Economic Analysis of Oyster Production in Maryland

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Introduction

Shellfish aquaculture has grown rapidly in Maryland in recent years, due to a combination of educational and training efforts by Maryland Sea Grant Extension and implementation of new leasing laws by the Department of Natural Resources. With rapid increases in the number of requests for new aquaculture leases, new permittees, and increased acreage in shellfish production, in-depth comprehensive economic information on current production costs and economies of scale is critical to provide guidance to shellfish producers.

The overall goal of this study was to develop an in-depth economic analysis that will produce standardized costs of production on oyster production in Maryland. Specific objectives include: 1) develop a series of detailed enterprise budgets using standardized methodologies and assumptions for various scales of oyster production that include traditional bottom culture and various types of containerized culture methods; and 2) identify whether economies of scale exist for the various culture methods.

Methods

Producer Interviews

Submerged land and water column leaseholders actively engaged in oyster aquaculture in Maryland were interviewed in 2018. A complete list of leaseholders was obtained from the Maryland Department of Natural Resources, which is the lead agency for oyster aquaculture in Maryland. The entire population of leaseholders was contacted initially to determine whether they were actively engaged in commercial production of oysters in Maryland. Data were subsequently obtained by direct in-person interviews with active Maryland oyster producers using both traditional bottom and container culture methods. All interviews were conducted in 2018.

Questions were formulated to collect descriptive information about each farm, quantities and unit costs of all farm inputs, production costs, marketing costs, and sales. Each participant received a letter from the Maryland Department of Natural Resources to encourage participation. This was followed up by an e-mail message or telephone call to: 1) determine whether each was actively engaged in commercial oyster production in Maryland; and 2) to schedule an appointment for a visit to the farm at the respondent's convenience. The questionnaire was administered primarily via direct, in-person interviews on a single visit. Each interview lasted approximately 45 minutes. Interview methods were as described in Engle et al. (2017) and Dillman et al. (2009).

Every effort was made to ensure that data were transported and stored in a secure manner. Each questionnaire was coded with a number system to protect the identity of the participant. The name of the business and contact person were not entered into the data spreadsheets; only the coding number was used to enter data. The file linking coding numbers to participants was a separate file that will be destroyed following completion of the project and publication of results. Hard copy responses were also stored securely and will be later destroyed upon completion of the project and publication of results. Only aggregated data are reported and no individual farm-level data will be reported.

Enterprise Budget Development

Detailed enterprise budgets were developed for both traditional bottom culture and bottom cage container culture of shellfish in Maryland, each for three scales of production. For traditional bottom culture, the production levels modeled were: 200 bushels; 2,000 bushels; and 6,000 bushels. For bottom cage container culture, the production levels of 5,000 boxes[1], 10,000 boxes, and 15,000 boxes were modeled. Standardized economic engineering methodologies were used to develop each budget (Engle 2010). Data obtained from the personal interviews were used as a basis for assigning values for input expenses.

The enterprise budgets include information on both short-term and long-term profitability of each scale of business with each type of production method. Short-term profitability was measured by the breakeven price above variable costs. If the breakeven price above variable cost is greater than the market price, then the enterprise modeled is profitable in the short term (typically 1 year). For an enterprise to be profitable and viable in the long-term, the business needs to cover non-cash costs such as annual depreciation as well as opportunity costs related to the use of key factors of production such as unpaid owner and family labor. Economics shows that if an individual can make more money doing something else, most individuals will change to the more profitable activity at some point in the future. Thus, the budgets include non-cash costs of annual depreciation as well as costs of all capital used (operating and investment), whether the source of capital was the producer's equity or whether loans were acquired to provide the capital needed. Long-term profitability is measured on enterprise budgets in two ways: 1) whether the net returns are positive or negative; and 2) whether the breakeven price above total costs is greater or less than market price.

The type of information included in enterprise budgets is critical for those seeking to enter the business of shellfish farming. Existing producers also use enterprise budgets to make decisions and to consider trade-offs of changes and adjustments to changing market and economic conditions. Thus, developing and maintaining current enterprise budgets for key aquaculture species is a critical aspect of effective Extension programs.

