percent (Table 11).

The combined effect of changes in shrimp prices and survival rate on the projected IRR was generated (Table 12). At $3.50/lb or less, the projected IRR was less than six percent regardless of the survival rates (Table 12). In contrast, if the survival rate was 65% or greater and the shrimp price at least $4.00/lb, the projected IRR was always

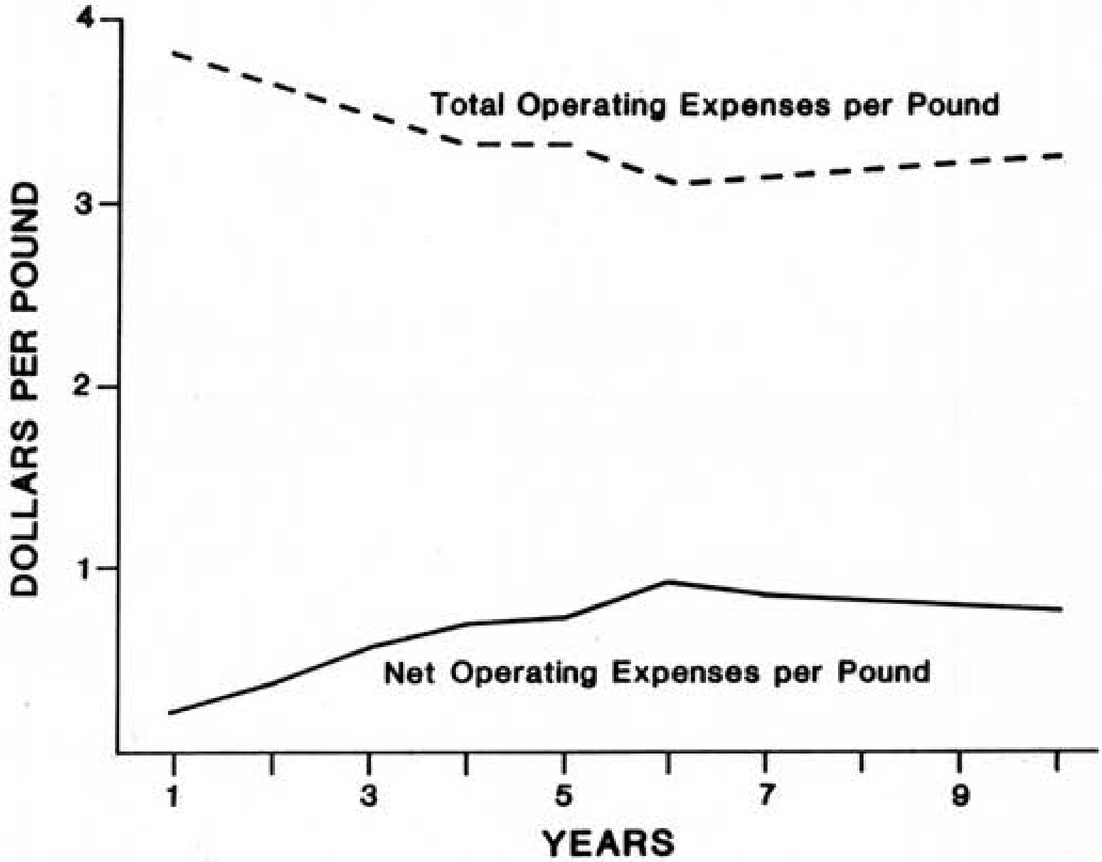

Fig. 4. Projected annual total cost per pound (heads-off) and net income before taxes per pound (base scenario) for a hypothetical 176-acre semi-intensive marine shrimp farm in coastal South Carolina.

greater than three percent (Table 12). For a high survival rate (i.e. 80% or greater) with the shrimp price at least \$4.00/lb, the projected IRR was 18% or greater (Table 12).

DISCUSSION

Projected Payback Periods

The projected payback period (PP) indicates that the initial investment under the base scenario assumptions would be reached in about five years (Table 5). In contrast, the discounted payback period (DPP) at 10% would be nearly eight years for the base scenario (Table 5). It is suggested that potential investors in aquaculture ventures use the DPP as a financial analysis tool to either replace or supplement the PP method. The PP method ignores the time value of money (Bhandari, 1986). The DPP considers the time value of money while measuring relative liquidity of a given project.

