AQUACULTURE EXTENSION
Illinois - Indiana Sea Grant Program

Sea Grant # IL-IN-SG-FS-92-IS

Fact Sheet AS-487

ECONOMICS

Analyzing the Profitability of Hybrid Striped Bass Cage Culture

Jean Rosscup Riepe
Department of Agricultural Economics
Purdue University

LaDon Swann
Illinois-lndirtna Sea Grant Program
Purdue University

Paul B. Brown
Deparment of Forestry and Natural Resources
Purdue University

The aquiculture industry is growing in the North Central Region, including the states of Illinois and Indiana. This growth is understandable. Farmers consider an aquiculture enterprise as a productive use of otherwise idle resources or as a means to farm diversification. Both farm and nonfarm entrepreneurs believe aquiculture is an opportunity to profit from the shift in consumer preferences from red meat to chicken and seafood.

The Value of Enterprise Budgeting

Before deciding whether to undertake or to continue an aquiculture enterprise, the successful aquaculturist needs to develop a business plan and evaluate the potential profitability. Enterprise budgeting is a management tool useful for both planning and profitability analysis. With regard to business planning, developing an enterprise budget is an excellent, organized method for helping the aquaculturist understand all aspects, costs, and input requirements of every stage of the operation, from production system selection to product marketing.

To facilitate profitability analysis, enterprise budgets require numerical estimates of production assumptions and factors (such as pond size and feed conversion, respectively), direct costs (for feed), indirect costs (for equipment), marketing revenues, and input requirements (such as investment costs and feed quantities needed). Enterprise budgeting encourages consistent and accurate record keeping, a vital management tool, during the months that the fish are being produced and marketed. It alerts the aquaculturist to types of data necessary to analyze profitability.

The Enterprise Budget

The assumptions and estimates of production factors, costs, and revenues summarized in Table 1 should serve only as guidelines for potential or current aquaculturists. Even though the figures reflect average management skills and costs, they cannot accurately represent any particular situation. A column titled "Your Farm" has been included in the budget for the individual to adjust the given budget figures to the realities of each aquaculturist's situation.

The equations used to make budget calculations are included in Table I to enable aquaculturists to calculate their own figures, whether through use of a calculator or computer spreadsheet. Aquaculturists with their own computers can easily incorporate budget items and equations into a spreadsheet program. Alternatively, county agricultural agents can assist interested parties in the use of FINPACK or other software packages for computerized budget analysis.

The enterprise budget in Table 1 outlines the financial considerations important to hybrid striped bass cage culture. The budget reflects specific production and marketing conditions, as set forth in the first section of the table; it represents an average year in the operation of the enterprise. The budget is divided into four sections: Assumptions and Production Factors, Direct Costs, Indirect Costs, and Profitability Calculations.

Assumptions and Production Factors

This first section contains the assumptions and production information necessary to correctly interpret the cost, revenue, and profitability estimates. Assumptions concerning such things as the pond size, length of production cycle, type of cage, and interest rate define the specific setting for the budget. The assumptions are included directly in the

Table 1. Enterprise budget for hybrid striped bass cage culture in an existing 5-acre pond in Indiana.

Assumptions and Production Factors

Pond size: 5 acres
Harvest size: 1.5 lbs
Production cycle: 6 months
Cage description: 3.5'x4', cylindrical
Fish marketing: fish sold live, pond-side
Labor needed: 45 min/day= 22.5 hrs/month
Production: 1,000 lbs/A = 5,000 Ibs.
Market price: $2.00/lb.
No. of fish/cage harvested: 250
Interest rate: 12%
Death loss: 10%
Fingerling size: 6-8 inches

No. of fish harvested: 5,000 lbs ÷ 1.5 lbs = 3,333 fish
No. of fingerlings purchased: No. of fish harvested ÷ (l-death loss)= 3333 ÷ (1-.10) =3333 ÷ .9= 3704 fingerlings
No. of cages: No. fish Fish/cage= 3333 ÷ 250 = 13.33 + 1 = 14 cages
No. of fingerlings/cage: No. fingerlings ÷ (No. cages-1)= 3704 ÷ 13 = 285 fingerlings/cage
Feed conversion: 2.0 Ibs. feed/lb. gain
Feed quantity: No. fingerlings purchased x harvest size x feed conversion =3704 x 1.5 x 2.0 = 11,112 Ibs, of feed
Cage construction costs: $15 labor + $20 frame, flotation + $5 wire + $25 netting = $65/cage
:$65/cage x 14 cages= $910 total