Traditional Bottom Culture. Maryland shellfish farmers have a variety of options for raising oysters in traditional bottom culture. For example, diploid and triploid larvae are both available as either disease-resistant or wild strain. To standardize the analysis, the most common set of management practices was selected for the base analysis. Thus, the base scenario for the traditional bottom culture enterprise budgets was formulated based on the assumption that all oyster production for this enterprise was that of remote setting of wild diploid larvae followed by traditional bottom culture to produce oysters for subsequent sale by the bushel to a wholesaler/dealer who picked up the oysters from the producer on the waterfront.

Container Culture. Maryland oyster producers interviewed who used mostly container methods primarily planted triploid oysters in bottom cages for sale as single oysters. Most purchased triploid oyster seed that was then nursed in an upweller for subsequent planting into bottom

[1] Boxes were 100-count each, containing 100 oysters per box.

culture cages. Thus, the base scenario used for the enterprise budgets for container culture was that of a producer purchasing triploid oyster seed for use in a nursery upweller and later planted into bottom culture cages and harvested for sale as single oysters.

General Business Information

The Maryland shellfish producers interviewed were also asked questions related to whether they were applying for additional leases, the number of years it took to harvest oysters from the seed planted on their leases, their perceptions of whether the oyster market is becoming saturated, and the types of buyers they sell to. They were also asked to rate the problems they experienced raising oysters on a scale of 1 to 4 with 1 being "never a problem," 2 being "rarely a problem," 3 being "sometimes a problem," and 4 being "always a problem." Responses were sorted by those respondents raising oysters using traditional bottom culture methods and those using container methods.

Results

When asked if they were applying for additional leases, less than half (44%) of traditional bottom culture respondents indicated that they were seeking additional leases (Table 1). Of the respondents who used container culture, however, 62.5% indicated that they were seeking additional leases. Respondents reported differences in the time to harvest, with those raising oysters in traditional bottom culture reporting a mean time to harvest of 2.8 years as compared to 1.6 years on average reported by respondents who raised oysters in container culture (Table 2). This likely is due to the difference in seed planted because most producers raising oysters in traditional bottom culture use diploid larvae whereas most producers who use containers use triploid oyster seed. Location of the lease also affects oyster growth, often with faster growth in the lower as compared with oysters raised in the upper part of the bay. Nearly two-thirds of traditional bottom culture respondents (67%) and those using containers to raise oysters (62.5%) indicated that they were not concerned about saturation of their markets for oysters (Table 3). Table 4 summarizes responses related to the primary type of buyer for traditional bottom culture and container culture respondents. More than three-fourths (78%) of traditional bottom culture respondents sold their oysters primarily to wholesalers. Respondents who used container culture methods reported greater diversity in the types of buyers for their products, with 25% of respondents selling primarily to combination wholesaler/distributor/direct-to-retail, 25% direct to retail, and 12.5% each to wholesalers, distributors, and wholesaler/distributors.

Producers were asked to rank problems that they experienced on a scale of 1 to 4, with 1 being never a problem, 2 rarely a problem, 3 sometimes a problem, and 4 always a problem. The two most frequently mentioned problems by both traditional bottom and container culture farmers were acquiring permits and leases, which was followed by "other regulations" (Fig. 1). While Maryland has worked to reduce the regulatory burdens of its shellfish growers, regulatory issues continue to pose problems. Container culture respondents rated the death of oysters, bottom type, and seed availability as sometimes a problem, whereas poor or slow growth, lack of available loans, theft of oysters, and market price were rated as rarely a problem. The container death rate likely mirrors the mortality problems that have been experienced with triploid oysters. More hatcheries are needed to address the seed availability and timing constraints mentioned by oyster

growers. The issue of bottom type could be addressed by opening more grounds that were formerly natural oyster reefs where shell is available without the expense of purchasing it from Virginia or dredging fossil shell from upper bay reefs. Traditional bottom culture respondents rated bottom type, pollution of water, death of oysters, and theft of oysters as rarely a problem. The remaining categories of potential problems were rated as never a problem by traditional bottom culture respondents. Appendix Table 1 lists additional problems mentioned by both traditional bottom and container culture respondents. While ice and weather were reported as issues, on-water chilling options may offer protection from vibrio in the summer.

