Partial Budgeting as a Decision-Making Tool for Catfish Producers

With an Example for East Mississippi Catfish Producers

Aquaculture, or catfish farming, is a complex and dynamic industry. New technology and new production techniques that promise higher returns or lower costs are constantly being introduced. Producers routinely find themselves in the position of evaluating whether or not a new investment or some other type of change to the existing operation will be worthwhile. In evaluating a proposed change to an existing aquaculture operation, the basic issue to be addressed is whether or not the long-term profitability of the farm will be improved. In evaluating these long-term effects, a partial budget can be a very useful tool for fish farmers, lenders, and Extension specialists.

Elements of a Partial Budget

Basically, a partial budget is made up of four components: two components identify changes in the operation that will increase profits, and two components identify changes in the operation that will decrease profits. Interpreting the results of a partial budget is very simple. If increased profits exceed decreased profits, then the change being considered is likely to be positive in terms of profitability. A basic outline of a partial budget would look something like this:

	Changes that Increase Revenue
+	Changes that Reduce Costs
	Increased Profits

	Changes that Decrease Revenue
+	Changes that Increase Costs
	Decreased Profits

The difficulty in applying a partial budget to a particular problem is in accounting for *all* cost and return changes that will result. Each profit-changing item must be included to determine whether or not the proposed change to an operation will be profitable. This means that a reasonably complete itemization of changes to the operation's income and expenses must be developed. In some cases, this is a relatively simple matter; however, for more complex changes in the production process, defining all of the changes that will occur can be difficult. Moreover, realistic dollar amounts must be associated with each of these changes. It is, therefore, very important to carefully consider how any proposed change to an operation will affect revenue items, such as total production, and expense items, such as labor and equipment requirements, feed use, and utilities. In many cases, information from university research or demonstration projects will be available to help with this step in the budgeting process.

A Partial Budget Example for East Mississippi Catfish Producers

Analysis of Purchasing 6-Inch Fingerlings for Growout OR Purchasing 3.5-Inch Fingerlings and Growing to 7- and 8-Inch Stockers for On-Farm Growout

The application of a partial budget to a specific decision will help to illustrate how this tool might be useful to catfish producers. Consider the example of a producer deciding whether to continue raising catfish with a multiple-batch stocking system using purchased 6-inch fingerlings

Mississippi State University Extension Service

stocked at 6,500 per acre (i.e., his current practice) or to convert to an alternative production system where 3.5-inch fingerlings are purchased and grown to 7- and 8-inch fingerling size on a portion of his pond acreage, and then used as stockers in his remaining pond acreage for foodfish production. The partial budget process is useful in comparing the economics and efficiencies of these two alternatives.

In this example, the producer initially has 58 acres of ponds (five 10-acre ponds and one 8-acre pond) in foodfish production. He is targeting one 8-acre pond for the fingerling-to-stocker fish production and the remaining 50 acres for foodfish production. Key differences in output levels and input use between these two production management systems are presented in Table 1. It should be noted that the figures used in this example are based on area aquaculture Extension specialists' knowledge of east Mississippi production capabilities and producer experiences with these production systems. This knowledge was used to develop the partial budget in Table 2, which summarizes the key differences between these two management scenarios.

The first step in the partial budgeting process is to identify any changes to the operation that will increase the operation's profits. The producer must determine if the proposed change to the operation will lead to any increase in revenue. Table 1 and Appendix Table 1A give details of the production assumptions for the two alternative management schemes. When the 8-acre pond of initial foodfish production is converted to production of 7- and 8-inch stockers, there is a reduction in overall pounds of food-size catfish produced. The question is whether the stocker system's profitability, including a reduction in production revenue and associated reduction in production costs, more than offsets the current profitability of using 6-inch fingerlings to produce food-size fish. In this example, the producer expects a decrease in total production. Therefore, in the "Added Income" section of the partial enterprise budget (Table 2), a zero dollar value is recorded. (However, if, for example, a producer expects to increase the farm by one 8-acre pond for the 3.5-inch fingerlings and would have the initial 58 acres for foodfish production, that additional foodfish quantity's value would need to be included as additional income in the partial budget, and the construction of the 8-acre pond and any additional equipment purchased would need to be included as well.)