Direct Costs

Budget item	Unit	Cost/Unit	Quantity	Annual Cost	% of TC	Your Farm
Fingerlings	head	$0.75	3,704	$2,778.00	43.7%	
Feed	lb.	$0.25	11,112	2,778.00	43.7%	
Chemicals	cage	$2.50	14	35.00	0.6%	
Subtotal of operating capital				$5,591.00	88.0%	
Interest on operating capital	$	6%	$5,591	335.46	5.3%	
Total Direct Costs/Year				**$5,926.46**	**93.2%**	

Indirect Costs

Budget Item	Useful Life A	Initial Investment B	Annual Depreciation C = B ÷ A	Average Interest D=(B÷2)xi.r.	Annual Cost E = C + D	% of Total costs	Your Farm
Cages	10 yrs.	$910	$91.00	$54.60	$145.60	2.37%.	
Boat	10 yrs.	500	50.00	30.00	80.00	1.3%	
Oxygen meter	5 yrs.	400	80.00	24.00	104.00	1.6%	
Permits, etc.	1 yr.	50	50.00	3.00	53.00	0.8%	
Miscellaneous[a]	4 yrs.	150	37.50	900	46.50	0.7%	
		$2,010		$120.60			
Total Indirect Costs/Year					**$429.10**	**6.8%**	

[a] Scales, rope, dipnets, and buckets.

Profitability Calculations

		Your Farm
Total yearly costs (Direct + Indirect)	**$6,355.56**	
Break-even price (Total Yearly Costs ÷ Production)	$1.27/lb.	
Break-even price / direct (Direct Costs ÷ Production)	$1.18/lb.	
Gross revenue (Production x Market Price)	$10,000.00	
Net revenue (Gross Revenue - Total Yearly costs)	**$3,644.44**	
First year cash requirement (Total Investment +(2 xTotal Average Interest) +Total Direct Costs)	$8,177.66	
First year cash requirement excluding interest (Total Investment + Subtotal of Operating Capita])	**$7,601.00**	

table rather than in the accompanying text to minimize misinterpretations and to enable use of the budget apart from the text. Estimates of production factors including death loss, feed conversion, fingerling stocking rate, and cage production costs also are included because they directly affect cost and profitability estimates; however, they are cumbersome to include within the costs and profitability calculations themselves. Equations for calculating production factors are included where applicable.

Direct Costs

The itemization and calculation of direct costs forms the second part of Table 1. Direct costs of production are costs which vary with the level of production; they are not incurred if there is no planned production in a given year. Items included as direct costs in this budget are fingerlings, feed, chemicals, and interest on operating capital (the other direct costs).

Indirect Costs

The data and equations for calculating the annual costs of budget items classified as indirect costs are included in the third section of the enterprise budget. Indirect costs are those which, once the enterprise is underway, are incurred regardless of the level of production, even if that level is zero. In Table 1, indirect costs for depreciation and interest on investment are included for the budget items cages, boat, oxygen meter, permit and licenses, and miscellaneous, Al I equipment items have useful lives of multiple years. Since an enterprise budget is set up to reflect costs and returns for an average year, the costs incurred by the enterprise in the first year to obtain and maintain the equipment must be spread out over the useful life of the equipment. The equations in the columns labeled A through E indicate how an annual cost for each item is calculated. The annual cost for each budget item does not vary within a production cycle and would only change if the useful life or initial investment of the budget item changed, or the interest rate paid changed.

Profitability Calculations

The final section of Table 1 contains the equations and results of profitability calculations. The calculations were based on data obtained either from the Assumptions and Production Factors section or from cost calculations in the Direct Costs and Indirect Costs sections.

Total Yearly Costs is the summation of total direct costs per year and total indirect costs per year. This figure reflects all costs of the enterprise for an "average" year, not for a specific year. For example, costs in the first year of operation will be quite different than costs in the second, because of the first year initial investments in equipment and miscellaneous items.

It should be noted that the total yearly cost figure in the enterprise budget in Table 1 reflects only those costs included in the Direct Costs and Indirect Costs sections of Table 1. Depending upon the particular situation or the desired use of the enterprise budget, other items may need to be included as direct or indirect costs. For example, a farmer who intends to compare the profitability of an aquiculture enterprise with that of another farm enterprise may take into account the value of land. labor, and management inputs that are needed in the aquiculture enterprise. Appropriate annual charges for these budget items would be included in the Indirect Costs section.

A different type of example could be used for an aquaculturist who plans to process the fish after harvest and sell fillets to a local restaurant. This alternative marketing plan might require additional direct costs for budget items such as hired processing labor, materials consumed during processing, transport fuel costs, or marketing costs. Extra indirect costs may be incurred as well: annual costs for a hauling truck, processing equipment, buildings, and equipment to store or transport the fillets. It is very important for the aquaculturist to consider and include all costs determined appropriate and important for analyzing profitability.

