North Central Regional Aquaculture Center

In cooperation with USDA's Cooperative State Research, Education and Extension Service

Costs for Pond Production of Yellow Perch in the North Central Region, 1994–95

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Introduction

The development of culture methods for yellow perch has sparked interest throughout the North Central Region (NCR). Many researchers and industry entrepreneurs believe that this species holds tremendous potential for aquaculture in the region, from both production and marketing perspectives. As a result, a substantial amount of research on yellow perch culture methods has been undertaken in the region in recent years. Economic research on yellow perch, however, has been more limited. The budget work reported in this publication is the result of an effort by Purdue University and the North Central Regional Aquaculture Center (NCRAC) to provide economic information on yellow perch production in ponds. A fuller presentation and explanation of these pond budgets can be found in NCRAC Technical Bulletin #111.

The enterprise budget

An enterprise budget is a management tool that organizes and calculates cost information. It is a financial document that provides a detailed estimate of the costs associated with all of the inputs and investments needed for a specific enterprise.

An enterprise budget is useful, both during its development and upon its completion. The budget development process forces the aquaculturist to spend time investigating, collecting, organizing, and analyzing specific cost information relevant to the long-term success of the business. The completed enterprise budget provides the aquaculturist with a reasonable estimate of production costs and profitability, and with a decision-making guide.

An enterprise budget has limitations, however. A budget can be useless or misleading if its developer does not invest the necessary time and effort needed to obtain realistic estimates. Also, an enterprise budget is an estimate at a fixed point in time (like a photograph) whereas the "real" world is constantly moving and changing (like a full-length movie). Prices can fluctuate from one day to the next without warning. Production values (e.g., feed conversion ratio, death loss, feed intake, growth rate) also change and they can be hard to estimate precisely. This is especially true if the aquaculturist has not kept good records or has not yet settled into a consistent production plan. Therefore, an enterprise budget should be updated regularly.

Finally, every enterprise budget is enterprise-specific. Published budgets, such as those presented in this publication, will never take the place of self-produced budgets that reflect the aquaculturist's own physical location, management skills, water and land resources, capital availability, production knowledge, risk-taking behavior, marketing abilities, equipment, system setup, and production values.

North Central Regional Aquaculture Center
Fact Sheet Series #111
USDA grant # 93-38500-8392
May 1997

Pond budget assumptions

Following is a brief description of the assumptions used in the yellow perch budgets and the methods employed for obtaining budget data. For a more thorough discussion of these issues, see NCRAC Technical Bulletin # 111.

Many assumptions underlie the yellow perch budgets in this publication. Each of them influences the production cost estimates. Therefore, the cost estimates should be used as guidelines only.

The budgets contain assumed values of several production parameters including death loss, feed conversion ratio, production time, fingerling size, harvest size, stocking density, and labor per day. The cost data in the budgets are based on these assumed production values. The values assumed were obtained by interviewing yellow perch experts at various universities in the NCR. There are not enough private yellow perch producers in the region to be able to base cost data on their production values.

Some general budget assumptions are itemized below.

Production

It was assumed that advanced fingerlings (about 4-5 inches) are stocked in the ponds at the beginning of the outdoor growing season (April). The fish are then grown out to market size by the end of the growing season (October / November).

Marketing

It was assumed that the producer harvests the fish and markets them in the round, on ice, to wholesale food fish buyers. A pickup truck with a refrigerator unit in the bed is used to transport the fish.

Size of operation

Two different sizes of operations were modeled: 5,000 and 50,000 lbs. of production.

Land

A land charge was assumed for each operation based on property taxes and opportunity cost. For both pond operations, the opportunity cost is the net revenue that the operator could have made if the land had been used for corn production instead of being converted to ponds.

Accounting procedure

The budgets do not reflect U.S. Internal Revenue Service (IRS) rules and regulations for farm enterprise accounting. Aquaculturists should seek professional guidance when preparing their own budgets and tax statements.

Location

The budgets reflect costs and physical characteristics for Tippecanoe County, Indiana where Purdue University is located. Since every budget is location specific, costs for other locations in the North Central Region would likely be different.

The specific production assumptions for the pond culture budgets are given in Table 1. There are some differences based on the size of the operation.

Pond layout

The physical configurations of the two pond production systems are important and differ somewhat. For the 5,000-lb. operation, there is one

Table 1. Budget assumptions for pond production of food-size yellow perch in Tippecanoe County, Indiana, 1995.