Once all items contributing to increased income have been accounted for, the producer must decide if the proposed change will lead to any reductions in cost. In this example, several items have been identified that would be expected to reduce production costs. The most significant cost reduction is seen in the reduction of 6-inch fingerling purchases, which will be replaced by 3.5-inch fingerling purchases (included in the "Added Costs" section). The initial system's stocking rate of 6,500 6-inch fingerlings per acre in 58 water acres amounts to 377,000 fingerlings valued at $0.09 each, or $33,930 overall. Associated with the purchase of 6-inch fingerlings is the transport cost to deliver the fingerlings to the pond. Three 150-mile trips could transport these fingerlings at a cost of $500 per trip, totaling $1,500. These values are placed into the "Reduced Cost" portion of the partial budget because they will not occur in the alternative scenario.

Another aspect of the change in production systems contributing to cost reductions are an overall decrease in the quantity and value of foodfish feed costs. Feed required to produce 412,815 pounds of fish from the initial 6-inch system at a 2.25 feed conversion ratio is 446.212 tons of 28-percent protein feed; and at $220 per ton for 28-percent protein feed, the total feed cost is $98,167. In the proposed alternative (growing food-size fish from 7- and 8-inch fingerlings), the resulting foodfish production of 399,750 pounds requires 409.844 tons of 28-percent protein feed that would cost $90,166. It is the dollar value difference between these two feed costs ($8,001) that goes into the "Reduced Costs" section of the partial enterprise budget (Table 2). The feed costs for raising the 3.5-inch fingerlings to 7- and 8-inch fingerlings will not be included here, but will be included in the "Added Costs" section of the partial budget.

The final reduced cost is a result of the lowered harvest and transportation costs from the reduction in overall foodfish produced. Later in this publication, when addressing "Reduced Income," a detailed explanation of this reduction will be discussed, but the change to the alternative system will result in 13,065 fewer pounds of food-size fish being produced. The cost to harvest and transport fish is approximately $0.05 per pound. Thus, there will be a reduced cost of $653 due to the change from the current to the alternative production system.

The "Benefits" in the left-hand column of the partial enterprise budget on Table 2 is complete when the "Added Income" ($0) and "Reduced Costs" ($33,930 + $1,500 + $8,001 + $653 = $44,084) are added together for a combined $44,084 in additional benefits from the proposed change (Table 2).

The next step in the evaluation process is to identify any changes to the operation that would decrease profits. Any changes in the operation that would increase costs must be included in the "Added Costs" section of the partial budget. In this example, a number of costs would be expected to increase. This alternative system would require the purchase and transport of 3.5-inch fingerlings, feeding the fingerlings until they reach the 7- and 8-inch size, hiring custom harvesters to conduct two partial harvestings of stockers, and use of rotenone to kill off any unwanted fish between fingerling-to-stocker production cycles.

The purchase of 3.5-inch fingerlings for the proposed 8-acre pond stocked at 75,000 per acre would require 600,000 3.5-inch fingerlings. At this size, fingerlings are priced at $0.01 per inch, so 3.5-inch fingerlings would cost $0.035 each. For 600,000 fingerlings, the total fingerling cost would be $21,000. This amount is entered into the "Added Costs" section of Table 2. The transport of 3.5-inch fingerlings to the farm would require only one shipment at a cost of $500, and this amount is entered into the "Added Costs" section as well.