Traditional Bottom Culture

Tables 5, 7, and 9 present the annual costs and returns portions of the enterprise budgets for production scales of 200 bushels; 2,000 bushels; and 6,000 bushels, respectively. Values in the budgets were obtained by averaging interview responses. The acreage of leases for each production scale of traditional bottom culture were based on those acres in production (not total lease acres held) as reported by survey respondents and were: 2 acres leased for the 200-bushel scale; 40 acres leased for the 2,000-bushel scale; and 435 acres leased for the 6,000-bushel scale. Tables 6, 8, and 10 present the capital investment costs portion of the enterprise budgets for each respective scale of production. Net returns to unpaid owner and family labor and management were positive and breakeven prices above total costs were below market price for all three scales of production, indicating that all three scales of production were profitable. When the opportunity costs of unpaid owner and family labor were considered, the 200-bushel production scale was not profitable. None of the respondents who raised oysters in traditional bottom culture reported expenditures for labor other than some minor occasional labor in their operations. This means that the owner/family provides the labor, and the returns to oyster production become the earnings of the owner/family. For direct comparisons across budgets, given the inclusion of hired labor expenses in the 6,000-bushel scale, the net returns to management value is most appropriate in that opportunity costs of labor are accounted for across all three budgets.

Net returns to management of oyster production increased with the scale of production. Breakeven prices above variable and above total costs, however, decreased as scale increased from 200 bushels to 2,000 bushels, but then increased slightly from the 2,000-bushel to the 6,000-bushel. This apparent decrease in economies of scale was due to greater capital, legal, and interest expenses per bushel at the greater production level.

Bottom Cage Culture

Tables 11, 13, and 15 present the annual costs and returns portions of the enterprise budgets for production scales of 5,000 boxes, 10,000 boxes, and 15,000 boxes. Tables 12, 14, and 16 present the capital investment costs portion of the enterprise budgets for each respective production scale. Net returns were positive and breakeven prices above total costs were below market price for all three scales of production, indicating that all three scales were profitable.

Net returns of oyster production increased with the scale of production, and breakeven prices above total costs decreased as the scale of production increased from 5,000 boxes to 15,000 boxes, indicating that economies of scale are present in bottom cage culture of oysters.

Discussion

Survival rates (of the number of oysters planted to the number harvested) reported by oyster growers were quite a bit lower in 2018 than in more typical years likely due to the greater amount of freshwater in 2018. Thus, a sensitivity analysis was conducted of the effect of more typical survival rates of 50% (Table 17). All scenarios evaluated were profitable with greater net returns and lower breakeven prices above both variable and above total costs.

Maryland at one time had an active oyster industry with state-wide production of approximately 2.5 to 3 million oysters with good market demand. The enterprise budgets developed in this study generally point to economies of scale but also demonstrate profitability of oyster farming with differing culture gear and differing scales of production. Additional research is needed to identify pathways to re-build Maryland's processing capacity, develop new products for both oyster meat and shell oysters, and to estimate the feasibility of various innovations for oyster production and marketing.

Anticipated Benefits

Anticipated benefits of this work include having current economic information for oyster growers applying for leases and to structure loans appropriately. This will allow Maryland oyster producers to develop more accurate business plans and to make more informed decisions. Results will be used in on-going training programs on aquaculture business planning. Project results will further support the MARBIDCO Shellfish Aquaculture Loan Program both by providing current information for projecting economic and cash flow returns and to use the results on economies of scale to assess the sizes of aquaculture leases necessary for financial viability. In addition, current economic cost information will inform efforts to develop nutrient credits that could potentially pay growers for nutrients that their animals remove from the Chesapeake Bay.

References

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Table 1. Are you applying for more leases?

Response	Traditional bottom culture	Container culture
Yes	44%	62.5%
No	56%	37.5%
No response	0%	0%

Table 2. How many years does it take from seed planting to harvest on your lease?