Cost and Return Comparisons

Using a highland culturing system with 79 acres (32 ha) of water surface, Sandifer and Bauer (1985) estimated that the initial investment in a semi-intensive 30,364 PL/acre (75,000 PL/ha) farm would be \$1,650/acre (\$4,081/ha), excluding land costs. Initial costs are estimated to be higher for the system described here partly because Sandifer and Bauer (1985) included no land smoothing costs, lower stocking densities (75,000 PL/ha), and a

Table 5. Projected payback period (PP) and discounted payback period (DPP) for the base scenario and changes in selected variables for a hypothetical 176-acre shrimp farm constructed in South Carolina.

Variable: Survival Rate	PP	DPP 10%	DPP 20%
85%	3.8 yrs.	4.9 yrs.	8.3 yrs.
80%	4.3 yrs.	5.8 yrs.	E
**75%	5.8 yrs.	7.7 yrs.	E
70%	10 yrs.	9.7 yrs.	E
62.1%		E	E
Shrimp Price			
$5.00/lb.	2.9 yrs.	3.5 yrs.	4.5 yrs.
4.50/lb.	3.6 yrs.	4.6 yrs.	6.8 yrs.
**4.00/lb.	4.9 yrs.	7.7 yrs.	E
3.49/lb.	10 yrs.	E	E

E-Exceeds the first 10-year period.

*The discounted payback period (DPP) is defined as the period required for the initial investment to equal the discounted value of projected cash inflows.

**Base scenario.

lower capacity water exchange system.

Excluding land costs and operating capital, projected initial investment costs per area (water surface) for a semi-intensive shrimp farm in South Carolina ($3,850/acre, Table 3) were lower than $4,250/acre ($10,500/ha) for a 120-acre Texas shrimp farm (John et al., 1983) but significantly higher than projected by Hollin and Griffin (1985), $2,970/acre ($7,340/ha), for a 500-acre farm in Texas.

Projected total operating costs per area cultured were also significantly lower in South Carolina than those projected by Huang, et al., (1984) for a 120 acre (grow-out) Texas farm, $3,620/acre ($8,940/ha) to $4,740/acre ($11,720/ha) using various stocking strategies. In our analysis, net operating income before taxes ranged from $187/acre ($463/ha) to $865/acre ($2,136/ha). Huang, et al., (1984) projected a net return before taxes ranging from $9.70/acre ($24/ha) to $1,750/acre ($4,311/ha) when polyculturing P. stylirostris and P. vannamei in the first year. For a large 500-acre shrimp farm, Hollin and Griffin (1985) reported a $1,290/acre ($3,193/ha) net return in the first year of operation in Texas.

A comparison of the projected IRR for South Carolina to other states is difficult because of several factors, including culturing techniques (e.g. headstarting with nurseries, etc.) and farm size. As others have reported (e.g. Griffin, et al., 1985) significant

Table 6. Sensitivity of the projected 10-year internal rate of return (IRR) to changes in in production variables for a 176-acre hypothetical shrimp farm constructed in South Carolina.

Production Variable	Data Source	Range	Average, Absolute Change in the IRR for a One Percent Change in a given Variable
Postlarvae Cost	Table 7	$20-$14**	0.10%
Feed Price	Table 8	$0.16-0.24/lb	0.16%
Shrimp Prices	Table 9	$4.50-3.50/lb	0.94%
Survival Rate	Table 10	75%-65%	0.77%
Leasing Cost	Table 11	$120-40/acre	0.02%

*Range used in calculating absolute change in IRR.

**PL cost which declines 10%/year and reached a minimum of $12./1,000 (see Table 7).

Table 7. Internal rate of return (IRR) vs. projected marine shrimp (P. vannamei) postlarvae (PL) costs (dollar/thousand) for a hypothetical 176-acre semi-intensive shrimp farm in South Carolina.

PL Stocking Density: 50,000/acre (123,500/ha)

First Year PL Cost*	Annual** Price Change	Minimum	IRR (First 10 Years)
$18.00	(No price change)	$18.00	8.5%
18.00	-5.0%	12.00	12.3%
20.00	-10.0%	12.00	12.5%
***18.00	-10.0%	12.00	13.8%
18.00	-10.0%	10.00	14.5%
16.00	-10.0%	12.00	14.9%
14.00	-10.0%	12.00	15.8%

* Postlarvae costs include estimated shipping expenses.

** Projected annual rate of decline in PL costs.

*** Base scenario.

Table 8. Projected annual feed and feed conversion ratios costs vs. the projected internal rate of return (IRR) for a hypothetical 176-acre semi-intensive shrimp farm in South Carolina.