Growing the 3.5-inch fingerlings requires 35-percent protein feed until the fingerlings become 4.5 inches long. They require a 32-percent protein feed thereafter, until they are 8 inches long. Once put into the final growout pond, the fish require a 28-percent protein feed. Feed cost varies by the amount of protein in the feed. For this example, the 35-percent protein feed costs $350 per ton, the 32-percent protein feed costs $230 per ton, and the 28-percent protein feed costs $220 per ton. Additional fingerling and stocker feed quantity and value were calculated as follows:

1) 35 percent feed cost for raising fingerlings from 3.5 to 4.5 inches = $1,843, where
   a) weight gained from the 3.5- to 4.5-inch fingerling = (4.5-inch fingerling weight of 26.3 pounds/1,000 fish minus the weight of 3.5-inch fingerlings, 13.3 pounds/1,000 fish = a weight increase of 13.0 pounds/1,000 fish); is multiplied by
   b) weight gained for stocked 8-acre pond = 8 acres x 75,000 fingerlings/acre divided by 1,000 fish to put this term into like units with fingerling weights of pounds/1,000 fish x 90 percent survival; and is multiplied by
   c) feed conversion ratio of 1.5; and is divided by
   d) 2,000 pounds per ton to convert feed pounds consumed into tons consumed; and is multiplied by
   e) cost of 35-percent protein feed = $350 per ton;
      = additional cost of 35-percent protein feed = $1,843

2) 32 percent feed cost for growing 4.5-inch fingerlings to 7-inch stockers = $5,357, where
   a) weight gained from the 4.5-inch fingerling to 7-inch stocker = (7-inch stocker weight of 91.0 pounds/1,000 fish minus the weight of 4.5-inch fingerlings, 26.3 pounds/1,000 fish = a weight increase of 64.7 pounds); is multiplied by
   b) weight gained for stocked 8-acre pond = 8 acres x 75,000 fingerlings/acre divided by 1,000 fish to put this term into like units with fingerling weights of pounds/1,000 fish x 80 percent survival; and is multiplied by
   c) feed conversion ratio of 1.5; and is divided by
   d) 2,000 pounds per ton to convert feed pounds consumed into tons of feed consumed; and is multiplied by
   e) cost of 32-percent protein feed = $230 per ton;
      = additional cost of 32-percent protein feed = $5,357

3) 32 percent feed cost for growing remaining 50 percent of 7-inch stockers to 8-inch stockers = $1,565, where
   a) weight gained from the 7-inch stocker to 8-inch stocker = (8-inch stocker weight of 133.0 pounds/1,000 fish minus the weight of 7-inch stocker, 91.0 pounds/1,000 fish = a weight increase of 42.0 pounds);
   b) weight gained for stocked 8-acre pond = 8 acres x 75,000 fingerlings/acre divided by 1,000 fish to put this term into like units with fingerling weights of pounds/1,000 fish x 80 percent survival x 50 percent due to half being partially harvested in 2) above; and is multiplied by
   c) feed conversion ratio of 1.5; and is divided by
   d) 2,000 pounds per ton to convert feed pounds consumed into tons of feed consumed; and is multiplied by
   e) cost of 32-percent protein feed = $230 per ton;
      = additional cost of 32-percent protein feed = $1,739

To partially harvest the 7-inch stockers in July, you will need to hire a custom harvesting crew to harvest approximately 50 percent of the 7-inch stockers and transfer/stock them into the foodfish ponds at the rate of 3,250 per acre (half of the 6,500 per acre). A second complete harvesting of the fingerling-to-stocker pond will occur in late fall when 8-inch stockers will be harvested, transferred, and stocked into the foodfish acreage at 3,250 per acre. Custom harvest crews will need to be used because the purchase of the seining equipment would be too expensive for this size operation. Having custom seining crews come to your farm as you need them for the first partial harvest may be difficult as there are not many custom harvest crews in east Mississippi. This is one of the main disadvantages of this system and will be discussed under advantages and disadvantages of this proposed change. Each harvest will require approximately 4.5 hours at $125 per hour or $562.50 per partial harvest; for two harvests, the cost will be $1,125.