Break-Even Price is calculated by dividing total yearly costs by pounds produced and marketed. The break-even price indicates the minimum market price per pound that must be obtained to cover all costs of the operation. If the aquaculturist is able to obtain a greater price, then a profit is made on the enterprise. A lesser price will result in a loss. It is important for Aquaculturists to know their break-even prices in order to negotiate acceptable selling prices.

Break-Even Price/Direct is a break-even price variation where only direct costs are used to calculate the break-even price. The Break-Even Price/Direct is useful in making economic decisions only after the enterprise has been started. Before actually undertaking production in the first and subsequent years, the aquaculturist must make a decision about whether or not producing fish at any production level is profitable for that particular production cycle. Since indirect costs are incurred regardless of the level of production, even zero, the Break-Even Price/Direct becomes the absolute minimum market price which the producer could accept and cover the direct costs of production. A market price below this price signals the producer not to undertake production at all for that production cycle. A price above indicates that not only are direct costs recouped, but all or a portion of the indirect costs are covered as well.

Gross Revenue is the value of all marketed fish. The exact figure can be obtained by multiplying pounds produced and marketed by market price. Be sure that the "pound" in pounds produced is the same type as the "pound" in market price per pound. That is, if the fish are to be sold by liveweight, then the calculation should be for liveweight produced and dollars per pound of liveweight. If fillets will be sold, then both parts of the equation should be based on pounds of fillets. This also is important when calculating break-even prices.

Net Revenue is the money left over once total yearly costs have been subtracted from gross revenue. Net

revenue should be interpreted differently depending upon which costs are included as indirect costs, For example, if charges for land, labor, and management are all included in the budget as indirect costs, then net revenue is considered profit. However, if these items are not included as indirect costs, then net revenue is typically considered a return to land, labor, and management.

First Year Cash Requirement, while not affecting the profitability of an enterprise, does enter into the decision to startup the enterprise. The first year cash requirement is a summation of all the cash outlays that are needed in the first year of production. This figure is not automatically calculated in a budget because the budget figures represent an "average" year. Cash outlays during the first year include not only payments for all direct costs, but also for the initial purchase of equipment and other indirect budget items, as well as up to one full year's interest on the initial investment amount. If the potential aquaculturist does not have or cannot raise this level of funding, the enterprise should not be undertaken. Keep in mind that calculating the first year cash requirement cannot take the place of preparing a cash flow statement as part of the overall business plan.

First Year Cash Requirement Excluding Interest summarizes first year cash outlays but without the interest costs on operating capital and investment. Most enterprise budgets are put together assuming the producer needs to borrow the necessary funds; but when this is not the case for a particular situation, interest costs can be dropped from the entire budget.

Changes in Budget Parameters

In a world of limited resources, the aquaculturist must decide which budget parameters (assumptions, production factors, costs, etc.) need the most careful attention in order to ensure profitability. It is very easy, in the name of minimizing costs, to spend 60% of the hours devoted to labor and management of the enterprise on budget parameters which, when their values fluctuate,

Table 2. Effect of changes in key budget parameters on break-even price and profitability.

Budget parameters	Break-even prices (percent change from budget) / Alternative values (percent change from budget)				Sensitivity pctg.[a]
Harvest Size (lbs. per fish)	$1.39 (+9%)	$1.27 (O%)	$1.19 (-6%)	$1.12 (-12%)	57-35%
	1.25 (-17%)	1.50 (0%)	1.75 (+17%)	2.00 (+33%)	
Death Loss (percent)	$1.21 (-5%)	$1.27 (0%)	$1.34 (+6%)	$1.42 (+12%)	12%
	5 (-50%)	10 (0%)	15 (+50%)	20 (+100%)	
Feed Conversion (lbs. feed/lb. gain)	$1.12 (-12%)	$1.27 (O%)	$1.42 (+12%)	$1.57 (+24%)	44%
	1.5 (-25%)	2.0 (0%)	2.5 (+25%)	3.0 (+50%)	
Feed Cost ($ per lb.)	$1.04 (-18%)	$1.15 (-9%)	$1.27 (0%)	$1.39 (+9%)	44%
	0.15 (-40%)	0.20 (-20%)	0.25 (O%)	0.30 (+20%)	
Fingerling Cost ($ per head)	$1.11 (-13%)	$1.19 (-6%)	$1.27 (O%)	$1.35 (+6%)	44%
	0.55 (-27%)	0.65 (-13%)	0.75 (0%)	0.85 (+13%)	
Interest (% per annum)	$1.24 (-2%)	$1.26 (-1%)	$1.27 (O%)	$1.29 (+2%)	7%
	8 (-33%)	10 (-17%)	12 (0%)	14 (+17%)	

