

Lesson 10: Assessing Profitability of a Mariculture Operation

Objectives:

By the end of this lesson, students will be able to:

1. Identify factors that affect marine aquaculture business profitability.
2. Conduct a sensitivity analysis using Excel or Google spreadsheets to determine how specific factors affect profitability.
3. Explain how demand and supply for aquaculture products affect the product's price.

Career and Technical Education Standards:

- Relevant to Agricultural Education courses

Grade Level: 11-12

Duration: 2 class periods

Overview:

In operating a marine aquaculture business, the manager must be familiar with the biological and environmental requirements of the species they grow, as well as the factors that affect profitability of their enterprise. If their business is not economically viable, it will not be in operation for long.

In this activity, students will use real data from oyster farming operations in Virginia to examine the costs of doing business. They will become familiar with farm enterprise budgets, which are common business planning tools used in agribusiness.

Vocabulary:

consumer demand: willingness and ability of consumers to purchase a quantity of products

direct relationship: relationship between two variables in which one increases or decreases, and the other goes in the same direction

farm enterprise budget: estimation of receipts (income), costs and profits associated with the production of agricultural products

fixed costs: expenditures that a business incurs, such as rent, that are constant whatever the quantity of goods or services produced

inverse relationship: relationship between two variables in which one increases or decreases, and the other goes in the opposite direction

market supply: amount of product available for consumers to purchase

operating expenses: expenditures that a business incurs as a result of performing its normal business operations, and that vary with the amount produced; also known as variable costs

Profit or return on investment: performance measure used to evaluate the efficiency of an investment; difference between the amount earned and the amount spent in buying, operating or producing something

Scarcity: the basic economic problem — the gap between limited resources and theoretically limitless wants

Sensitivity analysis: study of how changes in the values of independent variables result in uncertainty in the output of an economic model

Materials Needed:

- Excel
- Farm budget tool [Excel]
- Farm budget tool user manual [pdf]

Background:

As with any business venture, running a successful aquaculture operation means juggling a number of different economic variables. For example, growers must account for the money they invest into the business to keep it running while also keeping track of their earnings.

To ensure that their business is profitable, growers often use a business planning tool called a farm enterprise budget. The budget tool relies on detailed spreadsheets of business expenses to project costs and revenue, which can help determine profitability.

Farmers just starting out can use enterprise budget tools provided by university agriculture extension programs. These tools not only help the farmer project whether or not their business might be profitable, but the results also can be helpful when seeking bank loans.

A general business rule is that costs like labor and equipment should not exceed revenue — that is, the total sales of the final product. However, when a business is new, it is likely to operate at a loss for several years.

Revenue depends on two variables: quantity of product sold and the product's price. In turn, the quantity of product sold and price also depend on two variables: consumer demand and market supply of the product.

There is a direct relationship between demand and price. If demand for the product increases, its price increases.

On the other hand, there is an inverse relationship between product supply and price. If supply of the product increases, its price decreases.

Figure 1 shows the relationship graphically between supply and demand. Price (P) is on the y-axis. The x-axis is defined by the quantity (Q) of product sold. Where S intersects with D is the point at which supply meets demand. You can think of that point as a state of equilibrium.

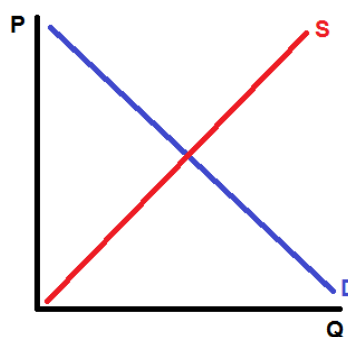


Figure 1. Supply and demand

For a real-world example of how supply changes affect market prices, consider clam production in Florida, which increased significantly from the 1990s through the 2000s (<http://www.gainesville.com/news/20130620/cedar-keys-clam-farmers-feel-squeezed-out/1>).

Many small-scale clam farmers claimed they lost half or more of their annual earnings from clam production due to excess market supply.

Figure 2 illustrates how increased supply leads to lower prices when demand remains constant. As supply increases from S to S' , price falls from P to P' .

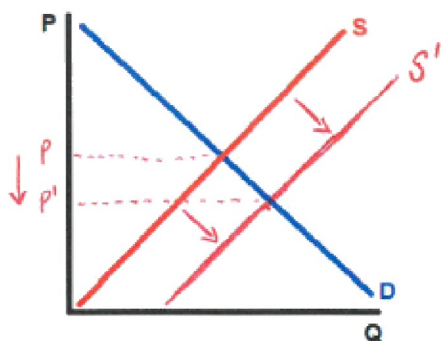


Figure 2. Increased supply

Alternatively, Figure 3 illustrates how increased demand leads to higher prices when supply remains constant. As demand increases from D to D' , price increases from P to P' . This trend is playing out in the cultivated oyster market in North Carolina.

