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The Economic Impact of Buying Local

Documenting the Potential Benefits of Increased Shellfish Mariculture Production in South Carolina

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Executive SUMMARY

In 2021, one of the priorities of the South Carolina Sea Grant Consortium (SCSGC) is to facilitate the long-run sustainable expansion of shellfish mariculture in South Carolina. One of the strategies being employed in this effort is gauging interest across universities and other educational institutions in the state in investing in a series of new infrastructure and research initiatives that supports this long-run sustainable expansion. These investments are designed to increase local mariculture oyster production in order to capture the demand in South Carolina that is currently being met by out-of-state suppliers. Whenever South Carolina consumers purchase oysters (or any other good) from an out-of-state supplier, these dollars are effectively "lost" because they are not being spent within the state and thus do not generate local economic activity. As such, to the extent that additional local mariculture oyster production can increase the number of in-state purchases among South Carolina mariculture oyster consumers, this would represent a set of economic gains for the state.

The purpose of this study is threefold: (1) to quantify the current demand for mariculture oysters in South Carolina that is currently being met by out-of-state suppliers; (2) to determine the extent to which four new hypothetical infrastructure investments currently being proposed by the SCSGC and their research partners would satisfy this demand and generate new economic activity for South Carolina; and (3) to conduct a cost/benefit analysis of each hypothetical scenario with respect to the net impact each scenario would likely have on South Carolina's tax revenue over time.

The key findings of this study are as follows:

→ *The total demand for mariculture oysters in South Carolina far exceeds the total supply produced in-state.* ***This study estimates that only one out of every five mariculture oysters purchased by consumers in South Carolina is produced in South Carolina.*** *This reveals a significant potential demand for additional local production that is not currently being satisfied.*

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Before the onset of the COVID-19 pandemic, approximately 1.2 million mariculture oysters were being produced in South Carolina annually, of which roughly 83.5 percent were being sold in-state. ***With the total demand for mariculture oysters in South Carolina estimated to be 5.3 million, the market potential for mariculture oysters is therefore likely to be more than triple the current production level of existing South Carolina oyster farms.***

The SCSGC and its partners are currently proposing four possible infrastructure investment scenarios to increase the in-state volume of mariculture oyster production: (1) a land-based hatchery operation with an accompanying land purchase; (2) a land-based hatchery operation without an accompanying land purchase; (3) a barge hatchery operation; (4) an offshore mariculture operation. At full capacity, Scenarios 1-3 are projected to produce 4.5 million mariculture oysters annually while Scenario 4 would produce 2.7 million annually. ***Scenarios 1-3, which represent the largest increases in potential in-state mariculture oyster production, would likely be almost fully absorbed in South Carolina markets.***

The total annual economic impacts resulting from all business activities associated with the SCSGC hypothetical investment scenarios are estimated to be approximately $5,834,767 by Year 5 in Scenarios 1-3 and $3,717,157 by Year 6 in Scenario 4. *These figures reflect the dollar value of all final goods and services produced in South Carolina that can be attributed (either directly or indirectly) to the ongoing operations within each scenario.*

Although state tax revenue deficits will be created during the first year of investment in Scenarios 1-3, by Year 2 these deficits will turn to annual surpluses as mariculture oyster production begins and estimated state tax revenues rise. *Scenario 4 will require virtually no state funding, and as such, is unlikely to create a deficit during any period during construction or operation.*

This study estimates that the "break-even" year for the SCSGC infrastructure investments – that is – the year at which the cumulative financial benefits to the state of South Carolina in the form of tax revenue begin to exceed the cumulative costs – varies depending upon the specific scenario. ***Scenarios 1, 2, and 3 have estimated break-even points at Years 9, 6, and 8, respectively. Scenario 4 will not face a break-even year since it will require virtually no state-level funding.***

SECTION ONE

Introduction

One of the major draws of South Carolina to people from all over the world is the beautiful coastal region of the state. Charleston, in particular, is consistently ranked as one of the world's foremost vacation destinations. Yet the coast is far more valuable to South Carolina than just as an attraction for visitors. Coastal South Carolina maintains a thriving tourism sector, but also supports a growing mariculture industry, seaports that support over $63 billion[1] in annual economic activity, and many other smaller industries that are directly driven by access to the natural coastal resources.

