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Profitability of Hybrid Striped Bass Cage Aquaculture in the Midwest

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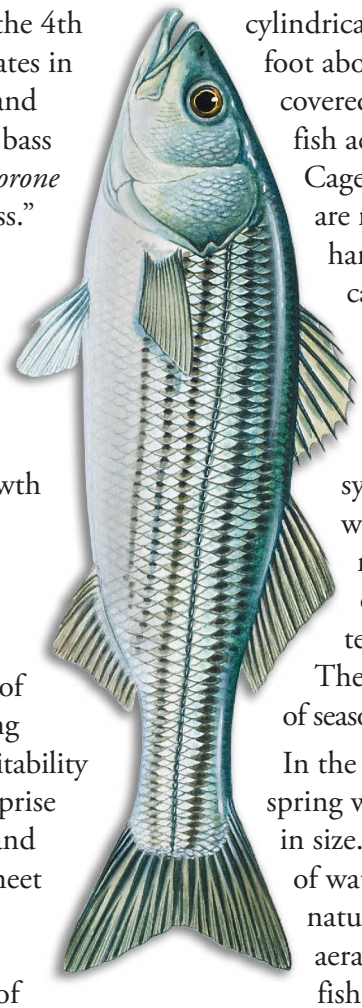
The hybrid striped bass (HSB) industry is the 4th largest aquaculture industry in the United States in terms of sales value, behind catfish, salmon, and trout. HSB is a cross between a female white bass (*Morone chrysops*) and a male striped bass (*Morone saxatilis*). HSB is also known as "sunshine bass." The hybridization of the white bass and the striped bass makes HSB more tolerant to extreme temperatures and dissolved oxygen than either of its parents. Most southern states produce HSB in ponds, with most of the production occurring in North Carolina, Texas, and Florida. There is potential for growth in production in Indiana and the Midwest because of the abundance of farm ponds and private lakes.



This analysis uses an annual enterprise budget to evaluate the potential profitability of HSB cage operation. The enterprise budgeting process is essential for both planning and profitability analyses. It gives a snapshot view of the enterprise relating to all input requirements and costs, and expected revenue/returns. A detailed spreadsheet tool for this enterprise budgeting process for HSB, as well as for other fish species, is available at Purdue University's Department of Agricultural Economics Web page: https://ag.purdue.edu/agecon/Pages/Aquaculture-Budget.aspx.

Cage-Culture Considerations

Farm ponds or private lakes to be used for floating cages should be deep enough to allow enough water circulation through and within the cages. Cages can be cylindrical or rectangular and should have at least a foot above the water surface. Cages should be covered to prevent predators from getting in and fish accidentally jumping out of the cages. Cages can be of different sizes, but larger sizes are not recommended because of difficulty in handling, especially at harvest time. The cages should be anchored in the pond/lake or secured to a dock. Although not essential, aeration of cages and/or water surrounding the cages is highly recommended as part of a de-stratification system. The aeration helps to mix warm water on the surface during warm weather months with cooler water in lower water columns, resulting in uniform water temperatures and oxygen concentration. The process also minimizes the deadly effects of seasonal pond "turnover."

In the Midwest, the production cycle begins in spring with feed-trained fingerlings of 4-8 inches in size. Stocking density is about a fish per gallon of water, depending on the fingerling size, nature of the pond/lake, water circulation, aeration, etc. Others recommend stocking 6 fish per cubic foot of 6-8 inch fingerlings. The volume of water required for stocking is estimated by the part of the cage under water. The fish is grown to market size from 1.25 to 2 pounds over 18 months with formulated feed. Market size fish are harvested and sold either as fresh on ice or to live fish markets. HSB produced in Indiana are sold live to live haulers with no processing.

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An Example

This example uses data from three cage aquaculture operations in Indiana as well as input from aquaculture research and Extension faculty and staff at public universities in the Midwest. A representative 20-cage operation is used in the study reported here, which is very feasible in most farm ponds and private lakes in the Midwest.