The last added cost will be the use of rotenone to kill off everything in the fingerling-to-stocker pond every year or two. If used every second year, the rotenone cost will be $747. The rotenone cost was calculated based upon the acre-feet of water in the pond (8-acre pond x 4-foot average depth = 32 acre-feet of water) divided by the rotenone treatment rate (1 gallon of rotenone to treat 3 acre-feet of water) multiplied by the cost of rotenone ($350 per 5-gallon can of rotenone) divided by 5 gallons per can of rotenone. Ponds are deeper in east Mississippi, so the pond water level would be lowered to reduce the acre-feet of water that would need to be treated. Existing manager/owner labor will be used to apply the rotenone, so no additional charge is included.

Finally, any potential decreases in revenue should be taken into account. In this example, the switch to a 7- and 8-inch stocker production system would result in an income reduction. The overall foodfish production for the initial system is 412,815 pounds versus the alternative production system producing 399,750 pounds; this is a decrease of 13,065 pounds and, valued at $0.70 per pound, is a decrease in sales receipts of $9,146. This amount will go into the "Reduced Income" section of Table 2.

The "Costs" section in the right-hand column of the partial enterprise budget in Table 2 is complete when the "Added Costs" ($21,000 + $500 + $1,843 + $5,357 + $1,739 + 1,125 + $747 = $32,311) and "Reduced Income" ($9,146) are added together for a combined $41,457 in additional costs or decreased profits from the proposed change (Table 2).

Table 2 shows a completed partial enterprise budget for the example comparison between the current use of 6-inch fingerlings and the use of 3.5-inch fingerlings to produce 7- and 8-inch stockers for on-farm stocking for a foodfish production system. Note that the numbers in this partial budget show how much a given revenue or expense item would *change* in moving from the current production system to the proposed alternative system. For example, the $33,930 for purchasing 6-inch fingerlings in the "Reduced Costs" section of the partial budget (Table 2) represents the removal of this expense, but it does not mean no fingerlings are used. In the "Added Costs" section of the partial budget, the purchase of 3.5-inch fingerlings is included. In other words, the producer estimates that fingerling expenses will go down by about $12,930 ($33,930 - $21,000) in moving from the use of 6-inch fingerlings to the use of 3.5-inch fingerlings. Table 1 and Appendix Table 1A show the physical production differences that contribute to changes in key income/expense items in the partial budget.

Interpreting Partial Budget Results

Results of the partial budgeting exercise indicate that moving to the new production system (growing 3.5-inch fingerlings to 7- and 8-inch stockers for use in stocking foodfish acres) from the current system (using 6-inch fingerlings) would be a profitable change. The overall revenue change is projected to be $2,627 ($44,084 - $41,457), or $45 per acre for a 58-acre operation in east Mississippi; however, it is important to keep in mind the potential limitations of the partial budgeting analysis.

Producers need to spend time thinking through the change in operations. Write a list of all the possible advantages and disadvantages of the proposed change. The following paragraphs provide examples of the pros and cons for the sample exercise outlined above.

First, the outcome of any partial budgeting analysis obviously depends on the assumptions used in developing the budget. The example presented here is complex, in that it evaluates the important fingerling procurement aspect of the production system. The fingerling size, number, and time of delivery are important to the production and financial standing of a catfish production operation. Developing this partial budget requires many assumptions, especially concerning survival percentages, and the ability to have a custom harvest crew come when needed to the farm to harvest, transport, and stock the foodfish ponds with the larger 7- and 8-inch stockers. These are important non-cash considerations and may overrule the financial results of the partial enterprise budget analysis, especially if the profit generated from the operational change is small.

The non-cash advantages of such a proposed change to the alternative production system include:

1. The time to get 8-inch stockers to harvest size is less than that for raising 6-inch fingerlings to foodfish size, which allows more frequent cash sales and additional crops over the long term;
2. Fingerlings are on the farm when needed and there are no additional transportation costs for larger, stocker-size fish;
3. Long (3- to 4-hour) hauling times are not required for the stocker fish, so they are less stressed when harvested and restocked on-farm, which may increase their survival; and
4. You are able to take your own fish count samples when restocking stockers, so you have a better idea of the number of fish you are putting into your ponds.