	Size of operation	
	5,000 lbs.	**50,000 lbs.**
Assumed values		
Pond size (acres)	1.6667	4.1667
Production/acre (lbs.)	3,000	3,000
Number of ponds	1	4
Fingerling size (inches)	4.0	4.0
Harvest size (lbs.)	0.33	0.33
Production time (mos.)	7.0	7.0
Death loss	5%	5%
Feed conversion ratio (lbs. feed/1.0 lb. gain)	1.80	1.80
Labor per day (hours)	1.5	3.5
Interest rates		
Operating capital	12%	12%
Investment capital	9%	9%
Investment repairs, taxes, and insurance rate	3.5%	3.5%
Calculated values		
Targeted production (lbs.)	5,000	50,000
Number of harvested fish	15,152	151,516
Number of fingerlings	15,949	159,491
Feed quantity (lbs.)	9,231	92,308

square pond with one well, one ditch, and one gravel-covered levee. The pond surface area is 1.67 acres and the land area is 1.88 acres. For the 50,000-lb. operation, there are four square ponds, which form a larger square. This operation has one well, two ditches, and two gravel-covered interior levees. The surface area is 4.17 acres per pond, while the total land area is 17.78 acres. For both ponds, the levees are constructed to the same dimensions. The crown width is 12 feet and the depth is 6.5 feet, with levee slopes of 3:1 for exterior sides and 2:1 for interior sides.

Investment and annual ownership costs

Table 2 contains the necessary investment items, their unit costs,

Table 2. Investment and annual ownership costs for pond production of food-size yellow perch in Tippecanoe County, Indiana, 1995.

System equipment	5,000 lbs. production			50,000 lbs. production		
	Units	Unit cost ($)	Investment ($)	Unit (no.)	Unit cost ($)	Investment ($)
Pond & water supply investment						
Levees (cu. yds.)	7,711	3.5	26,989	34,534	2.75	94,969
Drainpipe (12": ft)	64	6.6	423	256	6.60	1,690
Drain/valve	1	289	289	4	289	1,156
Anti-seep collars	2	230	460	8	230	1,840
Well and pump	1	4,850	4,850	1	15,225	15,225
Grass seed (lbs.)	2.5	1.7	4	20	1.70	34
Gravel (tons)	39.5	11	435	122	11.00	1,342
Equipment requirements						
ATV, 4-wheeler				1	5,000	5,000
Boat				1	500	500
Oxygen/temp meter				1	338	338
Chemical test kit	1	28	28			
Thermometer	1	10.5	11			
Electric aerator	1	700	700	8	700	5,600
Electrical service	1	600	600	1	600	600
Feeder				1	1,650	1,650
Feed storage				1	800	800
Scale	1	90	90	1	190	190
Dipnets	1	36	36	2	36	72
Waders	1	95	95	1	95	95
Harvesting/marketing equipment						
Seine	1	832	832	1	1,293	1,293
Fish baskets	2	11	22	10	10	95
Containers for fish on ice	27	10	270	60	10	600
Refrigerator unit	1	3,000	3,000	1	7,000	7,000
Miscellaneous	1	50	50	1	150	150
Total investment			**$39,182**			**$140,238**
Total annual depreciation (Investment/useful life)			$2,670			$9,426
Total annual interest (1/2 * investment * investment capital rate)			1,763			6,311
Total annual repairs, taxes, & insurance (Investment * investment R,T,I rate)			1,371			4,908
Annual land charge (Opportunity cost + property taxes)			190			1,830
Total annual ownership cost			**$5,994**			**$22,475**

total investment, and annual ownership costs. Some of the more important assumptions and calculations regarding investment items are listed below.

Levee construction
The construction of levees for the single pond in the 5,000-lb. operation requires 1,134 running feet of exterior / interior levees for a total of 7,711 cubic yards of dirt. For the 50,000-lb. operation, there are eight exterior / interior levees totaling 3,520 running feet and four interior / interior levees requiring 1,760 running feet. The levees for the larger pond system require 34,534 total cubic yards.

Well and pump
It was assumed that the well is drilled to a depth of 100 feet, but that the water rises up to 50 feet below the surface and is pumped from that level. Assuming a pumping capacity of 30 gallons per minute (gpm) per pond surface acre, the 5,000-lb. operation requires a 50 gpm well. This could be achieved with a 5-inch well and a 3-horsepower pump. For the 50,000-lb. operation, a 500 gpm well is required. This necessitates a 10-inch well and a 25-horsepower pump. The unit costs given in the budget include drilling, casing, screen, pump, and installation.