Projected Feed Costs ($/lb)	Projected IRR (1st 10 years)
$0.26 ($0.57/kg)	8.8%
0.24 (0.53/kg)	10.5%
0.22 (0.49/kg)	12.2%
*0.20 (0.44/kg)	13.8%
0.18 (0.40/kg)	15.3%
0.16 (0.35/kg)	16.9%
0.14 (0.31/kg)	18.4%

Feed Conversion Ratio 1st yr.	2nd yr.	3rd yr.	4th-10th yr.	Projected IRR (1st 10 years)
2.5	No Change			11.8%
*2.5	2.4	2.3	2.1	13.8%
2.5	2.3	2.1	2.0	14.5%
2.1	No Change			14.7%

*Base scenario.

Table 9. Projected internal rate of return vs. projected shrimp prices (heads-off) for a hypothetical semi-intensive 176-acre shrimp farm in South Carolina.

Projected Shrimp Prices ($/lb.)	Projected IRR (1st 10 years)
$5.00 ($11.02/kg)	33.5%
4.50 (9.92/kg)	24.1%
* 4.00 (8.82/kg)	13.8%
3.50 (7.72/kg)	0.5%
3.49 (7.68/kg) 10-year Payback Period	0
3.10 (6.83/kg)	-20.5%

*Base scenario.

economies of size can be captured compared to initial investment cost both by increasing the size of the farm and/or ponds. Hanson, et al., (1985) projected that the IRR for a 247-acre Texas shrimp farm using 9.9 acre (4.0 ha) ponds would be nearly nine percentage points higher than for a 148-acre farm. Based on their data for farms larger than 247 acres, the IRR increases about 0.4 percentage points for about every 25 acre increase in area (Hanson, et al., 1985). Consequently, the IRR for a semi-intensive shrimp farm in South Carolina would be expected to increase with the size of the farm.

Table 10. Projected internal rate of return (IRR) vs. projected white shrimp (*Penaeus vannamei*) post larvae survival in grow-out ponds for a hypothetical semi-intensive 176-acre shrimp farm in South Carolina.

Projected Survival Rate*	Headless Yield/Area (3rd-10th Year)	IRR (1st 10 Years)
85%	1,059 lb/acre (1,187 kg/ha)	22.2%
80%	997 lb/acre (1,118 kg/ha)	18.1%
**75%	935 lb/acre (1,048 kg/ha)	13.8%
70%	873 lb/acre (979 kg/ha)	9.1%
65%	810 lb/acre (908 kg/ha)	3.6%
62.1%	774 lb/acre (868 kg/ha) (10-Year Payback Period)	0%
60%	748 lb/acre (839 kg/ha)	-2.9%
55%	686 lb/acre (769 kg/ha)	-11.8%

*This is the projected survival rate attained in Year 3. In Year 1, the projected survival is five percentage points less than above projected rate and two points less in Year 2.

Note: Based on the maximum experimental yield about 1460 lb/acre (headless), as reported by Stokes, et al (1986), the projected IRR would reach 48%.

Table 11. Projected land costs vs. the internal rate of return (IRR) for a 176-acre semi-intensive marine shrimp farm in South Carolina.

PURCHASED LAND:

Projected Purchase Price* ($/acre)	Projected IRR (1st 10 years)
$3,800	-1.6%
3,600	-1.0%
3,400	-0.5%
3,200	0.1%
3,000	0.7%
2,800	1.3%
2,600	2.0%
2,400	2.7%
2,200	3.5%

LEASED LAND

Projected Leasing Price ($/acre)	Projected IRR (1st 10 years)
$120	12.0%
100	12.7%
80	13.4%
**70	13.8%
60	14.1%
40	14.8%

* Land purchased or leased is assumed to be 30% larger than the total cultured water surface (i.e. 176 acres).

** Base scenario

Table 12. Projected internal rate of return vs. projected survival rates and projected shrimp prices (heads-off) for a hypothetical semi-intensive 176-acre shrimp farm in South Carolina.

Projected Shrimp Prices ($/lb)		Projected Survival Rate 85%	80%	75%	70%	65%	60%
$5.00	($11.02/kg)	42.9%	38.2%	33.5%	28.5%	23.4%	18.0%
4.50	(9.92/kg)	32.9%	28.6%	24.1%	19.5%	14.5%	9.1%
*4.00	(8.82/kg)	22.2%	18.1%	13.8%	9.1%	3.6%	-2.9%
3.50	(7.72/kg)	9.9%	5.5%	0.5%	-5.5%	-14.1%	<-20%
3.10	(6.83/kg)	-3.9%	-10.0%	-20.5%	<-20%	<-20%	<-20%

*Base scenario shrimp price.