The main non-cash disadvantage of the proposed alternative production system change is that you would have to depend on custom harvesters because it would be too expensive to buy the seine nets, reels, baskets, loading truck and basket, boat, live haul truck, and additional labor required to do the harvesting yourself.

The non-cash advantages or disadvantages to the proposed change are very important and may well determine whether to make the change or not, even when the partial enterprise budget analysis is positive.

It is also important to carefully consider the values used in estimating cost and return entries in the partial budget. In this case, partial budget entries are based on the knowledge of Extension aquaculture specialists and producers who have tried these systems. Your experiences may be different. If you have found your operation to function differently from the assumptions used here, then you need to recalculate the values using the set of numbers you would be able to obtain. In some cases, such information may not be available and your best estimate will have to do. Even when it is available, research and/or demonstration project results (or the experience of other producers) may be quite different from what an individual producer will realize on his or her operation. For this reason, it can be extremely beneficial to examine how changes in key values—such as fish or feed prices or anticipated changes in production levels—affect the outcome of the partial enterprise budget analysis.

Second, the partial budget investigates how the profitability of the operation will be affected by a change in the operation *once that change has been fully implemented*. While a partial budget may reveal that a proposed change to an operation will be profitable, there may be significant cash flow implications of the change that cannot be addressed with the partial budget. For example, the partial budget examined here accounts for full dedication of a fingerling-to-stocker pond to supply the stocker needs of the whole farm. In some cases, a producer may have to construct an additional pond to accomplish this, and that would result in higher ownership costs (interest, depreciation, repair, and maintenance) associated with the additional pond and equipment purchases. It does not, however, indicate whether or not cash flow within this system would be sufficient to make principal payments on any loans taken out to finance these equipment purchases.

According to the example here, once the proposed change is fully implemented, additional reduced costs should be more than sufficient to cover additional expenditures for fingerlings, feed, harvesting, and rotenone. However, while the change is being implemented, the producer must determine if he or she can cover the higher costs until the benefits of the alternative production system are fully realized. Again, this is a cash flow issue that cannot be addressed within the partial budget framework. The partial budget should be considered a first step in evaluating whether or not a proposed change to an operation is worth pursuing. If a comprehensive partial budget analysis (including an evaluation of several different price and production level scenarios) shows that the change would likely be profitable, then additional investigation would need to be performed to determine the most feasible means of implementing the change.

It is well worth the effort to thoroughly evaluate the financial outcomes of any major change to your operation *before* you implement the change. This evaluation process may be time-consuming and difficult, but when done well, the producer can feel confident that the change will set the operation on a more secure financial footing.

Table 1. Key differences in output levels and input use between the current practice of purchasing 6-inch fingerlings and the proposed practice of purchasing 3.5-inch fingerlings to be grown to 7- and 8-inch stockers for use in foodfish production acreage.

Income/Expense Item	Unit	Purchasing 3.5-Inch Fingerlings and Growing to 7- and 8-Inch Stockers	Current System of Purchasing 6-Inch Fingerlings
Pond Water Acreage			
Fingerling-to-stocker	acres	8	0
Foodfish	acres	50	58
Foodfish Production	lbs	399,750	412,815
Final size	lbs each	1.5	1.5
Fingerlings, Total	number	600,000 3.5-inch fingerlings	377,000 6-inch fingerlings
Cost per Fingerling, $/inch	each	$0.01	$0.015
Stocking Rate			
Fingerling-to-stocker	no./acre	75,000	0
Foodfish	no./acre	3,250 7-inch fingerlings and 3,250 8-inch fingerlings	6,500 (in 1 stocking)
Feed	tons (cost/ton)		
35% protein, fing-stck		5.265 ($350/ton)	0
32% protein, fing-stck		30.852 ($230/ton)	0
28% protein, foodfish		409.844 ($220/ton)	446.212
Feed Conversion Ratio		from 3.5-inch to 8-inch = 1.5 from 8-inch to 1.5 lb = 2.25	from 6-inch to 1.5 lb = 2.25
Survival Rate	%	from 3.5-inch to 7-inch = 80% from 7-inch to 8-inch = 90% (Average = 72%) from 8-inch to 1.5 lb = 82%	from 6-inch to 1.5 lb = 73%