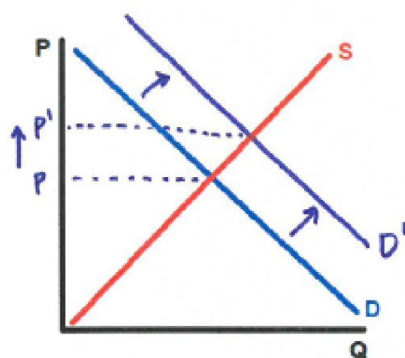


Figure 3. Increased demand

Activity:

Each student will determine the profitability of a hypothetical oyster aquaculture business. To do so, they will draw on an existing farm enterprise budget tool used by Virginia oyster farmers. The teacher should provide the Excel-based budget tool and user manual associated with this lesson to the students, along with the Student Worksheet at the end of this lesson

The budget tool assesses profitability over a two-year period. The business is considered profitable in a given year if it has a positive value for the “estimated pretax return to land, risk, and management” in row 82 in the “Oyster Crop Budget” tab spreadsheet. This value is the profit, or return on investment, of the business before taxes.

The student’s task is to assess the relationship between profitability and assumptions made within the enterprise budget tool. How much does a business’ profitability depend on assumptions about the price of the product, mortality rates and operating expenses like seed price and labor? This type of assessment is called a sensitivity analysis.

References:

1. Hudson, K., Kauffman, D., Murray, T.J., and A. Solomon. 2013. Cultchless (Single-Seed) Oyster crop budgets for Virginia. VT/0713/AAEC-40P. https://www.vims.edu/research/units/centerspartners/map/aquaculture/docs_aqua/2012OysterBudgetUserManual.pdf
2. Crane, K. 2013. Cedar Key’s clam farmers feel squeezed out. *The Gainesville Sun*. <https://www.gainesville.com/article/LK/20130620/>



TEACHER ANSWER KEY

Students will use a farm enterprise budget tool to determine the profitability of a hypothetical oyster aquaculture business. They will work with an existing tool used by Virginia oyster farmers to answer the questions below. Some questions require the student to change values in the spreadsheet to arrive at the correct answer.

1a. What are the top three operating expenses, top three fixed costs and top three permitting and ground leasing costs to operate the hypothetical oyster aquaculture business? Name them and provide the dollar amount for year 1 and year 2 of the business.

Operating Expenses	Dollar Amount in Year 1	Dollar Amount in Year 2
1. Full-time labor	\$24,960	\$24,960
2. Part-time labor	\$17,280	\$17,280
3. Triploid oyster seed	\$8,000	\$8,000
Fixed Costs		
1. Truck	\$5,000	\$5,000
2. Cages	\$3,333	\$3,333
3. Boat	\$2,806	\$2,806
Permitting/Ground Leasing Costs		
1. Surveying	\$510	\$0
2. Commercial fisherman registration license	\$190	\$190
3. Advertising cost	\$35	\$0

1b. Are there any costs that surprised you? Which one(s), and why?

Depreciation expenses could be surprising. Physical assets like boats, trucks and gear do not necessarily hold their value from one year to the next, depending on the level of wear and tear.

Permitting and ground leasing costs could be surprising as well. In North Carolina, oyster growers must secure a lease from the N.C. Division of Marine Fisheries, a process that involves search and surveying costs. An oyster grower can't begin operations until the lease is secured, so there also is a cost of time in which the business is not operating.

2. In the enterprise budget tool, what are the key assumptions regarding average market price and oyster mortality rate?

The average market price is assumed to be \$0.25 per oyster, and the oyster mortality rate is assumed to be 50%.

3a. If you plant 400,000 oyster seed, what is the dollar amount of your oyster sales (market oyster revenue) in year 1 and year 2?

Year 1: \$10,000 Year 2: \$50,000

3b. What is the estimated pretax profit, or return on investment, in year 1 and year 2?

Year 1: \$-67,779.60 Year 2: \$-23,675.60

3c. Is your business profitable?

No

4a. Assume that the price of oysters increases from \$0.25 to \$0.50 per oyster. What is the dollar amount of predicted annual oyster sales in year 1 and year 2?

Year 1: \$20,000 Year 2: \$100,000

4b. What is the estimated pretax profit, or return on investment, in year 1 and year 2?

Year 1: \$-57,779.60 Year 2: \$26,324.60

4c. Is your business profitable?

In year 1, no. In year 2, yes.

5a. Assume the price of oysters is again \$0.25 per oyster, but that the oyster mortality rate increases from 50% to 75% and the price of boat and truck fuel increases from \$4/gallon to \$6/gallon. How do these changes affect total annual expenses in year 1 and year 2?

Total annual expenses are now \$105,759 in year 1 and \$101,655 in year 2. Before they were \$78,057 in year 1 and \$73,953 in year 2. In other words, total annual expenses increased in year 1 and year 2.

5b. What is the estimated pretax profit, or return on investment, in year 1 and year 2?

Year 1: \$-95,759.40 Year 2: \$-51,655.40

5c. Is your business profitable?

