Partial Budgeting as a Decision-Making Tool for Catfish Producers

With an Example for Delta 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 Delta Mississippi Catfish Producers

Analysis of Raising Catfish in a Multiple-Batch Production System OR a Three-Phase Modular Production System

Applying a partial budget analysis to a specific operational decision will help to illustrate how this tool might be used by catfish producers. Consider the example of a producer deciding whether to continue raising catfish with a multiple-batch stocking system or to convert to a three-phase (modular) production system. This producer has

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1,100 acres of ponds in foodfish production and is targeting a 6,500 pound per acre total production with an average fish weight at harvest of 1.5 pounds. The partial budget process is useful in comparing the economics and efficiencies of these two alternatives.

Key differences in output levels and input use between the modular and multiple-batch catfish production systems are presented in Table 1. It should be pointed out that the figures used in this comparison are based on the results of research on both types of catfish production systems carried out at the Mississippi State University Delta Research and Extension Center in Stoneville, Mississippi; area aquaculture Extension specialists' knowledge of Delta Mississippi catfish production capabilities; and producer experiences with these production systems. These research results were used to develop detailed enterprise budgets for both types of production systems. The partial enterprise budget analysis presented here summarizes the differences in these two production management practices and is useful in demonstrating the partial budget analysis.

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. In this example, the producer expects to realize total production of 6,233,242 pounds in the modular system (6,493 pounds per acre of foodfish production) compared to 5,454,900 pounds from the current multiple-batch system (4,959 pounds per acre of foodfish ponds), as shown on Table 1. At a sales price of $0.70 per pound, the ***increased*** production value from the modular system is $544,839 ($568 per acre of foodfish production). This value is entered into the "Added Income" section of the partial budget on Table 2. In this example, there are no other sources of increased income from the proposed switch to a modular production system. If, for example, a producer expects the modular system to produce excess stockers that could be sold to other producers, then a second "Added Income" item could be included in the partial budget analysis.

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 could be expected to lead to production cost reductions. The most significant is a reduction in total feed costs. Total feed requirements are expected to be 6,706 tons for the modular system (643 tons in the fingerling-to-stocker phase [0.02 pound to 0.20 pound each] and 6,063 tons in the stocker-to-foodfish phase). In the multiple-batch system, total feed requirements are expected to be 7,956 tons. This reduction in feed usage associated with the modular system leads to a total cost reduction of $173,655, or $181 per acre (assuming that feed costs are $406.90 per ton for 35-percent protein feed in the fingerling-to-stocker phase and $230 per ton for 32-percent protein feed in the stocker-to-foodfish phase).

Another aspect of the modular system that will reduce costs is a decrease in the number of fingerlings required for initial stocking. This is due to the decreased combined mortality over the production cycle for the two production systems and the overall initial acreage and respective stocking rates for modular and multiple-batch systems. There is a reduction in required off-flavor treatments since such treatments are not necessary on acreage devoted to the fingerling-to-stocker phase of production. The dollar value of the cost reductions is put into the "Reduced Costs" section of the partial enterprise budget (Table 2).

The "Increased Profits" in the left-hand column of the partial enterprise budget on Table 2 is complete when the "Added Income" ($544,839) and "Reduced Costs" ($173,655 + $53,750 + $7,560 + $5,145 = $240,110) are added together for a combined $784,949 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 potential decreases in revenue should be taken into account. In this example, the switch to a modular production system would not be expected to result in any reduction in revenue. There may well be cases, though, where revenue would be expected to be reduced. For example, if the move to a modular system were part of an overall downsizing of the operation, income could be reduced.

Finally, any changes in the operation that would increase costs must be included in the partial budget. In this example, a number of costs would be expected to increase. The modular system requires additional fuel and labor costs associated with seining and moving fish a number of times. These operations also necessitate investment in some additional equipment (e.g., aerators and nets for seining). Thus, interest, depreciation, and repair and maintenance costs will be expected to be higher with the modular system. Overhead costs (such as insurance) would also be expected to be higher due to the greater investment in equipment, but this would depend on whether you have whole farm insurance or individually insured pieces of machinery. In the modular system, additional seining laborers would have to be hired. Finally, electricity costs are higher due to the need for increased aeration in the modular system. Each of the above costs would be entered into the "Added Costs" section of the partial budget.