1. **Water Acres:** The facility used for the analysis is assumed to be at least a 5-acre pond. This could be a private farm pond that is not suitable for pond aquaculture, private lake, or some other water bodies deep enough for floating cages. These water bodies can be leased for cage aquaculture similar to leasing agricultural lands for farming.
2. **Cages:** Cage dimension is 4ft x 4ft x 6ft cage, and by allowing a foot of the cage above water, the volume of water (in gallons) per cage is 3ft x 4ft x 6ft = 538.6 gallons of water. Farmers can construct their own cages with materials from a local hardware store. The construction cost is based on materials needed and amount of labor needed for construction.
3. **Production Schedule:** Fish are harvested from 18 months at an average weight of 1.5 pounds. Table 1 presents the production schedule for a 20-cage HSB operation. The 18-month production period implies that production is from spring of the first year to fall of the second year and/or from fall of the first year to the spring of the third year. This production schedule ensures annual harvesting of cages from the second year onwards, averaging 12 cages per year over a 10-year period. The annual enterprise budget for 12 cages is presented in Table 2.
4. **Fingerlings:** The number of fingerlings needed for stocking is based on the water volume in the cages and survival. The optimum stocking density is about a fish per gallon of water, but a conservative stocking density should be less. Fingerlings of about 4-5 inches are stocked at the beginning of a growing season for about 18 months.
5. **Production Parameters:** The survival rate of the fish during the production period and feed conversion are important factors in fish production and depend on a number of factors, including management. This analysis assumes:
    i. Survival rate of 70%
    ii. Feed conversion ratio of 1.5 pounds, i.e., on the average, 1.5 pounds of feed is needed to produce 1 pound of fish weight.
6. **Marketing:** The analysis assumes that harvested fish are marketed as live fish at the pond-side. Live fish haulers commonly come to pick up fish at the pond-side and pay wholesale prices. They then haul fish to major markets, so the producer typically does not incur marketing costs.

Table 1: Production Schedule for a 20-Cage HSB Operation

		SPRING	FALL	Total
Year 1	Stock	Batch 1 (10 cages)	Batch 2 (10 cages)	20 cages
	Harvest	-	-	-
Year 2	Stock		Batch 1 (10 cages)	10 cages
	Harvest	-	Batch 1 (10 cages)	10 cages
Year 3	Stock	Batch 2 (10 cages)	-	10 cages
	Harvest	Batch 2 (10 cages)	-	10 cages
Year 4	Stock	Batch 1 (10 cages)	Batch 2 (10 cages)	20 cages
	Harvest	Batch 1 (10 cages)	Batch 2 (10 cages)	20 cages
Year 5	Stock	-	Batch 1 (10 cages)	10 cages
	Harvest	-	Batch 1 (10 cages)	10 cages
Year 6	Stock	Batch 2 (10 cages)		10 cages
	Harvest	Batch 2 (10 cages)		10 cages

Table 2: Annual Enterprise Budget for a 12-Cage Hybrid Striped Bass Culture

	Unit	Cost / Unit ($)	Quantity	Cost ($)	% of Total cost
Sales Receipts	lb	3.75	9,540	35,775.00	
Variable Inputs:					
Fingerlings (4")	Number	0.55	9,091	5,000.00	16%
Feed Price	lb.	0.60	10,710	6,426.00	20%
Electricity Cost	kw-hr.	0.15	14,310	2,146.50	7%
Hired Labor	Hour	10.00	400	4,000.00	13%
Transportation Costs	fish	0.15	9,091	1,363.64	4%
Chemicals	year	100.00	12	1,200.00	4%
Insurance	%	20,136.13	0.02	402.72	1%
Loan + Interest	%			1,819.03	6%
Total Variable Costs (TVC)	$			**22,357.88**	**70.77%**
Cost/lb				**2.34**	
Fixed Inputs:					
Water acres	acre	250.00	12	3,000.00	9%
Cages	Number	9,000.00	0.2	1,800.00	6%
Storage Building	$	1,500.00	0.1	150.00	0%
De-stratification system	$	3,000.00	0.1	300.00	1%
Dock/Boat	$	2,000.00	0.1	200.00	1%
Miscellaneous farm equipment	$	3,000.00	0.2	600.00	2%
Maintenance	$	181.50	12	2,178.00	7%
Administration/Management	%	20,136.13	5%	1,006.81	3%
Total Fixed Costs				**9,234.81**	**29.23%**
Total Costs (TC)	$			**31,592.69**	**100.00%**
Break-even price (BEP)	$/lb			**3.31**	
Profit above TVC	$/lb			**1.41**	**42%**
Profit above TC	$/lb			**0.44**	**13%**