Statistic	Traditional bottom culture	Container culture
Mean	2.8	1.6
Median	3.0	1.0

Table 3. Do you worry about market saturation? Values in percentages of responses.

Response	Traditional bottom culture	Container culture
Yes	33%	25%
No	67%	62.5%
No response	0%	12.5%

Table 4. What type of buyer do you sell the majority of your products to?

Category of buyer	Traditional	Container
Wholesaler	78%	12.5%
Distributor	-	12.5%
Wholesaler/distributor	11%	12.5%
Combination wholesaler/distributor/direct to retail	0%	25%
Direct to retail	11%	25%
No response	-	12.5%

Table 5. Annual costs and returns for traditional bottom culture for 200-bushel scale of production, enterprise budget for Maryland oyster production.

Category	Unit	$ Per Unit	Quantity	Total value/cost ($)
Revenue				
Oysters	bushel	50	200	10,000
Variable Cost				
Larvae, diploid	million	$270	1.294	349
Labor	hours/ac	0.00	0	0
Fuel	bushel[a]	3.50	200	700
Shell for setting	bushel[a]	5.00	10	50
Pumping for setting	bushel[a]	1.50	200	300
Electricity	bushel[a]	1.5	200	300
Telephone	bushel[a]	1.00	200	200
Repairs & maintenance	bushel[a]	3.00	200	600
Office expenses	bushel[a]	0.75	200	150
Miscellaneous costs	bushel[a]	1.25	200	250
Transportation for sales	bushel[a]	1.30	200	260
Interest on operating capital	total	0.10	3,159	316
Total Variable Costs				3,475
Fixed Costs				
Insurance	bushel[a]	1.00	200	200
Lease Fees	acre	3.5	2.00[b]	7
Accounting fees	bushel[a]	1.00	200	200
Legal fees		0	0	0
Depreciation, equipment	total	2,861	1	2,861
Interest on capital invested	total	0.07	38,146	2,670
Total Fixed Cost				**5,938**
TOTAL COSTS				**9,413**
Net returns to unpaid owner/family labor & management				**587**
Opportunity costs of unpaid owner/family labor				**2,820**
Total Costs				**12,233**
Net Returns to Management				**-2,233**
Breakeven price above variable costs				**17**
Breakeven price above total costs				**61**

[a]Bushel harvested.

[b]Used 2 acres of lease, based on responses with sales of approximately 200 bushels.

Table 6. Capital investment costs, for traditional bottom culture for 200-bushel scale of production, enterprise budget for Maryland oyster production.

Item	Quantity	Unit Cost ($)	Total Cost ($)	Useful Life (yr)	Annual Depreciation ($)
Pickup truck	1	20,000	20,000	15	1,333
Oyster boat	1	10,000	10,000	25	400
Boat motor	1	3,500	3,500	10	350
Setting tanks	1	500	500	15	33
Blower	1	650	650	5	130
Dredge	1	2,500	2,500	20	125
Bottom stabilization	190	5	950	2	475
Harvest baskets	2	23	46	3	15
TOTAL			**38,146**		**2,861**

Table 7. Annual costs and returns for traditional bottom culture for 2,000-bushel scale of production, enterprise budget for Maryland oyster production.

Category	Unit	$ Per Unit	Quantity	Total value/cost ($)
Revenue				
Oysters	bushels	50	2,000	100,000
Variable Cost				
Larvae	million	$270	12.941	3,494
Labor	hours	0.00	0	0
Fuel	bushel[a]	2.00	2,000	4,000
Shell for setting	bushel[a]	5.00	100	500
Pumping for setting	bushel[a]	0.5	2,000	1,000
Electricity	bushel[a]	0.5	2,000	1,000
Telephone	bushel[a]	2	2,000	4,000
Repairs & maintenance	bushel[a]	2.75	2,000	5,500
Office expenses	bushel[a]	0.25	2,000	500
Miscellaneous costs	bushel[a]	0.75	2,000	1,500
Transportation		0.13	2,000	260
Interest on operating loan	total	0.10	21,754	2,175
Total Variable Costs				23,930
Fixed Costs				
Insurance	bushel[a]	0.50	1,000.00	500
Lease Fees	bushel[a]	3.50	40.00[b]	140
Accounting	bushel[a]	0.50	2,000	1,000
Legal	bushel[a]	0	0	0
Depreciation equipment	total	2,634	1	12,634
Interest on capital invested	total	11,914	0.07	7,834
Total Fixed Cost				22,108
TOTAL COSTS				46,037
Net returns to unpaid owner/family labor				55,885
Opportunity costs of family labor				28,200
Total Costs				74,237
Net Returns to Management				25,763
Breakeven price above variable costs				12
Breakeven price above total costs				37

[a]Bushel harvested.