The "Decreased Profits" in the right-hand side of the partial enterprise budget on Table 2 is complete when the "Added Costs" ($88,022 + $72,000 + $14,207 + $19,405 + $11,675 + $9,828 + $6,140 + $3,500 + $8,838 = $233,615) and "Reduced Income" ($0) are added

together for a combined $233,615 in additional costs from the proposed change (Table 2).

Table 2 shows a completed partial budget for the modular versus multiple-batch production system. Note that the numbers in this budget show how much a given revenue or expense item would change in moving from multiple-batch to modular production. For example, the $53,750 in fingerlings in the "Reduced Costs" section of the partial budget represents the difference in projected fingerling purchases between modular and multiple-batch production. In other words, the producer estimates that fingerling expenses will go down by this amount if the change to the modular production system occurred. Table 1 shows the physical production differences that contribute to changes in key income/expense items in the partial budget.

Complete enterprise budget summaries for the two production scenarios are provided to assist interested readers in understanding the detailed line item quantities and prices used to determine specific costs (Appendix Tables 1A through 5A) and to calculate cost changes in the partial enterprise budget (Table 2).

Interpreting Partial Budget Results

Results of the partial budgeting analysis indicate that moving to the modular production system would be a profitable decision based on the assumptions used here. The overall revenue increase is projected to be $551,334 ($784,949 - $233,615), or $501 per acre for a 1,100 catfish operation in the Delta region of 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 exercise obviously depends on the assumptions used in developing the budget. The example presented here is particularly complex because it evaluates a fundamental change in the entire catfish production system. Developing this partial budget analysis requires many assumptions concerning changes in total production, new equipment investments (and the loan terms under which those investments are made), and other required changes in physical factors of production (e.g., required aeration, total feed consumption, etc). It is important to carefully consider the values used in estimating cost and return entries in the partial budget analysis. In this case, partial budget entries are based on the results of research into modular production. In some cases, such information may not be available. 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 might 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 budget.

Some of the non-cash advantages of such a proposed change to the modular production system include:

1. The possibility of locating fry-to-fingerling ponds in areas of the farm that are near high-activity centers to scare off fish-eating birds, which will increase survivability. Once catfish become 8 inches in length (i.e., a stocker produced in the second phase of the modular system), they are too large to be consumed by fish-eating birds. Thus, stockers can be stocked into growout ponds that are located in more distant farm areas and not suffer from bird depredation;
2. Better knowledge of fish inventories after the fry-to-fingerling phase (i.e., counting harvested fingerlings going into stocker production ponds and counting stockers when harvested and moved to final foodfish growout ponds). Because stockers weigh 0.25 pound each, good estimates of the number of fish going into the final growout pond can be made. Additionally, knowing good numbers for stockers going into the final production ponds will enable you to better estimate the pounds of catfish that will be available for harvest;
3. If fish are going to die, it usually occurs when they are young. In the modular production system, you will know they have died, whereas in the multiple-batch system, small fish survival is unknown. Mortality is accounted for in the modular system simply by harvesting surviving fingerlings and restocking into the stocker production ponds;
4. You will use larger, stocker-size fish, so the final growout-to-foodsize fish will most likely result in higher survival compared to the multiple-batch system's overall lower survival rate;
5. You can adjust stocker-to-foodsize fish stocking rates to take advantage of higher prices. By stocking stockers at lower rates, foodsize fish can be grown in a shorter time period, which is beneficial when catfish prices are high; and
6. The need to stock larger stocker sizes at lower final stocking rates (i.e., stockers into final foodsize growout ponds) can reduce a number of water quality and disease issues that could be harmful to the fish.