Sensitivity Analysis

The sensitivity analysis indicates the projected IRR is more sensitive to relative changes in shrimp (output) prices and survival rate than variable input prices (i.e. postlarvae and feed). For example, a one percent increase in the projected feed price would reduce the projected IRR about 0.2 percentage points (see Table 6), while a one percent decrease in the survival rate would result in a 0.8 point decline, nearly four times the feed price effect on the projected IRR. The influence of survival rate and shrimp prices on the projected DPP is also apparent (Table 5). If the survival rate decreases to 70%, the DPP (discounted 10%) increases by two years. The DPP declines about three years if the average shrimp price increases $0.50/lb. compared to the base scenario (Table 5).

In this analysis, the projected IRR was most sensitive to changes in shrimp prices. A one percent change resulted in nearly a one percentage point change in the projected IRR (Table 6). Historically, seasonal adjusted wholesale U.S. shrimp prices have undergone major fluctuations (Adams and Prochaska, 1985), including a major downward trend in the 1983-85 period (Fig. 5) followed by a price increases in the first half of 1986 (Vondruska, 1986). If this pattern continues, shrimp sales in South Carolina would also be expected to fluctuate accordingly (Rhodes, 1984). Unfortunately, potential price instability, coupled with perhaps variable survival and growth rates influenced by weather conditions (e.g. temperature, wind, rainfall, etc.) constitute external and generally uncontrollable factors. If viewed as uncontrollable factors, they increase the riskiness in shrimp farming by increasing the potential variability of expected future returns.

Risk Considerations

The decision to invest in shrimp farming has some significant inherent risks (e.g. shrimp price fluctuations) like most commercial enterprises (Weston and Brigham, 1978); therefore, potential investors need to consider the influence of risk on shrimp farming profitability. Although the model used in this report can analyze the effects of altering different variables, the model is still deterministic; consequently, it does not attempt to simulate the stochastic variables (e.g. variability in production between ponds, probability of hurricane damage, shrimp price fluctuations, etc.) in the context of risk evaluation. Hanson, et al., (1985) has compared the projected after-tax IRR for culturing *P. stylirostris* from both a deterministic and a stochastic model. For a 247 acre (100 ha) hypothetical shrimp farm in Texas using 9.9 acre (4.0 ha) ponds, the deterministic model generated an after-tax IRR of 15.9%, but the stochastic model's IRR was 6.2 percentage points lower. Consequently, when examining a marine shrimp farming venture in the United States, six percent might be considered at least as a preliminary risk premium to be combined with the investors' weighted low risk or risk-free rate of return. The required rate of return (RRR) on this type of investment can be viewed as having two components:

$$RRR = r + p$$

where r is the long-term riskless rate of return, and p is a premium for risk. For example, if a group of investors can collectively obtain a 10-year projected IRR of eight percent on their capital after taxes at a relatively low risk level, then the RRR for that group might be 14% (8% + 6%).

Research Needs

Assuming the sensitivity analysis results for survival rates are a rough proxy for the projected effects of changing yields, the profitability of a shrimp farm can be significantly increased by increasing total gross sales, but it must be done in a manner where the incremental increase in sales exceeds the incremental costs of improving sales. Recent research in South Carolina (Sandifer, et al., 1986) suggested that yield can be increased by stocking PL's at higher densities (e.g. 182,000 PL/acre) coupled with more intensive pond management. Preliminary data indicates a significant increase in physical yield and, more importantly, a higher gross revenue per area compared to semi-intensive culturing techniques. With a simulated stocking density of 100,000 juvenile (1 gram) per acre (247,000/ha), Hollin and Griffin (1985) projected a IRR ranging from 9% to 23% for survival rates from 50% to 80% in a 40-acre Texas intensive shrimp farm. Intensive shrimp farming methods may hold promise in other states, but incremental variable costs associated with more intensive culturing technique need to be analyzed for South Carolina.