Feeding system
Hand feeding was assumed in the smaller operation. For the larger system, however, it was assumed that a blower feeder is pulled behind an All Terrain Vehicle (ATV).

Electrical service connection
Electrical service was assumed to run 200 yards from the farmstead to the ponds where the well is located.

Aerators
It was assumed that one-horsepower per surface acre is required for all ponds. Therefore, for the 5,000-lb. operation, one 2-horsepower aerator is needed, while two 2-horsepower aerators are needed for each of the four ponds in the larger operation.

Total investment and annual ownership costs
The estimated total investment is $39,182 for the 5,000-lb. operation

Table 3. Operating and total costs for pond production of food-size yellow perch in Tippecanoe County, Indiana, 1995: 5,000 lbs. production.

Item	Unit	Unit cost	Number of units	Annual cost	Cost per lb.	Percent total cost
Operating costs						
Fingerlings	head	$0.2639	15,949	$4,209	$0.84	24.2%
Feed	lb.	0.3690	9,231	3,406	0.68	19.6
Oxygen refill kit	each	19.00	2	38	0.01	0.2
Chemicals	acre	60.00	1.67	100	0.02	0.6
Electricity						
Aeration	kwh	0.0835	804	67	0.01	0.4
Pumping	each	83.00	1	83	0.02	0.5
Labor (unskilled)	hour	6.00	276	1,654	0.33	9.5
Labor (semi-skilled)	hour	10.00	39	394	0.08	2.3
Mower charge	each	100.00	1	100	0.02	0.6
Harvesting/marketing costs						
Ice	lb.	0.10	3,333	333	0.07	1.9
Labor	hour	6.00	20	120	0.02	0.7
Pickup charge	mile	0.25	600	150	0.03	0.9
Miscellaneous	each	1.00	20	20	0.00	0.1%
Interest (operating capital)	$	7.00%	10,674	747	0.15	4.3%
Total operating costs				**$11,421**		**65.6%**
Breakeven price—operating costs					**$2.28**	
Total annual ownership costs				**$5,994**	**$1.20**	**34.4%**
Total annual costs				**$17,416**		**100.0%**
Breakeven price—total costs					**$3.48**	

and $140,238 for the 50,000- lb. operation. Total annual ownership costs in the smaller and larger operations are $5,994 and $22,475, respectively. These fixed costs account for 34.4 and 21.0 percent of total annual costs, respectively. Annual ownership costs for the larger operation are 3.75 times higher than for the smaller operation. Since the production level is 10 times higher, this suggests substantial economies of size in pond production of yellow perch.

Operating costs

Operating costs are itemized in Tables 3 and 4 for the 5,000-lb. and 50,000-lb. operations, respectively.

Fingerlings

The number of fingerlings needed for each operation is calculated within the budgets. Calculations are based on pounds of production, harvest size of fish, and death loss assumptions. The cost per fingerling is the delivered price for four-inch yellow perch fingerlings trained on feed. The price is the same for both size operations.

Feed

The quantity of feed used is calculated within the budgets, based on assumptions made for feed conversion ratio, production target, and death loss. The feed prices used are delivered prices for floating, trout finishing feed. Unlike the fingerling prices, the feed prices used differ by size of operation. The feed price for the larger pond culture operation is 26.55 cents per pound compared to 36.90 cents per pound for the smaller operation. This difference is due to the cost advantage (mainly due to lower per pound shipping costs) gained by the higher volume purchaser. Feed shipments from the manufacturer were assumed to arrive every two months for both operations to ensure that feed quality is maintained. It was assumed that the fish are fed twice a day, perhaps less as they approach market weight.

Delivered prices for fingerlings and feed can vary substantially based on a number of factors including supplier, transportation costs, product quality, volume, and location of aquaculturist. See

Table 4. Operating and total costs for pond production of food-size yellow perch in Tippecanoe County, Indiana, 1995: 50,000 lbs. production.