[1] South Carolina Ports Authority: http://www.port-of-charleston.com

Because it is such an important part of the state's economy, it is critically important to responsibly manage and maintain coastal resources while simultaneously developing greater economic opportunities that take advantage of these resources for the benefit of South Carolinians. The South Carolina Sea Grant Consortium (SCSGC) was created as an independent state agency designed for exactly this purpose – that is – to generate science-based information that enhances the practical use and conservation of coastal and marine resources that fosters a sustainable economy and environment for the state of South Carolina.

In 2021, one of the priorities of the SCSGC is to facilitate the long-run sustainable expansion of shellfish mariculture in South Carolina. One of the strategies being employed in this effort is gauging interest across universities and other educational institutions in the state in investing in a series of new infrastructure and research initiatives that supports this long-run sustainable expansion. These investments are designed to increase local mariculture oyster production in order to capture the demand in South Carolina that is currently being met by out-of-state suppliers. Whenever South Carolina consumers purchase oysters (or any other good) from an out-of-state supplier, these dollars are effectively "lost" because they are not being spent within the state and thus do not generate local economic activity. As such, to the extent that additional local mariculture oyster production can increase the number of in-state purchases among South Carolina mariculture oyster consumers, this would represent a set of economic gains for the state.

With wild harvests of fish and shellfish declining domestically and internationally, mariculture is increasingly looked at as a viable supplementary protein source to offset pressure on wild-caught fisheries and meet demand for protein. Several states along the east coast have established shellfish mariculture research and/or training programs to help build capacity in answering key questions about growing shellfish in marine environments (e.g. pathogen mitigation, workforce training, determining optimal conditions for grow-out, seed development, etc.). While South Carolina has a small, but growing, oyster mariculture industry, there are currently no university or publicly-sponsored shellfish mariculture research programs in the state, nor is there a public oyster seed hatchery that can supply locally-produced seed to shellfish farmers in the state. The lack of availability of quality oyster seed is commonly brought up by oyster farmers as an industry constraint in South Carolina. Public hatcheries exist in several neighboring states (e.g. Georgia, North Carolina, Virginia) and these facilities help provide farmers, scientists, and regulators with the best available science to guide decision making in their respective states.

In 2020, the SCSGC connected with interested parties from the state's institutions of higher education to convene a Shellfish Mariculture Research and Workforce Training Working Group. The goal of this working group was to provide a forum for discussion on how best to supply the science and technical knowledge required to assist the shellfish mariculture industry in meeting production goals, as well as ensuring that mariculture production continues to be environmentally compatible, proactive in disease avoidance, and human use conflict is minimized. At the initial working group meeting, researchers discussed their interests and their research infrastructure. Institutional barriers to shellfish mariculture program development were identified to include: lack of suitable water adjacent facilities, lack of faculty expertise, lack of top-down university investment, and awareness gaps. After the initial working group meeting, SCSGC Extension Staff followed up with individual researchers and University representatives who expressed interest in advancing programs. Those partners that expressed the highest level of interest helped inform the development of the scenarios analyzed in this report.

The purpose of this study is threefold. First, an analysis is conducted to estimate the demand for mariculture oysters in South Carolina that is currently being met by out-of-state suppliers – along with the potential gains to economic activity for South Carolina if this out-of-state demand were instead captured by in-state suppliers. Second, this study estimates the extent to which the proposed SCSGC infrastructure investments would satisfy this demand and create new economic activity for South Carolina. Finally, a cost/benefit analysis is conducted of each hypothetical scenario with respect to the net impact each scenario would likely have on South Carolina's tax revenue over time.