Profitability Analysis

Table 2 presents the annual enterprise budget that ensures 12 harvested cages per year. The budget is divided into four sections: Sales Receipts, Variable Inputs (Costs), Fixed Inputs (Costs), and Measure of Profitability. The costs associated with the variable inputs are expenses incurred with production of HSB. The costs associated with the fixed inputs are expenses that will be incurred whether HSB production takes place or not. Initial investment requires some cash and in-kind financial commitment. Fixed cost items in cage production of HSB include the water body to use, cages, storage building, de-stratification system (air pumps, air stones, etc.), boat or a dock, miscellaneous farm equipment such as nets, scale, testing equipment, buckets, etc.), and maintenance.

Revenue

The wholesale price is $3.75/lb. This is the price paid by live haulers at pond-side. The budget assumes harvesting 530 fish at 1.5lb per cage for a total of 9,540lbs. At $3.75/lb, total sales revenue amounts to $35,775 per year.

Variable Costs

- **Fingerlings:** The volume of water per cage is 538.6 gallons. Assuming 530 fish per cage (6,360 fish for 12 cages) and expected 1.5lb/fish weight at the end of production period, the total pounds of fish expected from the 12 cages is 9,540 (6,360 X 1.5) pounds of harvested fish (Table 2). A survival rate of 70% is assumed, so to obtain the target amount of fish to be harvested, more fish should be stocked to account for the deaths. A total of 9,091 (6,360 / 70%) fingerlings are needed to obtain the targeted 6,360 fish reaching a market size of 1.5 pounds at harvest. In the budget, fingerlings cost accounts for 16% of total cost.
- **Feed:** Fish should be fed to satiation daily with a 41% protein feed. Feeding may be twice a day and much less frequent prior to the harvesting period. Assuming a feed conversion ratio of 1.5, 10,710lb (ending biomass less beginning biomass X 1.5) of feed is needed. At a unit cost of $0.60/lb, feed costs amounts to $6,426 and account for 20% of total cost.
- **Labor:** Labor is hired for miscellaneous activities on the farm, including equipment maintenance and repair, stocking, feeding, and harvesting. Hired labor is considered a variable input, but operator/family labor is considered part of administration/management and as such considered as fixed cost. It is assumed that about 1 hour a day is required for hired labor for a total of 400 hours per year at a rate of $10/hr. The total hired labor cost for the year is $4,000.
- **Electricity:** Electricity may be required to run air pumps, aerators, and a de-stratification system. It is estimated that about 14,310 kw-hr is required at a rate of $0.15/kw-hr for an estimated cost of $2,147/year. This accounts for 7% of total costs.
- **Transportation:** Transporting of fingerlings, feed, and other farm supplies is estimated to be $1,364.
- **Miscellaneous:** Chemical cost is based on typical usage on the farms from which data was collected, but it can vary quite significantly depending on disease prevalence and severity. This is estimated to be $1,200 per year. The budget makes provision for insurance cost (estimated to be 2% of all operational costs). It is assumed that a commercial loan is secured for the capital costs with a 20% down payment and interest rate of 9%. The loan payment with interest accounts for 6% of total variables cost.

Fixed Costs

- **Water Acres Rental:** The analysis assumes a rental of $50/water acre, so for 5 acres, $3,000 is to be paid in rent for a year ($50 X 5 acres X 12 months). This amounts to 9% of total cost. The charge reflects land rents in Indiana for specialty crops. The Indiana Department of Agriculture considers aquaculture a type of specialty agriculture. If this is a private farm pond or lake, the rental amount represents the opportunity cost of the property.
- **Cages:** The cost of a cage is taken to be $450, and a cage is assumed to have an operational life of 5 years with no salvage value. That amounts to $9,000 for the 20 cages. This amount is spread over the 5 years of operational life to obtain an annual cost of $1,800.
- **Storage Building:** A storage building is required for feed and farm equipment. It is estimated that a good-sized farm building will cost about $1,500 and be used for 10 years. This assumption means an annual cost of $150.
- **De-stratification System:** The system is basically the use of an aeration system to frequently mix water at lower levels with surface water. This could

be electric-powered air diffusers, pump aerators, paddle wheels, fountains, etc. De-stratification results in relatively uniform water temperatures throughout the water column, increased availability of dissolved oxygen to the fish, and reduction in any potential chemical buildup near the cages. These factors enhance the growth of fish. The system is estimated to cost $3,000 with an operational life of 10 years, bringing the yearly cost to $300.