The main non-cash disadvantages of the proposed alternative production system change include:

1. The need for more laborers for the additional harvests required to operate the modular production system. If you could not find reliable labor, additional harvesting of fingerlings and stockers would be difficult or impossible, and the advantages of the modular system would be lost;
2. The farm needs to be at least 250 acres in size before the modular system will begin to make economic sense, as there is an economy of scale involved. Smaller farm sizes do not have enough ponds to produce enough stockers to stock enough foodfish ponds to produce enough fish to be viable; and
3. A good deal of organization, management, monitoring, and record-keeping is required to stay on top of the modular production system. This could mean you would need to hire an additional manager.

The non-cash advantages or disadvantages to the proposed production system 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 aquaculture Extension 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 might 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 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 higher ownership costs (interest, depreciation, repair, and maintenance) associated with additional 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.

Likewise, once the change to a modular system is fully implemented, additional income/reduced costs should be more than sufficient to cover additional out-of-pocket expenditures on electricity and fuel. However, while the change is being implemented, would the producer be able to cover these higher costs until the benefits of increased production could be realized? This is a cash flow issue that cannot be addressed with the partial budget analysis. 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 modular and multiple-batch catfish production systems.

Income/Expense Item	Unit	Modular Production	Multiple-Batch Production
Pond Water Acreage			
Fingerling-to-stocker	acres	140	0
Foodfish		960	1,100
Foodfish Production	lbs	6,233,242	5,454,900
Final size	lbs each	1.5	1.5
Fingerlings, Total	each	7.00 million	8.25 million
Stocking Rate			
Fingerling-to-stocker	no./acre	50,000	0
Foodfish	no./acre	4,800	7,500
Feed	tons	6,706	7,956
35% protein, fing-stck		643	0
32% protein, foodfish		6,063	7,956
Diuron	treatments	5,760	6,600
Electricity			
Aeration	10 hp-hrs	241,377	153,589
10-hp aerators	total	248	220
Fingerling-to-stocker	hp/acre		N/A
Foodfish	hp/acre		2
Meter charges	meter/month	413	28
Labor (seining)	person	9	5

Table 2. Partial enterprise budget example for a 1,100-acre Delta Mississippi catfish operation considering changing from its current multiple-batch production system to the alternative modular production system.

A. Increased Profits		B. Decreased Profits	
1. Added Income		**1. Added Costs**	
a. Change in foodfish production (6,233,242 lbs - 5,454,900 lbs) x $0.70/lb	$544,839	a. Aeration electricity	$88,022
		b. Labor	$72,000
		c. Depreciation on equipment	$14,207
Subtotal	**$544,839**	d. Repair and maintenance	$19,405
		e. Additional transport of harvested fish	$11,675
2. Reduced Costs		f. Diesel fuel	$9,828
a. Foodfish/stocker feed	$173,655	g. Interest on equipment	$6,140
b. Fingerlings (-1.05 million 4.3-inch fingerlings)	$53,750	h. Miscellaneous expenses	$3,500
c. Reduced off-flavor costs (less diuron)	$7,560	i. Interest on operating capital	$8,838
d. Meter charges	$5,145		
Subtotal	**$240,110**	**Subtotal**	**$233,615**
		2. Reduced income	$0
		Subtotal	**$0**
A. Total	**$784,949**	**B. Total**	**$233,615**
Profit or Loss (A-B) =	**$551,334 for the 1,100-acre farm**		
	$501 per acre increase		

Note: Modular production system has a target production of 6,500 pounds per acre and a target harvest weight of 1.5 pounds per fish.

Appendix

Table 1A. Modular Catfish Production Enterprise Budget: Key Production Parameters

Stocker acres	140
Growout acres	960
Total acres	1,100
Fingerling beginning weight (lbs/fingerling)	0.0221
Stocker ending weight (lbs/stocker)	0.208
Final weight, lbs	1.67
Fingerling price ($/each)	$0.043
Stocking rates	
Fingerlings/acre	50,000
Stockers/acre	4,800
Survival rate	
Fingerling-to-stocker	72.6%
Stocker-to-harvest	90.0%
Interest rates	
Short-term	8.75%
Intermediate-term	8.00%
Long-term	7.00%
Feed prices ($/ton)	
Fingerling-to-stocker (35% protein)	$406.90
Stocker-to-harvest (32% protein)	$230.00
FCR	
Fingerling-to-stocker	1.36
Stocker-to-harvest	2.00
Catfish price ($/lb)	$0.70
Price to transport harvested fish ($/lb)	$0.015
Electricity cost ($/kw for 10-hp aerator)	$0.932

Table 2A. Modular Catfish Production Enterprise Budget: Fingerling-to-Stocker Phase Variable Costs.