[b]Used 40 acres of lease, based on survey responses with sales of approximately 2,000 bushels total.

Table 8. Capital investment costs, for traditional bottom culture for 2,000-bushel scale of production, enterprise budget for Maryland oyster production.

Item	Quantity	Unit Cost ($)	Total Cost ($)	Useful Life (yr)	Annual Depreciation ($)
Pickup truck	1	25,000	25,000	15	1,667
Oyster boat	1	25,000	25,000	25	1,000
Boat motor	1	5,000	5,000	10	500
Setting tanks	16	1,500	24,000	15	1,600
Heater	24	650	15,600	10	1,560
Shellwasher	1	2,500	2,500	10	250
Dredge	1	3,000	3,000	20	150
Bottom stabilization	1,900	6	11,400	2	5,700
Harvest baskets	18	23	414	2	207
Total			111,914		12,634

Table 9. Annual costs and returns for traditional bottom culture for 6,000-bushel scale of production, enterprise budget for Maryland oyster production.

Category	Unit	$ Per Unit	Quantity	Total value/cost ($)
Revenue				
Oysters	bushel[a]	50	6,000	300,000
Variable Cost				
Larvae	million	$270	38.824	10,482
Labor	hours	9.40	9,000	84,600
Fuel	bushel[a]	1.35	6,000	8,100
Shell for setting	bushel[a]	5.00	300	1,500
Pumping for setting	bushel[a]	0.17	6,000	1,020
Electricity	bushel[a]	0.13	6,000	780
Telephone	bushel[a]	2.46	6,000	14,760
Repairs & maintenance	bushel[a]	2.5	6,000	15,000
Office expenses	bushel[a]	0.06	6,000	360
Miscellaneous costs	bushel[a]	0.47	6,000	2,820
Transportation	bushel[a]	0.026	6,000	156
Interest on operating cap.	bushel[a]	0.10	139,578	13,958
Total Variable Costs	bushel[a]			153,536
Fixed Costs				
Insurance	bushel[a]	0.25	6,000	1,500
Lease fees	bushel[a]	3.5	435.00[b]	1,523
Accounting	bushel[a]	0.25	6,000	1,500
Legal	bushel[a]	0.58	6,000	3,480
Depreciation, equipment	total	41,850	1	41,850
Interest on capital invested	total	394,573	0.07	27,620
Total Fixed Cost				77,473
Total Costs				231,009
Net Returns to Management				68,991
Breakeven Price				
Above variable costs				26
Above total costs				39

[a]Bushel harvested.

[b]Used 435 acres of lease based on survey responses with sales of approximately 6,000 bushels total.

Table 10. Capital investment costs, for traditional bottom culture for 6,000-bushel scale of production, enterprise budget for Maryland oyster production.

Item	Quantity	Unit Cost ($)	Total Cost ($)	Useful Life (yr)	Annual Depreciation ($)
Pickup truck	1	30,000	30,000	15	2,000
Oyster boat	3	30,000	90,000	25	3,600
Boat motor	3	7,500	22,500	8	2,813
Setting tanks	48	2,500	120,000	15	8,000
Blower	10	1,500	15,000	5	3,000
Pump	10	1,500	15,000	5	3,000
Heater	100	700	70,000	10	7,000
Shellwasher	1	3,000	3,000	10	300
Dredge	2	3,000	6,000	10	600
Bottom stabilization	5,700	3.83	21,831	2	10,916
Harvest baskets	54	23	1,242	2	621
TOTAL			394,573		41,850

Table 11. Annual costs and returns for caged bottom culture for 5,000-box (100 count) scale of production, enterprise budget for Maryland oyster production.