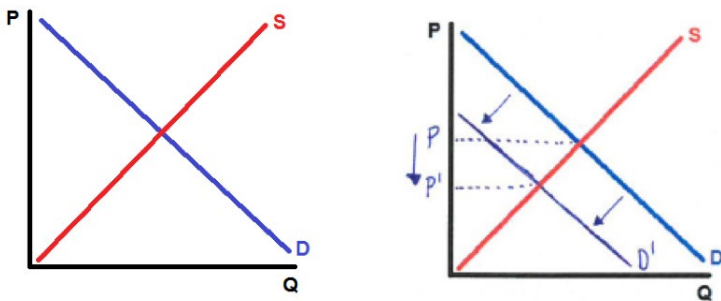
No.

6. List any additional costs not included in the budget tool. How might those costs affect the profitability of your oyster farm?

Costs of land and marketing. An oyster grower needs access to the waterfront and, preferably, land near the waterfront to operate their business. Marketing is another ongoing operating expense. Both costs will reduce profitability.

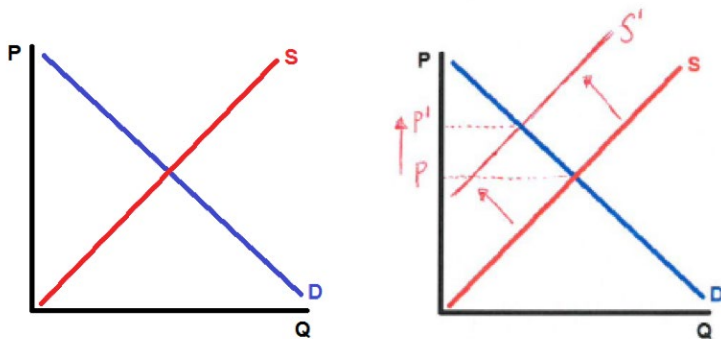
7. If consumer demand decreases for oysters, how are market prices likely to change? What is the effect on business profitability? Adjust the graph below to illustrate the effect of decreased demand on prices.

If consumer demand decreases for oysters, market prices will decrease, which could adversely affect business profitability.



8. If supply of oysters decreases, how are market prices likely to change? What is the effect on business profitability? Adjust the graph below to illustrate the effect of decreased supply on prices.

If supply of oysters decreases, market prices will increase, which could positively affect business profitability.





Assessing Profitability of a Mariculture Operation



Student Worksheet Name _____

You will use a farm enterprise budget tool to determine the profitability of a hypothetical oyster aquaculture business. You will work with an existing tool used by Virginia oyster farmers. Use the budget tool provided by your teacher to

answer the questions below. Click on the “Oyster Crop Budget” tab in the Excel budget tool. Some questions require that you change values in the spreadsheet to arrive at the correct answer.

1a. What are the top three operating expenses, top three fixed costs and top three permitting and ground leasing costs to operate the hypothetical oyster aquaculture business? Name them and provide the dollar amount for year 1 and year 2 of the business.

Operating Expenses	Dollar Amount in Year 1	Dollar Amount in Year 2
1.		
2.		
3.		
Fixed Costs	Dollar Amount in Year 1	Dollar Amount in Year 2
1.		
2.		
3.		
Permitting/Ground Leasing Costs	Dollar Amount in Year 1	Dollar Amount in Year 2
1.		
2.		
3.		



1b. Are there any costs that surprised you? Which one(s), and why?

2. In the enterprise budget tool, what are the key assumptions regarding average market price and oyster mortality rate?

3a. If you plant 400,000 oyster seed, what is the dollar amount of your annual oyster sales (market oyster revenue) in year 1 and year 2?

3b. What is the estimated pretax profit, or return on investment, in year 1 and year 2?

3c. Is your business profitable?



4a. Assume that the price of oysters increases from \$0.25 to \$.50 per oyster. What is the dollar amount of predicted annual oyster sales in year 1 and year 2?

4b. What is the estimated pretax profit, or return on investment, in year 1 and year 2?

4c. Is your business profitable?

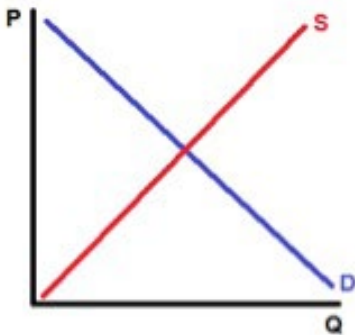
5a. Assume the price of oysters is again \$0.25 per oyster, but that the oyster mortality rate increases from 50% to 75% and the price of boat and truck fuel increases from \$4/gallon to \$6/gallon. How do these changes affect total annual expenses in year 1 and year 2?

5b. What is the estimated pretax profit, or return on investment, in year 1 and year 2?

5c. Is your business profitable?

6. List any additional costs not included in the budget tool. How might those costs affect the profitability of your oyster farm?

7. If consumer demand decreases for oysters, how are market prices likely to change? What is the effect on business profitability? Adjust the graph below to illustrate the effect of decreased demand on prices.



8. If supply of oysters decreases, how are market prices likely to change? What is the effect on business profitability? Adjust the graph below to illustrate the effect of decreased supply on prices.