Item	Unit	Unit cost	Number of units	Annual cost	Cost per lb.	Percent total cost
Operating costs						
Fingerlings	head	$0.2639	159,491	$42,090	$0.84	39.3%
Feed	lb.	0.2655	92,308	24,508	0.49	22.9
Chemicals	acre	60.00	16.67	1,000	0.02	0.9
Fuel, ATV	gal.	1.00	450	450	0.01	0.4
Electricity						
Aeration	kwh	0.0835	6,432	537	0.01	0.5
Pumping	each	625.00	1	625	0.01	0.6
Labor (unskilled)	hour	6.00	643	3,859	0.08	3.6
Labor (semi-skilled)	hour	10.00	92	919	0.02	0.9
Mower charge	each	600.00	1	600	0.01	0.6
Harvesting/marketing costs						
Ice	lb.	0.10	33,333	3,333	0.07	3.1
Labor	hour	6.00	104	624	0.01	0.6
Pickup charge	mile	0.25	1,800	450	0.01	0.4
Miscellaneous	each	1.00	75	75	0.00	0.1
Interest (operating capital)	$	7.00	79,069	5,535	0.11	5.2
Total operating costs				**$84,604**		**79.0%**
Breakeven price—operating costs					**$1.69**	
Total annual ownership costs				**$22,475**	**$0.45**	**21.0%**
Total annual costs				**$107,079**		**100.0%**
Breakeven price—total costs					**$2.14**	

Appendix B in NCRAC Technical Bulletin #111 for estimates of delivered prices at different locations around the NCR.

Electricity

Electrical costs are incurred for aeration and pumping. The aerator(s) in each operation is assumed to run six hours per day (midnight to 6:00 am) during June and July, plus 10 percent. For pumping costs, it was assumed that the ponds are drained and filled once every four years.

Labor

Labor is included as an operating cost because it was assumed that the labor is hired for the production cycle only if production is actually undertaken for that year. Labor was charged to the smaller and larger pond operations at the rate of 1.5 and 3.5 hours per day, respectively.

Harvesting and marketing costs

These costs are based on the assumptions of icing down the yellow perch in the round in plastic (polyethylene) containers, placing a refrigeration unit in the bed of a pickup, and hauling the containers of fish and ice to a wholesale foodfish market. Labor charges of 4 hours per day for 26 days were assumed for the larger operation and 1 hour per day for 20 days for the smaller operation. Ice requirements were calculated on the assumption that a 60 / 40 relationship exists between pounds of fish and pounds of ice. A pickup charge was based on expected mileage for delivering fish to markets within a 50-mile radius of the farm.

Total operating costs

Annual operating costs are $11,421 for the 5,000-lb. operation to $84,604 for the 50,000-lb. operation. The operating cost items contributing the largest share to total costs include fingerlings, feed, labor, and interest.

Total costs and breakeven prices

Total annual costs for the 5,000-lb. operation are $17,416, and those for the 50,000-lb. operation are $107,079. While the production level for the larger operation is 10 times higher than the production level for the smaller operation, total costs are only 6.15 times higher. This suggests substantial economies of size in pond culture.

Breakeven prices (total costs per pound) are also substantially different by size of operation. The breakeven price is $3.48 / lb. for the smaller operation versus $2.14 / lb. for the larger operation. Wholesale market prices for perch in the round are expected to range from about $2.00 to $3.00 / lb. during the remainder of the 1990s. Thus, a larger pond culture operation, which can capture economies of size, is economically feasible for the NCR. The economic feasibility of the smaller pond culture operation, however, is highly questionable. Operating costs might be decreased through obtaining more favorable prices for feed and fingerlings. However, per pound annual ownership costs for the small operation would be difficult to lower. These are quite high ($1.20 / lb.) compared to the larger operation ($0.45 / lb.).

Sensitivity analysis

Another useful management tool, one that is based on the enterprise budget, is sensitivity analysis. Sensitivity analysis involves inserting alternative values of market prices, cost items, or biological production parameters into the budget in order to calculate the impacts on total costs. Table 5 shows the sensitivity of the breakeven prices (total costs per pound) to alternative values of several budget items.

Sensitivity analysis results in Table 5 show that, for all budget items, the impacts on breakeven prices in terms of cents per pound are virtually identical between the two sizes of operations. Thus, a 5-cent increase in feed price increases breakeven prices by 10 cents for both the 5,000-lb. and 50,000-lb. operations, even though their initial breakeven prices are vastly different ($3.48 / lb. versus $2.14 / lb.).

Some budget items, when their values are varied, appear to have greater influence on breakeven prices than other budget items. Breakeven prices seem to be affected more by changes in fingerling price, feed price, and market size of the fish and less by changes in feed conversion ratio or death loss. Fingerling price changes have a larger impact than feed price changes on breakeven prices. A $0.05 per head increase in fingerling price raises breakeven prices by $0.17 / lb., while a similar increase in feed price ($0.05 / lb.) causes breakeven prices to rise $0.10 / lb.. Market size changes also can have a substantial effect on breakeven prices, but the effect is much larger when market size is smaller. For example, when market size is increased 0.05 lbs. from 0.20 to 0.25 lbs., then breakeven prices fall $0.30 / lb. versus $0.06 / lb. when market size increases the same amount from 0.45 to 0.50 lbs..