Category	Unit	$ Per Unit	Quantity	Total value/cost ($)
Revenue				
Oyster singles	100-ct box[a]	$49.00	5,000	245,000
Variable Cost				
Triploid seed	100-ct box[a]	$0.009	2,000,000	18,000
Labor	100-ct box[a]	16.50	5,000	82,500
Fuel	100-ct box[a]	1.42	5,000	7,100
Pumping for nursery	100-ct box[a]	0.33	5,000	1,650
Electricity	100-ct box[a]	0.74	5,000	3,700
Lab testing	100-ct box[a]	0.17	5,000	850
Telephone	100-ct box[a]	0.68	5,000	3,400
Repairs & maintenance	100-ct box[a]	4.08	5,000	20,400
Office expenses	100-ct box[a]	$0.38	5,000	1,900
Miscellaneous costs	100-ct box[a]	1.04	5,000	5,200
Containers for sales	100-ct box[a]	1.7	5,000	8,500
Advertising costs	100-ct box[a]	1.10	5,000	5,500
Transportation & freight	100-ct box[a]	3.05	5,000	15,250
Interest on operating capital	total	0.10	173,950	17,395
Total Variable Costs				**191,345**
Fixed Costs				
Insurance	100-ct box[a]	0.635	5,000	3,175
Lease Fees	acre	25	10[b]	250
Accounting fees	100-ct box[a]	0.275	5,000	1,375
Legal fees	100-ct box[a]	0	0	0
Depreciation, equipment	total	19,336	1	19,336
Interest on capital invested	total	0.10	155,375	15,538
Total Fixed Cost				**39,674**
TOTAL COSTS				**231,019**
Net Returns to Management				**13,981**
Breakeven Price				
Above variable costs				38
Above total costs				46

[a]Box harvested.
[b]Based on 500 boxes/acre

Table 12. Capital investment costs, for cadged bottom culture for 5,000-bushel box (100 count) scale of production, enterprise budget for Maryland oyster production.

Item	Quantity	Unit Cost ($)	Total Cost ($)	Useful Life (yr)	Annual Depreciation ($)
Cages for oysters	500	90	45,000	7	6,429
Pickup truck	1	24,375	24,375	15	1,625
Boat 1, skiff	1	35,000	35,000	11	3,182
Boat motor	1	5,000	5,000	10	500
Bags for shellfish	2,000	1.50	3,000	4	750
Long lines	85	300	25,500	5	5,100
Upweller	2	3,000	6,000	10	600
Walk-in cold room	1	3,000	3,000	10	300
Sorter/cleaner	1	8,500	8,500	10	850
TOTAL			**155,375**		**19,336**

Table 13. Annual costs and returns for caged bottom culture for 10,000-box (100 count) scale of production, enterprise budget for Maryland oyster production.

Category	Unit	$ Per Unit	Quantity per acre	Total value/cost ($)
Revenue				
Oysters, single	each	49.00	10,000	490,000
Variable Cost				
Triploid seed	100-ct box[a]	0.009	4,000,000	36,000
Labor	100-ct box[a]	12.5	10,000	125,000
Fuel	100-ct box[a]	0.75	10,000	7,500
Pumping for nursery	100-ct box[a]	0.25	10,000	2,500
Electricity	100-ct box[a]	0.35	10,000	3,500
Lab testing	100-ct box[a]	0.14	10,000	1,400
Telephone	100-ct box[a]	0.49	10,000	4,900
Repairs & maintenance	100-ct box[a]	2.00	10,000	20,000
Office expenses	100-ct box[a]	0.17	10,000	1,700
Miscellaneous costs	100-ct box[a]	0.5	10,000	5,000
Containers for sales	100-ct box[a]	1.7	10,000	17,000
Advertising costs	100-ct box[a]	0.83	10,000	8,300
Transportation & freight	100-ct box[a]	1.08	10,000	10,800
Interest on operating capital	total	0.10	243,600	24,360
Total Variable Costs				267,960
Fixed Costs				
Insurance	100-ct box[a]	0.75	10,000	7,500
Lease Fees	100-ct box[a]	25	20[b]	500
Accounting	100-ct box[a]	0.375	10,000	3,750
Legal	100-ct box[a]	0.35	10,000	3,500
Depreciation, equipment	total	27,014	1	27,014
Interest on capital invested	total	0.10	224,875	22,488
Total Fixed Cost				**64,752**
Total Cost				**332,712**
Net Returns to Management				**157,288**
Breakeven Price				
Above variable costs				27
Above total costs				33

[a]Box harvested.