	Unit	Quantity	Price or Cost/Unit	Value or Cost	Per Water-Acre Value
2. Variable Costs					
Fingerling-to-Stocker Costs					
Feed, 35% protein	ton	643	$406.90	261,623	238
Fingerlings, 4.3 inches, 0.221 pounds each	each	7,000,000	$0.043	301,000	274
Aeration	10-hp hr	121,184	$0.93	112,907	103
Meter charges	meter-month	45	$35.00	1,575	1
Water pumping	acre	140	$55.44	7,762	7
Labor and Management					
Management	$/year	13%	$140,000	17,818	16
Seining labor	$/year	4	$18,000	72,000	65
Other labor	$/year	13%	$200,000	25,455	23
Fuel and Lubricants					
Diesel	gal	15,703	$1.05	16,489	15
Gasoline	gal	3,154	$1.41	4,448	4
Repairs and Maintenance	month	6	$1,581	9,486	9
Bird Chasing	year	75%	$10,000	7,500	7
Chemicals					
Salt	ton	140	$53	7,420	7
Copper sulfate, trematode treatment	trt/acre	140	$9.00	1,260	1
Overhead Expenses /1		140	$11	1,540	1
Miscellaneous Expenses	per acre	140	$25.00	3,500	3
Interest on Operating Capital	$	851,782	8.75%	67,078	61
SUBTOTAL Fingerling-to-Stocker Variable Costs				**918,860**	**1,268**

Table 3A. Modular Catfish Production Enterprise Budget: Stocker-to-Foodfish Returns and Variable Costs.

	Unit	Quantity	Price or Cost/Unit	Value or Cost	Per Water-Acre Value
Stocker-to-Final Size Costs					
Feed, 32% protein	ton	6,063	$230	1,394,537	1,268
Labor					
Management	$/year	87%	$140,000	122,182	111
Seining labor	$/year	5	$18,000	90,000	82
Hired labor, at various wages	$/year	87%	$200,000	174,545	159
Transport of Harvested Fish /1	lb	6,233,242	$0.015	93,499	85
Fuel and Lubricants					
Diesel	gal	107,681	$1.05	113,065	103
Gasoline	gal	21,629	$1.41	30,497	28
Electricity					
Aeration	10-hp hr	120,193	$0.932	111,984	102
Meter charges	meter-month	368	$35.00	12,880	12
Water pumping	acre	960	$55.44	53,222	48
Repairs and Maintenance	month	14	$8,432	118,053	107
Bird Chasing	year	25%	$10,000	2,500	2
Chemicals					
Salt	ton	960	$53	50,880	46
Diuron, off-flavor control	6 trt/acre	5,760	$9	51,840	47
Copper sulfate, trematode treatment	trt/acre	960	$9	8,640	8
Overhead Expenses /1		960	$11	10,560	10
Miscellaneous Expenses	per acre	1,100	$25	27,500	25
Interest on Operating Capital	$	1,849,789	8.75%	161,857	147
SUBTOTAL Stocker-to-Foodfish Variable Costs				**2,628,241**	**2,304**
TOTAL VARIABLE COSTS (including Table 2A costs)				**3,547,101**	**3,225**

Table 4A. Modular Catfish Production Enterprise Budget: Cost and Return Summary.