Image source: Laseagrant.org

Image source: gacoast.uga.edu

Image source: choosedorchester.org

SECTION TWO

The Size and Scope of the South Carolina Mariculture Oyster Market

ASSESSING CURRENT SUPPLY AND DEMAND IN SOUTH CAROLINA

When assessing the size and scope of the market for oysters in any region, it is important to first recognize that there are two specific types of oysters sold: mariculture oysters and wild harvest oysters. Wild harvest oysters are those that grow naturally in a saltwater body and are seasonally harvested and typically available for purchase and consumption between October and May. They are usually sold in bushels to a seafood processor or a seafood market, with a minority being sold directly to consumers or restaurants. For example, oyster roasts generally serve wild harvest oysters because they are sold in bushels in large quantities. Mariculture oysters, by contrast, are grown using controlled techniques, where the oyster seed is first spawned in a hatchery, grown to a juvenile size, and then managed by farmers in a marine environment. The final market-size products are often of higher quality, and are usually sold as single oysters, as opposed to clusters. Moreover, hatcheries have the ability to produce triploid oysters, which are often sterile, meaning they maintain meat quality throughout all seasons and therefore are available for consumption year-round. As a result, mariculture oysters are sold at a much higher price point than wild harvest oysters. Most mariculture oysters are sold to restaurants.

Table 1 displays the total annual sales data of each type of oyster produced in South Carolina between 2015 and 2020. Note that although the total statewide wholesale revenue of wild harvest oyster sales has increased by approximately 36.1 percent along with an accompanying decline in sales quantity of 11.3 percent, mariculture oyster wholesale sales revenue and quantity each increased by over 400 percent during the same time period. In addition, mariculture oysters maintained an average wholesale price of approximately $0.81 vs. $0.20 for wild harvest oysters between 2018 and 2020. The increase in demand for mariculture oysters in recent years can therefore be easily observed. Note also that due to the COVID-19 pandemic, wholesale revenues and quantities among both types were generally lower in 2020.

Table 1 – South Carolina Produced Oyster Sales

Source: South Carolina Department of Natural Resources[2]

S.C. Mariculture Oysters			
Year	Wholesale Revenue	Quantity	Avg. Price
2015	$106,032	166,859	$0.64
2016	$135,547	188,370	$0.72
2017	$272,441	341,488	$0.80
2018	$647,520	854,097	$0.76
2019	$999,795	1,193,892	$0.84
2020	$728,295	870,838	$0.84

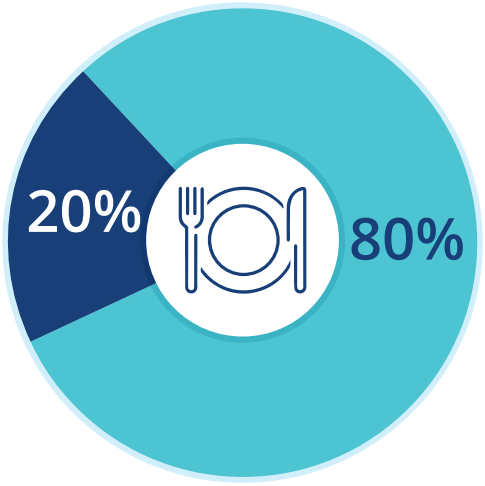
S.C. Wild Harvest Oysters			
Year	Wholesale Revenue	Quantity	Avg. Price
2015	$2,258,393	16,607,654	$0.14
2016	$2,320,623	15,668,438	$0.15
2017	$2,612,258	16,201,481	$0.16
2018	$2,967,178	15,944,077	$0.19
2019	$3,725,107	18,452,269	$0.20
2020	$3,073,591	14,738,312	$0.21

[2] *Mariculture Production Statistics, 2020*. South Carolina Department of Natural Resources, Office of Fisheries Management, Fisheries Statistics Section, Commercial Dealer Logbook Program. Data provided by E. Hiltz on March 30, 2021. Calculations in Table 1 assume an average wild harvest oyster weight of 0.3055 lbs., including shell weight. While mariculture oysters are typically sold as singles, wild harvest oysters are typically sold in bushels in South Carolina. However, estimates for per-oyster prices of wild harvest oysters are provided here to indicate how wild harvest and mariculture oysters are sold and consumed differently in South Carolina. Price estimates reflect that mariculture oysters are consumed as a more "luxury" seafood product when compared to wild harvest oysters.