Table 2. Partial enterprise budget example for a 58-acre east Mississippi catfish operation considering changing from its current practice of purchasing 6-inch catfish fingerlings for use in foodfish production to the alternative practice of purchasing 3.5-inch catfish fingerlings to be grown to 7- and 8-inch stockers for use in foodfish production.

A. Increased Profits		**B. Decreased Profits**	
1. Added Income		**1. Added Costs**	
- No expected change	$0	a. Purchase of 3.5-inch fingerlings (600,000 fingerlings)	$21,000
Subtotal	**$0**	b. Transport of 3.5-inch fingerlings to farm, approximately 140 miles one way	$500
2. Reduced Costs		c. 3.5- to 4.5-inch fingerling feed costs, 35% protein	$1,843
a. Purchase of 6-inch fingerlings (to be stocked at 6,500/acre)	$33,930	d. 4.5- to 7-inch fingerling feed costs to first partial harvest, 32% protein	$5,357
b. Transport of 6-inch fingerlings to farm	$1,500	e. 7- to >8-inch fingerling feed costs to second partial harvest, 32% protein	$1,739
c. Reduced foodfish feed cost	$8,001	f. Two partial harvestings	$1,125
d. Reduced harvesting cost due to reduced production	$653	g. Rotenone cost to kill off everything in pond every second year	$747
Subtotal	**$44,084**	**Subtotal**	**$32,311**
		2. Reduced income	
		a. Reduced quantity of foodfish sales from 8-inch fingerlings	$9,146
		Subtotal	**$9,146**
A. Total	**$44,084**	**B. Total**	**$41,457**
Profit or Loss (A-B) =	**$2,627**	**PROFIT for the 58-acre farm change (50 foodfish acres plus 8 stocker acres)**	
	$45	**per acre CHANGE (not including foodfish sales)**	

Appendix

Table 1A. Calculations used for estimating food-size fish growout in the partial budgeting example investigating the change from the current practice of using 6-inch fingerlings to produce food-size fish to the proposed practice of using 3.5-inch fingerlings to produce 7- and 8-inch stockers to produce food-size fish.

	Using 6-Inch Fingerlings	Using 7- and 8-Inch Stockers
Final weight, lb/fish	1.5	1.5
Fingerling weight, lb/fish	0.0588	0.133
Weight gain, lb/fish	1.4412	1.367
FCR, lb feed per lb meat produced	2.25	2.25
Feed required to produce final foodfish, lb/fish	3.243	3.075
Total 28-percent protein feed required[1], tons	446.21	409.84
Feed cost, $/ton	220	220
Total feed cost, $	$98,167	$90,166
Other variable costs[2], $	$98,167	$90,166
Stocking rate, no./acre	6,500	6,500
Foodfish acres	58	50
Survival rate, %	73%	82%
Number of fish at harvest time	275,210	266,500
Food-size fish pounds harvested	412,815	399,750
Fish price paid to producer, $/lb	$0.70	$0.70
Total sales receipts	$288,971	$279,825
Income above variable costs, $	$92,637	$99,494
Fixed costs, $687/acre	$39,846	$39,846
Total costs	$236,179	$220,177
Net return above all costs, $	$52,791	$59,648
Net return above all costs, $/acre	$910	$1,193
Breakeven price to cover all costs, $/lb	$0.57	$0.55
Breakeven price to cover cash costs, $/lb	$0.48	$0.45

[1]Feed amount was calculated as: (weight gain per fish x number of surviving fish x FCR) / 2,000.
[2]Feed typically represents 50 percent of all operating costs, so in this analysis the feed cost amount was an approximation for the remaining variable (operating) costs.

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