	Unit	Quantity	Price or Cost/Unit	Value or Cost	Per Water-Acre Value
Gross Receipts					
Catfish sales, average weight	lb	6,233,242	$0.70	**$4,363,269**	**$3,967**
Total Variable Costs				**$3,547,101**	**$3,225**
Income Above Variable Costs				**$816,168**	**$742**
Fixed Costs					
Land charge (not included)	$	1,056,000	8.75%	$0	$0
Machinery depreciation	$			$183,925	$167
Pond depreciation	$			$110,221	$100
Taxes (land)	acre	11.03	$1,320	$14,553	$13
Interest on pond construction costs	$ and %	884,780	7.00%	$61,935	$56
Interest on equipment/machinery purchases	$ and %	963,735	8.00%	$77,099	$70
Insurance	$/ac	1,100	$6.25	$6,875	$6
Total Fixed Costs				**$454,607**	**$413**
Total of All Specified Expenses				**$4,001,709**	**$3,638**
Net Returns Above All Specified Expenses				**$361,560**	**$329**
Net Returns Per Acre:	**Above Specified Variable Cost**			**$742**	
	Above Specified Total Costs			**$329**	
Breakeven Price:	**To Cover Specified Variable Expenses**			**$0.57**	
	To Cover Total Specified Expenses			**$0.64**	

Table 5A. Enterprise Budget for a 1,100-Acre Multiple-Batch Catfish Production Operation.

Acres		1,100	Fingerling price, $/each	$0.043
Final weight, lb		1.5	Price to transport harvested fish, $/lb	0.0150
Stocking rate, fingerlings/acre		7,500	Begin weight, lb/1,000	0.0221
Survival, %		58%	Price of feed, $/ton	$230
Feed fed per pound of fish gain		2.25	Electricity cost, $/kw-hr	$0.932
Price per pound of fish		0.7	Hired labor rate, $/week	varies
Interest rates	short-term	8.75%		
	intermediate	8.00%		
	long-term	7.00%		

	Weight Each	Unit	Quantity	Price or Cost/Unit	Value or Cost	Per Water-Acre Value
1. Gross Receipts						
Catfish sales	1.5	lb	5,454,900	0.70	3,818,430	3,471
2. Variable Costs						
Feed, foodfish		ton	7,956	230	1,829,816	1,663
Labor						
Management		year	3	46,667	140,000	127
Hired labor, at various wages		year	13	290,000	290,000	264
Fingerlings		each	8,250,000	0.043	354,750	323
Transport of harvested fish /1		lb	5,454,900	0.015	81,824	74
Fuel and Lubricants						
Diesel		gal	114,024	1.05	119,725	109
Gasoline		gal	24,784	1.41	34,945	32
Electricity						
Aeration		10-hp hr	146,903	0.932	136,869	124
Meter charges		meter-month	560	35	19,600	18
Water pumping		acre	1,100	55.44	60,984	55
Repairs and Maintenance		month	12	9,011	108,135	98
Bird Chasing		year		10,000	10,000	9
Chemicals						
Salt		ton	1,100	53	58,300	53
Diuron, off-flavor control		trt/acre	6,600	9	59,400	54
Copper sulfate, trematode treatment		trt/acre	1,100	9	9,900	9
Miscellaneous Expenses		per acre	1,100	25	27,500	25
Overhead /2		total	1,100	11	12,100	11
Interest on Operating Capital		$	2,515,385	8.75%	220,096	200
TOTAL VARIABLE COSTS					**3,573,944**	**3,249**
3. Income Above Variable Costs					**244,486**	**222**
4. Fixed Costs						
Land charge (not included)		$	1,056,000	7.00%	0	0
Machinery depreciation		$			169,717	154
Pond depreciation		$			110,221	100
Taxes (land)		acre	1,320	11.03	14,553	13
Interest on pond construction costs		$ and %	884,780	7.00%	61,935	56
Interest on equipment/machinery purchases		$ and %	886,985	8.00%	70,959	65
Insurance		$/ac	1,100	$ 6.25	6,875	6
TOTAL FIXED COSTS					**434,260**	**395**
5. Total of All Specified Expenses					**4,008,204**	**3,644**
6. Net Returns Above All Specified Expenses /3					**-189,774**	**-173**

Net Returns Per Acre:	**Above Specified Variable Costs**	**$222**
	Above Specified Total Costs	**$-173**
Breakeven Price:	**To Cover Specified Variable Costs, $/l**	**$ 0.655**
	To Cover Total Specified Costs, $/l	**$0.735**

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