In addition to this sales revenue resulting from locally produced mariculture oysters, South Carolinians also purchase a sizable volume of mariculture oysters that are imported from outside the state. The total demand for mariculture oysters, along with the percentage of this demand that comes from in-state suppliers, can be specifically estimated through the use of Regional Purchase Coefficients (RPCs) and Regional Supply Coefficients (RSCs). RPCs and RSCs are both standard metrics used in regional economic input-output models that estimate how local demand and local supply interact within each industry sector.

The RPC is defined as the proportion of local demand that is met by local production, whereas the RSC is defined as the proportion of local supply that goes to meet local demand. In this study, both definitions and all estimates of RPC and RSC values are based on the IMPLAN modeling tool.

In South Carolina, the current RPC for mariculture oysters is 19.6 percent. This implies that just one out of every five mariculture oysters purchased by consumers in South Carolina is produced in South Carolina.[3] Conversely, this also implies that four out of every five mariculture oysters purchased by consumers in South Carolina are produced by out-of-state suppliers. These estimates thus reveal a significant potential demand for additional local mariculture oyster production not currently being satisfied.

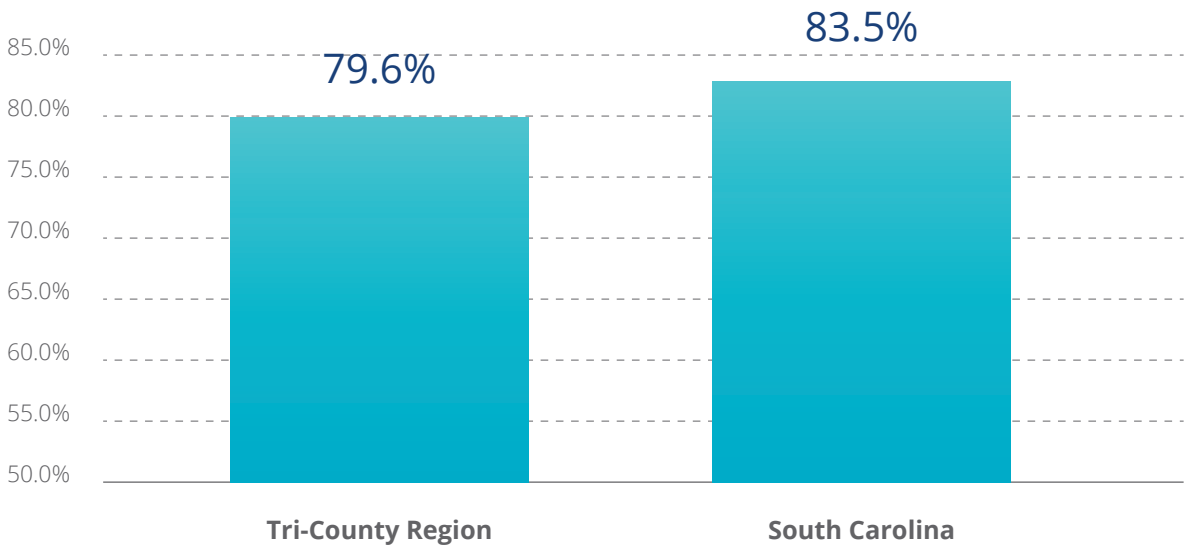


*Just **one out of every five mariculture oysters (20%)** purchased by consumers in South Carolina is produced in South Carolina. This reveals a significant potential demand for additional local mariculture oyster production not currently being satisfied.*

[3] Consumers in South Carolina include both residents and visitors.

Another important element surrounding mariculture oyster production in South Carolina is the fact that suppliers of mariculture oysters in South Carolina generally service local markets. This can be directly observed by examining South Carolina's RSC values as shown in **Figure 1**. For example, note that suppliers within the tri-county region sell 79.6 percent of their mariculture oysters within the tri-county region itself while South Carolina-based suppliers sell 83.5 percent of their mariculture oysters in-state.