In addition to attempting to increase gross sales by increasing physical yield for one crop, it may also be possible to increase annual gross revenues by culturing two crops in one grow-out season using a nursery system. Using a headstarting nursery, Hollin and Griffin (1985) projected a 10-year IRR of 23% with two crops/year. However, Wyban, et al. (1986) projected a 20-year IRR of only two percent for a hypothetical two-crop Texas shrimp farm using a nursery system.

Another possible approach to improving gross revenues may be the selective seining of small shrimp in the grow-out ponds during summer months for bait sales. Wholesale prices of $3.00/lb. for frozen shrimp (whole) bait

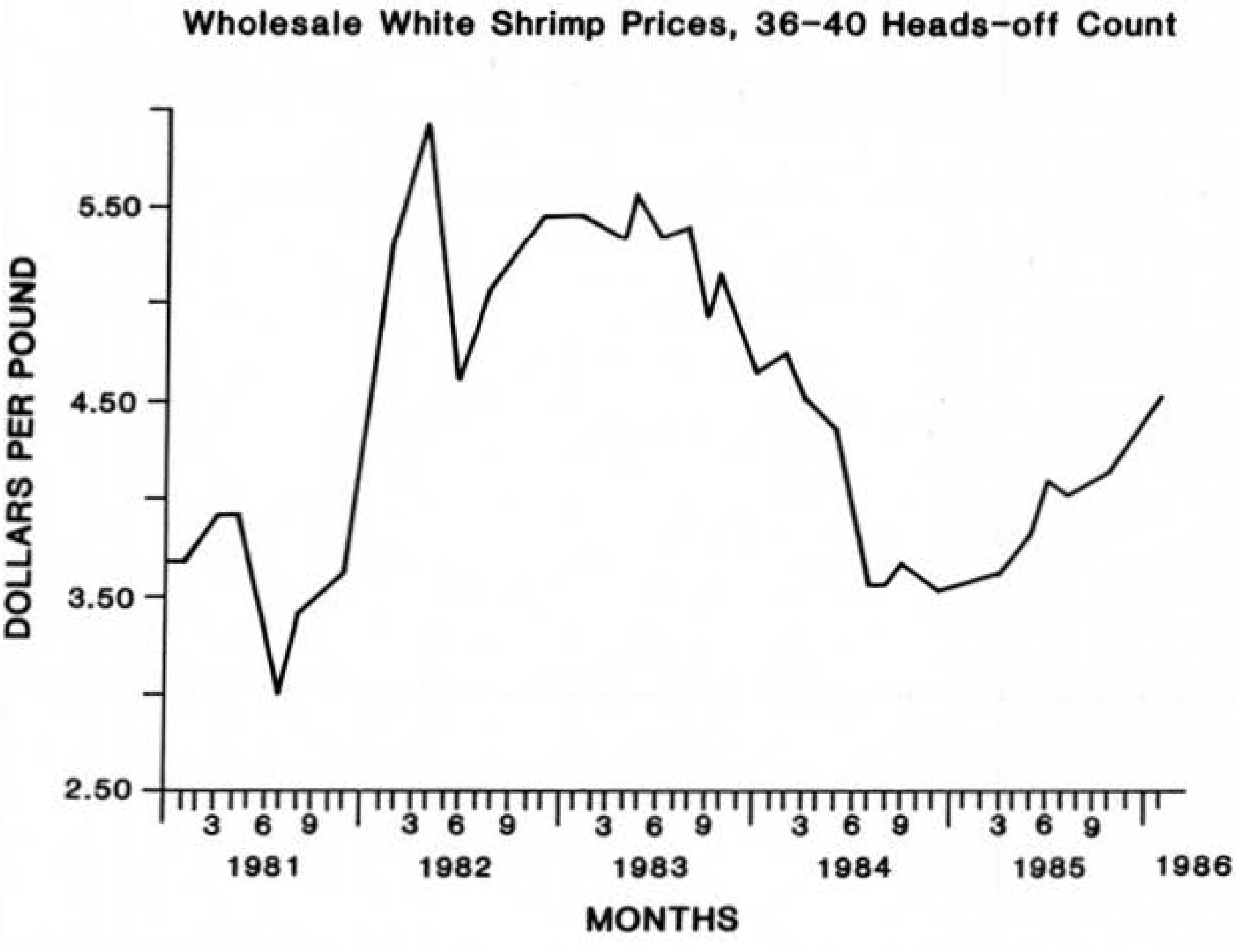

Fig. 5. Average monthly wholesale prices in New York for 36-40 count (heads-off) U.S. Gulf of Mexico white shrimp, 1981-86.

have been observed in South Carolina. Perhaps selective harvesting might also improve the harvest size of the shrimp in the fall. Incremental costs associated with seining for bait shrimp markets include additional harvesting labor, processing and distribution costs.