[b]Based on 500 boxes/acre of lease.

Table 14. Capital investment costs, for cadged bottom culture for 10,000-bushel box (100 count) scale of production, enterprise budget for Maryland oyster production.

Item	Unit	Quantity	Unit Cost ($)	Total Cost ($)	Useful Life (yr)	Annual Depreciation ($)
Cages for oysters	each	1,000	90	90,000	7	12,857
Pickup truck	each	1	24,375	24,375	15	1,625
Boat 1, skiff	each	1	35,000	35,000	11	3,182
Boat motor	each	1	7,500	7,500	10	750
Bags	each	4,000	1.50	6,000	4	1,500
Long lines	total	30	300	9,000	5	1,800
Upweller	each	4	6,000	24,000	10	2,400
Walk-in cold room	each	1	15,000	15,000	10	1,500
Sorter/cleaner	each	2	7,000	14,000	10	1,400
TOTAL				**224,875**		**27,014**

Table 15. Annual costs and returns for caged bottom culture for 15,000-box (100 count) scale of production, enterprise budget for Maryland oyster production.

Category	Unit	$ Per Unit	Quantity	Total value/cost ($)
Revenue				
Oyster singles	100-ct box[a]	49.00	15,000	735,000
Variable Cost				
Triploid seed	100-ct box[a]	0.009	6,000,000	54,000
Labor	100-ct box[a]	10	15,000	150,000
Fuel	100-ct box[a]	0.69	15,000	10,350
Pumping for nursery	100-ct box[a]	0.24	15,000	3,600
Electricity	100-ct box[a]	0.24	15,000	3,600
Lab testing	100-ct box[a]	0.13	15,000	1,950
Telephone	100-ct box[a]	0.3	15,000	4,500
Repairs & maintenance	100-ct box[a]	1.33	15,000	19,950
Office expenses	100-ct box[a]	0.15	15,000	2,250
Miscellaneous costs	100-ct box[a]	0.33	15,000	4,950
Containers for sales	100-ct box[a]	1.70	15,000	25,500
Advertising costs	100-ct box[a]	0.08	15,000	1,200
Transportation & freight	100-ct box[a]	0.35	15,000	5,250
Interest on operating capital	total	0.10	287,100	28,710
Total Variable Costs				315,810
Fixed Costs				
Insurance	100-ct box[a]	1.60	15,000	24,000
Lease Fees	acre	25	30[b]	750
Accounting	100-ct box[a]	0.25	15,000	3,750.00
Legal	100-ct box[a]	0.75	15,000	11,250
Depreciation, equipment	total	42,513	1	42,513
Interest on capital invested	total	0.10	371,950	37,195
Total Fixed Cost				**119,458**
Total Cost				**435,268**
Net Returns to Management				**299,732**
Breakeven Price				
Above variable costs				21
Above total costs				29

[a]Box harvested.
[b]Based on 500 boxes per acre.

Table 16. Capital investment costs, for caged bottom culture for 15,000-bushel box (100 count) scale of production, enterprise budget for Maryland oyster production.