Figure 1 – Pct. of Local Mariculture Oyster Production Meeting Local Demand



Combining all of the aforementioned data allows for a direct estimation of the potential unmet demand for South Carolina-produced mariculture oysters. As illustrated in **Table 2**, the current total demand for mariculture oysters in South Carolina is estimated to be approximately $4.4 million. In addition, as previously shown, approximately $999,795 worth of mariculture oysters are produced in South Carolina each year, of which $834,829 (83.5%) is sold in-state. Thus, the total potential unmet local demand for mariculture oysters is estimated to be roughly $3.5 million annually. These estimates suggest that the market potential for mariculture oysters in South Carolina is more than triple the current production of existing South Carolina oyster farms.

Table 2 – Supply and Demand for Mariculture Oysters

Estimates Reflect Pre-Pandemic (2019) Averages

Metric	Dollar Value
South Carolina Demand	$4,338,521
South Carolina Supply	$999,795
S.C. Production Meeting S.C. Demand	$834,829
Potential Unmet Demand	**$3,504,177**

THE ECONOMIC IMPACT OF SUPPLYING UNMET LOCAL DEMAND: METHODOLOGY

The estimated direct economic impact of $3.5 million in annual unmet demand for locally produced mariculture oysters as outlined above represents a significant opportunity for growth and expansion of South Carolina-based oyster farms. Yet this estimate alone does not provide a complete assessment of the potential economic benefits that would derive from an expansion of mariculture oyster production in the Palmetto State. The new, local expenditures that would occur as part of any new hatchery operations associated with supporting this $3.5 million in expanded sales volume represents new economic activity within the Palmetto State. However, these expenditures also lead to additional job creation and economic activity by way of the economic multiplier effect (or economic ripple effect).

*These estimates suggest that the market potential for mariculture oysters in South Carolina is **more than triple** the current production of existing South Carolina oyster farms.*

Economic multiplier effects can be divided into direct, indirect, and induced impacts. The direct impact reflects all in-state purchases made by mariculture oyster farms themselves. These expenditures incorporate employee wages and benefits, equipment purchases and maintenance, and other overhead or administrative costs. This spending activity increases demand and leads to the creation of new jobs and more income for employees and suppliers of these farms.

The indirect impact reflects all additional economic activity that results from inter-industry linkages between local firms in South Carolina. For example, when a South Carolina mariculture oyster hatchery purchases materials from in-state vendors such as power/energy, filtration pumps, or storage tanks, these in-state vendors experience an increase in demand. To satisfy this demand, they must purchase additional inputs from their own suppliers. These suppliers must then purchase additional supplies as well, and so on. These indirect effects ripple through the economy and affect many sectors throughout South Carolina.

The induced impact reflects additional economic activity that results from increases in the spending of household income. For example, when the aforementioned hatchery purchases materials from one of its suppliers and the overall demand for this supplier firm rises, some of the staff working for this supplier will see a rise in their income levels. Part of this income will then be spent locally on, for example, food, entertainment, or housing. These industries will then also see an increase in demand for their goods and services, which will lead to higher incomes for some of their employees, part of which will also be spent locally.

These successive rounds of indirect and induced spending do not go on forever, which is why a value can be calculated for each of them. In each round, money is "leaked out" for a variety of reasons. For example, firms may purchase some of their supplies from vendors located outside of South Carolina. In addition, employees will save part of their income or spend part of it with firms located outside of the state. In order to determine the total economic impact that will result from an initial direct impact, economic multipliers are used. An economic multiplier can be used to determine the total impact (direct, indirect, and induced) that results from an initial change in economic activity (the direct impact). Multipliers are different in each sector of the economy and are largely determined by the size of the local supplier network as well as the particular region being examined. To estimate the total potential impact on South Carolina that would likely result from expanding local supply to meet all in-state mariculture oyster demand, the Division of Research used a detailed structural model of the South Carolina economy containing specific information on economic linkages across the state's 536 industrial sectors. This study utilized the input-output modeling software IMPLAN in calculating all estimates.

THE ECONOMIC IMPACT OF SUPPLYING UNMET LOCAL DEMAND: PRIMARY RESULTS

As previously noted, the total increase in direct economic activity that would result from fully meeting all mariculture oyster demand in South Carolina through in-state production is estimated to be $3.5 million annually. This dollar value represents the increase in sales volume associated with mariculture oyster farms and all economic activity associated with hatchery operations that support this sales volume. These direct economic impacts also lead to indirect and induced impacts through increases in demand for goods and services in other related industries and through increases in household spending activity – all of which are estimated using economic multipliers. Each impact is reported in **Table 3**, along with the accompanying totals. These totals represent the overall increase in economic activity in South Carolina that would likely arise if in-state mariculture oyster producers were to meet all South Carolina-based mariculture oyster demand.