Increasing gross sales through obtaining higher shrimp prices is probably limited by several factors, including the commodity nature of shrimp marketing and growing availability of high quality, cultured imported shrimp from Latin America, especially Ecuador (Shrimp Notes, Inc., 1985). As previously mentioned, U.S. cultured shrimp seem to currently command a significant price premium in the United States. The magnitude and stability of this premium will probably depend upon the ability of U.S. farms to develop profitable market niches. Successful market "niching" depends upon the ability of the small firm to have an unique advantage over larger producers and for the market niche segment's potential sales to be too small to attract larger firms (Kotler, 1980).

Besides incrementally altering costs and revenues for culturing shrimp, the culture of molluscan seedstock like hard clams (*Mercenaria mercenaria*) during time periods when the grow-out ponds (Stevens, *et al*., 1985) are not being used for shrimp culture might also improve shrimp farm's total profitabilty. Moreover, the polyculture of shrimp and oysters (i.e. *Crassostrea virginica*) might also improve a shrimp farm's total gross revenues with only a minor increase in equipment and operating costs. The commercial feasibility of culturing hard clams, oysters or other molluscan species on marine shrimp farms in South Carolina needs to be analyzed.

SUMMARY AND CONCLUSIONS

1. A preliminary financial analysis of a hypothetical 176-acre highland marine shrimp farm in coastal South Carolina using leased land had a projected 10-year IRR of 14%. If the land is not leased but purchased at an average cost of $2,600/acre ($6,422/ha), the projected IRR drops to two percent. The discounted payback period at 10% would be nearly eight years with leased land.

2. With leased land, the projected IRR is more responsive to changes in shrimp (output) prices and grow-out survival rates than input prices for postlarvae, bulk feed and leasing. For every one percent change in the survival rate or shrimp price, the projected IRR changes nearly one percentage point. In contrast, the projected IRR changed less than 0.2 percentage points for every one percent change in postlarvae, feed and leasing input prices.

3. Excluding land costs and operating capital, the projected initial investment costs per acre (water surface) for a 176-acre semi-intensive shrimp farm would be similar if not lower than 148-acre Texas shrimp farm. However, the IRR for a semi-intensive shrimp farm in South Carolina would be expected to increase with the size of the farm.

4. Because the microcomputer model in this report is deterministic, it does not simulate stochastic variables which affect the riskiness inherent in shrimp farming. Based upon other work (i.e. Hanson, *et al*., 1985), it is suggested that potential investors assign at least a six percent risk premium when evaluating the 10-year after tax IRR for a shrimp farming venture in the United States.

5. Based upon the sensitivity analysis, opportunities to improve shrimp farming profitability will include improving yields, increasing the final harvest size, and/or securing higher shrimp prices. Preliminary results with intensive shrimp culturing techniques indicate that higher yields result in increased gross revenues per area. The grow-out of two crops/season with headstarting nursery systems and polyculture with other species (e.g. oysters, hard clams) may also be commercially feasible techniques for improving the profitability of a shrimp farming enterprise. The commercial feasibility of these approaches and others needs to be investigated for South Carolina.

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Appendix A. Accelerated Cost Recovery System (ACRS) depreciation schedule for hypothetical 176-acre semi-intensive marine shrimp farm in coastal South Carolina.

Projected Depreciation Schedule: (First Ten Years) 176-Acre Semi-Intensive Marine Shrimp Farm in South Carolina