[a] Percentage by which total costs and break-even price will change given a 100% change in the value of a budget parameter; or, given any percentage change in a budget parameter, the proportion of that change that is passed along to total costs and break-even price,

Note: Break-even price from Table 1 is $1.27/lb. Values in bold type are budget parameters used in Table 1.

have only negligible effects on total costs or break-even price. Efficiency demands that the producer eliminate and concentrate. Table 2 contains alternative values for several important budget parameters and the resulting break-even prices. The sensitivity percentage listed for each parameter tells how much of a given change in that parameter translates into a change in total costs or break-even price. For instance, a given change in feed conversion (say it increased 50% from 2.0 to 3.0) results in 44% of that change being passed along to total costs and break-even price (which would increase 24% from $1.27 to $1.57), while a change of similar magnitude (50% increase) in death loss results in only 12% of the change being passed along (total costs and break-even price increase 67%).

For those parameters which directly affect the annual cost of a particular budget item (e.g. feed cost per unit and feed conversion both directly affect the annual cost for feed), the sensitivity percentage is approximately the same as the percentage of total costs for which that budget item accounts. For example, since annual feed costs in Table 1 represents 44% of total costs, then the sensitivity percentage for both feed cost per unit and feed conversion is 44%. In Table 2, only death loss and harvest size do not directly affect annual costs, but both indirectly affect the annual costs for both fingerlings and feed. To determine sensitivity percentages for these two parameters, alternative values are used to recalculate the budget and determine the relative impact on total costs and break-even price.

The budget parameters with the highest sensitivity percentages have the largest impacts on total costs, break-even prices, and profitability. The producer should therefore spend relatively more time managing these parameters. The data in Table 2 reveal that death loss and interest costs are less important than harvest size, feed cost per unit, feed conversion, and fingerling costs per unit for a profitable hybrid striped bass cage culture enterprise.

Sensitivity analysis can be conducted by means of a five-step process.

Step 1. Calculate the proportion of total yearly costs for which each budget item accounts, and list the items with the highest proportions. In Table 1, the top three budget items are fingerlings (43.7%), feed (also 43.7%), and interest (7.2% including indirect interest costs).

Step 2. Identify for each budget item the components needed to calculate the annual cost. Fingerling annual cost in Table 1 does not depend only on cost per unit and quantity (number of fingerlings purchased) because the quantity is calculated from the production level, harvest size of the fish, and death loss. Since the production level is assumed to remain constant in this budget, only harvest size and death loss, along with fingerling cost, can vary and affect enterprise profitability. The budget parameters listed in the left-hand column of Table 2 are the variable components of the three most important budget items from Table 1.

Step 3. Determine whether each component directly or indirectly affects the annual cost of each budget item, Of the six components in this example, four directly affect annual costs: fingerling cost per unit, feed cost per unit, feed conversion, and interest cost per unit.

Step 4. Calculate sensitivity percentages. Recalculate the budget for each alternative value of each indirect component to obtain new total cost figures. For each combination of component value and recalculated total cost, divide the percentage change in the total cost by the percentage change in component value. Multiply this ratio by 100 to obtain the sensitivity percentage. For some indirect components, this percentage remains the same regardless of the value of the component or the size of the component's change. This is the case for death loss. As can be seen in Table 2, the sensitivity percentage for death loss remains a constant 12% (roughly). The sensitivity percentage changes for harvest size, though, as harvest size increases. The sensitivity percentage for each direct budget parameter is the same as the percentage of total costs for which the associated budget item accounts. From the budget in Table 1, then, all direct components of fingerling and feed annual costs have a sensitivity percentage of roughly 44%.

Step 5. List budget parameters and compare sensitivity percentages. After listing each budget parameter, write in the sensitivity percentage calculated in Step 4. For those with a non-constant percentage, write in the range of percentages corresponding to the expected range of alternative values of that component. For instance, since harvest size is not likely to be less than 1.0 lbs. or more than 2.0 lbs., the corresponding range of sensitivity percentages is 71-35%. Producers should concentrate on budget parameters with higher sensitivity percentages since these parameters have relatively larger impacts on profitability.

This fact sheet was made possible from Purdue's Crossroads 1990 initiative with supplemental funding from the Illinois-Indiana Sea Grant Program and Purdue University's Center for Agricultural Policy and Technology Assessment.

Printed on Recycled Paper

PRINTED WITH SOY INK

NA 89AA-D-SG058 RR 10/94 (1M)