Table 3 – Annual Increase in Economic Impact from In-State Producers Meeting all S.C. Mariculture Oyster Demand

Impact Type	Annual Output
Direct Effect	$3,504,177
Indirect Effect	$832,690
Induced Effect	$330,131
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Total Impact	**$4,666,998**

Each year, as **Table 3** denotes, the estimated economic benefit to South Carolina that would arise if new or existing South Carolina-based mariculture oyster farms were to expand production to meet all in-state demand is $4.7 million. The approximately $3.5 million in direct economic activity would lead to an additional $1,162,821 via the economic multiplier effect. This includes approximately $832,690 that would result from new demand for local suppliers resulting from in-state expenditures on the part of mariculture oyster farms. This direct economic activity also leads to induced effects totaling another $330,131 in economic output. This is a reflection of economic activity in South Carolina generated across all industries that results from increased household spending associated with all new job creation tied to increased mariculture oyster production.

SECTION THREE

A Cost/Benefit Analysis of Investments in South Carolina Mariculture Infrastructure

ESTIMATING THE ECONOMIC IMPACT OF NEW SCSGC MARICULTURE INFRASTRUCTURE

Currently, the oyster mariculture industry faces non-demand related constraints, one of which is the availability of local oyster seed. Oyster seed meant for mariculture production are most often produced in hatcheries. Several neighboring states have invested in publicly-funded hatchery infrastructure and mariculture research to help foster the sustainable expansion of the oyster mariculture industry in their respective states. An in-state publicly-funded hatchery or set of hatcheries in South Carolina is seen as a way to provide a foundation for ensuring the sustainable long-term expansion of the oyster mariculture industry in the state, as well as the added benefit of reduced oyster mortality and minimization of human health impacts through research conducted specifically in South Carolina's coastal environment.

To help facilitate increased South Carolina production of mariculture oysters, the SCSGC and its partners are currently proposing four hypothetical investment scenarios for new hatchery infrastructure development. This study now turns towards examining each of these scenarios by first documenting the economic impact of each investment scenario to the state of South Carolina and then conducting a cost/benefit analysis to determine the net gains to the state. This cost/benefit analysis will be completed by estimating the tax revenue generated through new mariculture oyster production and sales activity and comparing it to the financial contributions that the state of South Carolina will make towards the SCSGC-proposed infrastructure investments.

The four infrastructure investment scenarios are as follows: (1) a land-based hatchery operation with an accompanying land purchase; (2) a land-based hatchery operation without an accompanying land purchase; (3) a barge hatchery operation; (4) an offshore mariculture operation.

The reason why these four scenarios are chosen is due to partner interest. The project team first started with a "traditional land-based hatchery" scenario (Scenario 1), as these types of facilities are what are typically found in neighboring states that have these types of programs. Scenario 2 was developed to examine differences in returns based on the need to purchase water adjacent land versus renting the land (another non-demand constraint is the high price and low availability of suitable water adjacent land for a hatchery). Scenarios 3 and 4 were driven by partner interest in avoiding the high cost and low availability of an optimal land-based location (Scenario 3), and in minimizing human use conflict in estuaries and tidal creeks (Scenario 4).

In each of the first three scenarios, the SCSGC estimates that annual operations will consist of approximately five million seed being produced and then transferred onto farms to be grown to market size. In the offshore scenario, mariculture oysters will be grown to market size and operational capacity will scale up over time from an initial annual production target volume of approximately 500,000 mariculture oysters to three million by the 5th year of operations. It should be noted that this type of oyster growing in the offshore environment is not currently happening in South Carolina, and would first need a regulatory permit to be granted as well as a feasibility or proof-of-concept study. Based upon projected survival rates along with market prices and conditions as provided by the SCSGC, **Table 4** summarizes the expected annual wholesale sales revenue and quantity sold for the first ten years within each scenario.