		Years Projected									
		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
19-YEAR PROPERTY:					(In Thousands)						
Land clearing	$420/acre:	$96.3	0	0	0	0					
Pond construction	$1.00/cu.yd	330.4	0.0	0.0	0.0	0.0					
TOTAL		$426.7	$0	$0	$0	$0					
ACRS Depreciation		$37.6	$35.8	$32.4	$29.4	$26.9	$24.3	$22.2	$20.1	$17.9	$17.9
10-YEAR PROPERTY:											
Dike stabilization	$55/acre	$6.3									
Trailer		15.0	0	0	0	0					
TOTAL		$21.3	$0	$0	$0	$0					
ACRS Depreciation		$1.7	$3.0	$2.6	$2.1	$2.1	$2.1	$1.9	$1.9	$1.9	$1.9
5-YEAR PROPERTY:					(In Thousands)						
Seawater Pumps,	2	$34.0	$0	$0	$0	$0					
Harvesting Trailer & Pump		15.0	0	0	0						
Pump Inlet		10.0					$10.3				
Water Control Strutures		62.4	0	0	0	0					
Fence, barbed wire		2.6									
Feeding Equipment, 1		5.0									
Feed Storage bin,	2	9.0	0	0	0	0				0	0
Boat & Trailer		3.5					3.6	0	0	0	0
Harvest Equipment		4.0					4.1	0	0	0	0
Tractor with accessories		12.0									
Paddlewheel, 2 HP, 26		27.3	0	0	0	0	15.4			0	0
Trucks, 1-ton		10.0					10.3	0	0	0	0
ATV cycles	2	5.0	0	0	0	0				0	0
Lab Equipment		3.0					3.0	0	0	0	0
Storage/work shed		3.0					3.0	0	0	0	0
Shop Equipment		3.0					3.0	0	0	0	0
Office Equipment		10.0	0	0	0	0					
Miscellaneous Equipment		10.9					11.3	0	0	0	0
TOTAL		$229.7	$0.0	$0.0	$0.0	$0.0	$64.0	$0.0	$0.0	$0.0	$0.0
ACRS Depreciation:		$34.5	$50.5	$48.2	$48.2	$48.2	$9.6	$14.1	$13.4	$13.4	$13.4

Appendix B. Discounted cash flow analyses (base scenario) for a hypothetical 176-acre semi-intensive marine shrimp farm in coastal South Carolina.

Net Present Value & Internal Rate of Return Analysis
S.C. Marine Shrimp Farm Acres: 176
(First Ten Years) Hectares: 71

		Years Projected									
	Pre-Operating	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
Cash Source:						(In Thousands)					
Equity	$1,142										
Loan											
Depreciation		$73.7	$89.4	$83.2	$79.8	$77.3	$36.0	$38.2	$35.4	$33.3	$33.3
Net Income After Taxes		23.1	42.4	65.5	79.3	83.0	106.6	99.7	96.0	91.8	85.9
Land Sale less Reclamation											0.0
Total:	$1,142	$96.8	$131.7	$148.8	$159.1	$160.2	$142.6	$137.8	$131.4	$125.1	$119.2
Disbursement:						(In Thousands)					
Land Purchase	$0.0	$0.0	$0.0	$0.0							
Operating Capital	464.5										
Construction Expenses	426.7	$0.0	0	0	0	0					
Equipment Purchases	251.0	0.0	0	0	0	0	$64.0	0	0	0	0
Loan Payment (Principal)	0.0										
Total Disbursements:	$1,142	$0.0	$0.0	$0.0	$0.0	$0.0	$64.0	$0.0	$0.0	$0.0	$0.0
Net Cash Flow:	$0.0	$96.8	$131.7	$148.8	$159.1	$160.2	$78.6	$137.8	$131.4	$125.1	$119.2
Cumulative Cash Flow:	$0	$97	$229	$377	$536	$697	$775	$913	$1,045	$1,170	$1,289

Initial Investment: $678* After Tax Discount Rate: 20.00% Net Present Value: $ -140
After Tax Internal Rate of Return: 13.77%

* Initial investment used in calculating the IRR & NPV does not include "Operating Capital". The IRR & NPV were calculated using the "Net Cash Flow" at the end of each period.

Appendix C. Microcomputer assumption table (base scenario) for a financial model of a hypothetical 176-acre semi-intensive marine shrimp farm in coastal South Carolina.