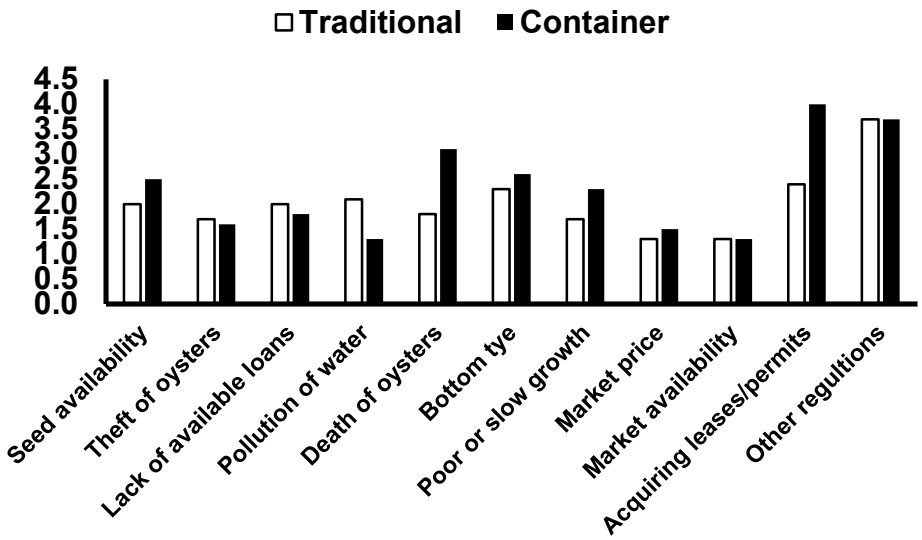
Item	Unit	Quantity	Unit Cost ($)	Total Cost ($)	Useful Life (yr)	Annual Depreciation ($)
Cages for oysters	each	1,500	90	135,000	7	19,286
Pickup truck	each	1	26,000	26,000	15	1,733
Truck 2	each	1	35,000	35,000	15	2,333
Boat 1, skiff	each	1	35,000	35,000	11	3,182
Boat motor	each	1	5,000	5,000	10	500
Boat 2	each	1	10,000	10,000	13	769
Boat motor	each	1	4,000	4,000	10	400
Boat 3	each	1	6,000	6,000	10	600
Boat motor	each	1	3,500	3,500	10	350
Bags for shellfish	each	6,000	1.50	9,000	4	2,250
Long lines	total	25.5	300	7,650	5	1,530
Upweller	each	6	8,300	49,800	10	4,980
Walk-in cold room	each	1	25,000	25,000	10	2,500
Sorter/cleaner	each	3	7,000	21,000	10	2,100
TOTAL				**371,950**		**42,513**

Table 17. Effect of survival of 50% in more typical years.

Production system/scale	25% survival			50% survival		
	Net returns	BEP/VC[a]	BEP/TC[b]	Net returns	BEP/VC[a]	BEP/TC[b]
Traditional bottom culture						
200 bushels	-2,233	17	61	-2,042	16	60
2,000 bushels	25,763	12	37	27,685	11	36
6,000 bushels	68,991	26	39	74,757	25	38
Container culture						
5,000 boxes	13,981	38	46	23,882	36	44
10,000 boxes	157,288	27	33	177,089	25	31
15,000 boxes	299,732	21	29	329,432	19	27

[a]Breakeven price above total variable costs.
[b]Breakeven price above total costs.

Figure 1. Problems ranked on a scale of 1 to 4 with 1 being Never a problem, 2 Rarely a problem, 3 Sometimes a problem, and 4 Always a problem.



Appendix Table 1. Other problems listed by Maryland oyster growers.

Traditional bottom culture	Container culture
Permitting process	Weather
Regulations on relays: over-regulated	1030 rule, orders are so big to handle this. Some producers have special exemption permits, cannot get one.
Dealing with the state and regulations, nursery permit renewal	Regulations are a challenge, licensing of people, landing oysters, time and temperature
Biofouling	Maryland public notice period – took 4.5 years to get first lease
Ice build up	Department of Health: oyster harvesting/shading/Dept. of environments says it is illegal to shade wetland areas
Maryland bureaucracy	Water quality testing, using a test designed in 1913.
Feb. 11 to 16 ice kill	Biofouling
	Biofouling every 3 weeks need to get cages up
	Maryland harvest deadlines in summer for vibrio; not permissible to do on-water chilling
	Department of Environment: discharge permits, threaten to fine, although have a permit
	Availability of quality labor
	Weather
	Perpetual attack from watermen and landowners.