Image source: sergeant.noaa.gov

Table 4 – Projected Sales Revenue from Each SCSGC Investment Scenario

Source: South Carolina Sea Grant Consortium

Investment Year	Scenario 1 Land-Based Hatchery Operation w/ Land Purchase		Scenario 2 Land-Based Hatchery Operation w/o Land Purchase		Scenario 3 Barge Hatchery Operation		Scenario 4 Offshore Mariculture Operation	
	Wholesale Revenue	Quantity	Wholesale Revenue	Quantity	Wholesale Revenue	Quantity	Wholesale Revenue	Quantity
1	$0	0	$0	0	$0	0	$0	0
2	$0	0	$0	0	$0	0	$356,000	500,000
3	$3,560,000	4,000,000	$3,560,000	4,000,000	$3,560,000	4,000,000	$378,250	500,000
4	$3,782,500	4,250,000	$3,782,500	4,250,000	$3,782,500	4,250,000	$801,000	1,000,000
5	$4,005,000	4,500,000	$4,005,000	4,500,000	$4,005,000	4,500,000	$801,000	1,000,000
6	$4,005,000	4,500,000	$4,005,000	4,500,000	$4,005,000	4,500,000	$2,403,00	3,000,000
7	$4,005,000	4,500,000	$4,005,000	4,500,000	$4,005,000	4,500,000	$2,403,00	3,000,000
8	$4,005,000	4,500,000	$4,005,000	4,500,000	$4,005,000	4,500,000	$2,403,00	3,000,000
9	$4,005,000	4,500,000	$4,005,000	4,500,000	$4,005,000	4,500,000	$2,403,00	3,000,000
10	$4,005,000	4,500,000	$4,005,000	4,500,000	$4,005,000	4,500,000	$2,403,00	3,000,000

Note that sales revenue is not generated until Year 3 in Scenarios 1-3 and Year 2 in Scenario 4. This reflects the fact that there will be an initial construction period for each scenario to build the planned infrastructure for all ongoing operations. The increase in quantity that occurs in Scenarios 1-3 reflect survival rate increases from a baseline of 80 percent in Year 3 to 90 percent by Year 5. In Scenario 4, quantity increases are a result of both an increase in the survival rate as well as in the raw number of mariculture oysters being grown to market size.

The largest anticipated volume of mariculture oysters that is projected to occur is 4.5 million by Year 5 in Scenarios 1-3. Such an increase in production would therefore be likely to be almost fully absorbed in South Carolina markets given that the current demand for mariculture oysters is already 4.2 million above current in-state production levels.[4] Even though such estimates suggest an excess in-state supply of approximately 0.3 million mariculture oysters, a growth rate in mariculture oyster demand of just 1.6 percent per year would eliminate this difference by Year 5 (2026) – or the year at which production levels of 4.5 million will be achieved assuming that infrastructure investments begin in 2021. To put this growth rate into perspective, South Carolina's population increased at an average annual rate of 1.2 percent between 2010 and 2020. Population growth will generally increase the demand over time for most goods, including mariculture oysters.

The proposed increase in South Carolina-based mariculture oyster production is likely to be ***almost fully absorbed in South Carolina markets****.*

The total annual economic output associated with each investment scenario over the course of the first ten years is displayed in **Tables 5-8** along with the estimated tax revenue that this output will generate. Note that these economic output estimates include all direct, indirect, and induced effects as described in Section II and thus represent the full economic impact to South Carolina that would result from each of the SCSGC investment scenarios. Also note that these economic impact estimates will represent a gain to the state of South Carolina regardless of whether or not the newly produced mariculture oysters are sold within the state. In other words, even if the mariculture oysters are produced within South Carolina and are then sold to customers outside the state, this would still represent a net increase in economic activity for South Carolina. Economic impacts resulting from new business activity is derived based on the location of production – not on the location of consumption.

[3] This estimate was calculated by taking the dollar value of unmet S.C. demand ($3,504,177) and dividing it by the wholesale price at the time ($0.84). This yielded an estimated result of 4,171,639 mariculture oysters.