Table 5. Sensitivity analysis of breakeven price to alternative budget values.

Budget item	Alternative budget values Breakeven price, ($ per lb.)							
5,000 lb. operation								
Fingerling price $ per head	0.10 (2.92)	0.15 (3.09)	0.20 (3.26)	0.25 (3.44)	**0.26** **(3.48)**	0.30 (3.61)	0.35 (3.78)	0.40 (3.95)
Feed price $ per lb.	0.15 (3.05)	0.20 (3.15)	0.25 (3.25)	0.30 (3.35)	0.35 (3.45)	**0.37** **(3.48)**	0.40 (3.54)	0.45 (3.64)
Market size bs.	0.20 (4.07)	0.25 (3.77)	0.30 (3.57)	**0.33** **(3.48)**	0.35 (3.43)	0.40 (3.33)	0.45 (3.24)	0.50 (3.18)
Feed conversion lbs. feed/lb. gain	1.40 (3.32)	1.60 (3.40)	**1.80** **(3.48)**	2.00 (3.56)	2.20 (3.64)	2.40 (3.73)	2.60 (3.81)	2.80 (3.89)
Death loss percent	0 (3.42)	**5** **(3.48)**	10 (3.55)	15 (3.63)	20 (3.71)	25 (3.81)	30 (3.91)	35 (4.03)
50,000 lb. operation								
Fingerling price $ per head	0.10 (1.58)	0.15 (1.75)	0.20 (1.92)	0.25 (2.09)	**0.26** **(2.14)**	0.30 (2.26)	0.35 (2.26)	0.40 (2.61)
Feed price $ per lb.	0.15 (1.91)	0.20 (2.01)	0.25 (2.11)	**0.27** **(2.14)**	0.30 (2.21)	0.35 (2.31)	0.40 (2.41)	0.45 (2.51)
Market size lbs.	0.20 (2.73)	0.25 (2.43)	0.30 (2.23)	**0.33** **(2.14)**	0.35 (2.09)	0.40 (1.98)	0.45 (1.90)	0.50 (1.84)
Feed conversion lbs. feed/lb. gain	1.40 (2.03)	1.60 (2.08)	**1.80** **(2.14)**	2.00 (2.20)	2.20 (2.26)	2.40 (2.32)	2.60 (2.37)	2.80 (2.43)
Death loss percent	0 (2.08)	**5** **(2.14)**	10 (2.21)	15 (2.28)	20 (2.35)	25 (2.44)	30 (2.54)	35 (2.65)

Note: Boldface budget values and associated breakeven prices are those used in the budgets.

Conclusions

The production costs estimated in this study suggest that pond production of yellow perch in larger systems, which are able to capture economies of size, is likely to be economically feasible. A breakeven price of $2.14 / lb. was estimated for the 50,000-lb. operation. This price level falls in the lower end of the range of expected market prices ($2.00 to $3.00 / lb.).

However, small pond operations that have high ownership costs per pound are likely to be unprofitable, even under the best of market conditions. (Ownership costs are annual costs associated with the ownership of capital investment items, such as levee ponds, and include interest, depreciation, repairs, taxes, and insurance.) In this study, the 5,000-lb. operation has a breakeven price of $3.48 / lb.. Annual ownership costs per pound are almost three times higher than for the larger operation. It would be difficult, indeed, to manage costs enough to bring the breakeven price down within the range of expected market prices.

Budget results suggest that significant economies of size in both investment costs and operating costs can be obtained by operating larger production facilities. Unfortunately, it is not yet known what size of operation or optimal pond size would yield the best economies for yellow perch pond production.

Fingerling and feed costs account for a major portion of total costs. Accordingly, changes in the prices of fingerlings and / or feed can significantly impact breakeven price.

The costs of production developed through these budgets reflect cost conditions in Tippecanoe County, Indiana for the mid 1990s. Costs will differ for other points in time, other locations in the NCR, and other operations. While these budgets have many uses, they cannot take the place of individualized, site-specific budgets developed by aquaculturists for their own enterprises.

This fact sheet was made possible by funding from the Purdue University Crossroads 1993 Initiative and the United States Department of Agriculture Grant #93-38500-8392.

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Design by Dennis Melchert, Ames Best Communications, Ames, Iowa

Originally published by Iowa State University, Ames, Iowa