Total Water Surface Acreage: 176

Ten Years Projected

ASSUMPTIONS:	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
Pond Sets Added in Current Year:	2	0	0							
Ponds per Set:	12	12	12	12	12	12	12	12	12	12
Pond Size, Acres (2.98 ha):	7.35	7.35	7.35	7.35	7.35	7.35	7.35	7.35	7.35	7.35
Total Number of Pond Sets:	2	2	2	2	2	2	2	2	2	2
Added Acres(71.42 ha):	176.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Number of Ponds:	24	24	24	24	24	24	24	24	24	24
Total Acres(71.42 ha in Yr. 1):	176.4	176.4	176.4	176.4	176.4	176.4	176.4	176.4	176.4	176.4
Land Cost, $/acre($7,410/ha):	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000
Leasing Cost, $/A($172.9/ha):	$70	$70	$70	$70	$70	$70	$70	$70	$70	$70
Land Added, acres(92.8 ha):*	229	0	0	0	0	0	0	0	0	0
Percent Leased:	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Percent Purchased:	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Land Leased, acres:	229	229	229	229	229	229	229	229	229	229
Land Purchased, acres:	0	0	0	0	0	0	0	0	0	0
Cubic Yards Per Set:	165,200	165,200	165,200	165,200	165,200	165,200	165,200	165,200	165,200	165,200
Total Cubic Yards Added:	330,400	0	0	0	0	0	0	0	0	0
Interest Rate for Cash Reserves:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Inflation Rate, Compounded/yr:	3.0%	103.0%	103.0%	103.0%	103.0%	103.0%	103.0%	103.0%	103.0%	103.0%
Labor Rate,$/hr	$5.00	$5.00	$5.00	$5.00	$5.00	$5.00	$5.00	$5.00	$5.00	$5.00
Stocking Costs $/ 1,000	$18.00	$16.20	$14.58	$13.12	$12.00	$12.00	$12.00	$12.00	$12.00	$12.00
PL Density, 1,000/ha:	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5
PL Density, 1,000/acre:	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
Feed Costs, $/lb ($0.441/kg):	$0.20	$0.20	$0.20	$0.20	$0.20	$0.20	$0.20	$0.20	$0.20	$0.20
Feed Ratio	2.5	2.4	2.3	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Fertilizer, $/lb ($0.551/kg):	$0.25	$0.25	$0.25	$0.25	$0.25	$0.25	$0.25	$0.25	$0.25	$0.25
Fertilizer Ratio, lb/acre	40	40	40	40	40	40	40	40	40	40
Packing Cost, $/lb:	$0.30	$0.30	$0.30	$0.30	$0.30	$0.30	$0.30	$0.30	$0.30	$0.30
Pumping Days per Season:	130	130	130	130	130	130	130	130	130	130
Average Hours per Day:	10	10	10	10	10	10	10	10	10	10
KW Consumption per Pump:	53	53	53	53	53	53	53	53	53	53
Electricity, $/KWH:	$0.07	$0.070	$0.070	$0.071	$0.071	$0.071	$0.071	$0.071	$0.072	$0.072
Harvest Size, g (hdless market)	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
Harvest Size, g (whole market):	10	10	10	10	10	10	10	10	10	10
Headless harvest (whole wt. %):	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Whole shrimp harvest:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Survival Rate	70.0%	73.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%
Average Tail (Heads-off) Yield:	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%
Price, $/Pound (Heads-off):	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
Price, $/Pound (Heads-on):	$3.00	$3.00	$3.00	$3.00	$3.00	$3.00	$3.00	$3.00	$3.00	$3.00
PROJECTED YIELDS:										
Yield, kg/ha (Whole):	1,556	1,623	1,667	1,667	1,667	1,667	1,667	1,667	1,667	1,667
Yield, lb/acre (Whole):	1,388	1,444	1,484	1,484	1,484	1,484	1,484	1,484	1,484	1,484
Total Yield, kg (all whole):	111,132	115,895	119,070	119,070	119,070	119,070	119,070	119,070	119,070	119,070
Yield/ha, kg (Heads-off):	980	1,022	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050
Total Heads-off Harvest, kg:	70,013	73,014	75,014	75,014	75,014	75,014	75,014	75,014	75,014	75,014
Total Heads-off Harvest, Pounds:	154,379	160,995	165,406	165,406	165,406	165,406	165,406	165,406	165,406	165,406
Yield/ha, kg (Heads-on Only):	0	0	0	0	0	0	0	0	0	0
Total Heads-on Harvest, kg:	0	0	0	0	0	0	0	0	0	0
Total Heads-on Harvest, Pounds:	0	0	0	0	0	0	0	0	0	0
PROJECTED SALES:										
Total Heads-off Sales ($1,000's)	$618	$644	$662	$662	$662	$662	$662	$662	$662	$662
Heads-off Sales/acre:	$3,499	$3,640	$3,739	$3,739	$3,739	$3,739	$3,739	$3,739	$3,739	$3,739
Total Heads-on Sales (1,000's):	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Heads-on Sales/acre:	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Aggregate Sales/acre:	$3,499	$3,640	$3,739	$3,739	$3,739	$3,739	$3,739	$3,739	$3,739	$3,739

* Land purchased and/or leased is assumed to be 30% larger than the total cultured water surface.