- **Dock/Boat:** The cages may be anchored to a dock for easy access to manage production, including feeding fish. In some instances, the cages can be anchored across the lake or pond, which requires the use of a small boat to gain access. It is estimated that a dock or boat will cost $2,000 and have an operational life of 10 years with no salvage value. If the cost is spread over the useful life of the property, it amounts to $200 per year.
- **Miscellaneous Farm Equipment and Utensils:** This includes nets, scale, testing equipment, buckets, etc., commonly needed on a fish farm. They are also assumed to last 5 years with no salvage value.
- **Other:** A 5% charge on total variable costs is estimated for administrative services and management as well as a 2% charge on annual fixed costs for maintenance.

Profitability

On the average, Table 2 suggests that, with a total cost of $31,593, the break-even price comes to $3.31/lb for cage aquaculture production of HSB. This is calculated by dividing the total cost of $31,593 by the quantity of harvested fish, 9,540lb. The break-even price is the price point where the selling price exactly covers the total cost. For the example presented in Table 2, it suggests that farmers can profit by selling fish at prices higher than the break-even price of $3.31/lb. The calculated profit margin above total variable cost is about $1.41/lb or 42%, while the profit margin above total cost is about $0.44/lb or 13%. The percentage profitability can be used for risk analysis on profitability outcomes and also to compare profitability with other aquaculture ventures or traditional agricultural enterprises.

Sensitivity Analysis

Aquaculture, just like any other agricultural enterprise, is a risky business. The variables considered to fluctuate more randomly and that thus would affect profitability include feed conversion, survival rate, selling price, fingerling price, and feed price. These variables fluctuate randomly because they are dependent on various uncertain factors such as the economy, gasoline prices, biology, weather patterns, management, etc. For example, feed conversion depends on type of feed, water temperature, and body metabolism; prices depend on supply and demand interactions in the marketplace and availability of substitutes. Other variables such as survival (or mortality) depend on disease incidence and management issues. Poor handling of fish during transportation and stocking causes stress in fish and can enhance disease incidence and consequent mortality.

The budget presented in Table 2 was subjected to sensitivity analysis to determine which variables had significant impact on percentage profitability. Survival rate and selling prices were found to have the most impact. Therefore, a range of selling prices and survival rates were assessed to examine profitability outcomes. The results are presented in Table 3. The percentage profitability outcomes ranges from a low of 6% with

Table 3: Percentage Profit with Different Survival Percentages and Selling Prices

Survival	Selling Price				
	$3.70	$3.80	$3.90	$4.00	$4.10
50%	6%	9%	11%	14%	17%
60%	9%	12%	15%	18%	21%
70%	12%	15%	18%	21%	24%
80%	14%	17%	20%	23%	26%

50% survival and $3.70/lb selling price to a high of 26% with 80% survival and selling price of $4.10/lb. Overall, there are positive profitability outcomes from the production Hybrid Striped Bass in cages at the current wholesale prices.

The spreadsheet tool available at Purdue University's Department of Agricultural Economics Web page https://ag.purdue.edu/agecon/Pages/Aquaculture-Budget.aspx may be used to assess various scenarios and potential outcomes for this HSB enterprise budgeting process.

Conclusion

The culture of hybrid striped bass in cages can be profitable. Farmers may hot have control over fingerling and selling price of their fish, but they can manage the production process well with attention to feed management and fish handling, which affect feed conversion and survival rate, respectively.

Suggested Literature/Tools

Aquaculture Economics and Marketing Resources, Purdue University. https://ag.purdue.edu/agecon/Pages/Aquaculture-Budget.aspx

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