As previously noted, for Scenarios 1-3, market size mariculture oyster sales will begin in Year 3, whereas it will begin in Year 2 for Scenario 4. As such, all of the economic impacts resulting in Years 1 and 2 from Scenarios 1-3 will be generated from construction and construction-related activities. Market size mariculture oyster sales begin in Year 3 and – along with anticipated grant dollars that will be received and invested in various South Carolina mariculture R&D initiatives – will represent the bulk of all economic activity associated with the new hatchery operations from that point forward. The estimated annual grant-based R&D revenue generation is based on the SCSGC's annual average investment in aquaculture related activities (research, extension, communication), including externally obtained grants, from 2018-2021.

In Scenario 1, the economic impact during Year 1 also includes the land purchase being made for the hatchery as facilitated through the SCSGC. By the 5th year in each of Scenarios 1-3, the total annual economic impact of each hatchery scenario is estimated to increase to $5,834,767. This figure represents the dollar value of all final goods and services produced in South Carolina that can be attributed (directly or indirectly) to the operations associated with the new mariculture oyster farms.

Scenario 4, which represents the offshore mariculture operation, will begin selling market size oysters in Year 2, but will maximize its annual production (and associated economic output) in Year 6. Specifically, the total annual economic impact of this offshore operation is estimated to be $3,717,157 by the 6th year of operations. This economic impact represents the lowest annual value of the four scenarios due to the fact that fewer mariculture oysters would be produced.

Table 5 – Scenario 1: Land-Based Hatchery Operation w/ Land Purchase

Investment Year	Estimated Total Annual Economic Output for South Carolina	Estimated Annual Tax Revenue Generated for South Carolina
1	$1,574,962	$41,453
2	$540,740	$14,232
3	$5,246,542	$138,089
4	$5,540,655	$145,830
5	$5,834,767	$153,571
6	$5,834,767	$153,571
7	$5,834,767	$153,571
8	$5,834,767	$153,571
9	$5,834,767	$153,571
10	$5,834,767	$153,571

Table 6 – Scenario 2: Land-Based Hatchery Operation w/o Land Purchase

Investment Year	Estimated Total Annual Economic Output for South Carolina	Estimated Annual Tax Revenue Generated for South Carolina
1	$752,694	$19,811
2	$540,740	$14,232
3	$5,246,542	$138,089
4	$5,540,655	$145,830
5	$5,834,767	$153,571
6	$5,834,767	$153,571
7	$5,834,767	$153,571
8	$5,834,767	$153,571
9	$5,834,767	$153,571
10	$5,834,767	$153,571

Table 7 – Scenario 3: Barge Hatchery Operation

Investment Year	Estimated Total Annual Economic Output for South Carolina	Estimated Annual Tax Revenue Generated for South Carolina
1	$1,002,771	$26,393
2	$540,740	$14,232
3	$5,246,542	$138,089
4	$5,540,655	$145,830
5	$5,834,767	$153,571
6	$5,834,767	$153,571
7	$5,834,767	$153,571
8	$5,834,767	$153,571
9	$5,834,767	$153,571
10	$5,834,767	$153,571

Table 8 – Scenario 4: Offshore Mariculture Operation

Investment Year	Estimated Total Annual Economic Output for South Carolina	Estimated Annual Tax Revenue Generated for South Carolina
1	$1,763,964	$46,428
2	$1,011,321	$26,618
3	$1,040,732	$27,392
4	$1,599,546	$42,100
5	$1,599,546	$42,100
6	$3,717,157	$97,836
7	$3,717,157	$97,836
8	$3,717,157	$97,836
9	$3,717,157	$97,836
10	$3,717,157	$97,836

The impact estimates derived in **Tables 5-8** represent new economic activity that will occur in the state of South Carolina as a result of the new operations associated with these investments in South Carolina mariculture. This new economic activity, in turn, will also generate new tax revenue for the state of South Carolina. Historically, every additional dollar that is generated in economic activity (i.e., nominal gross state product) within South Carolina also generates approximately 4.7 cents in new state tax revenue.[5] By applying this figure to the economic activity generated by the hatchery/offshore operations, the tax revenue from this total volume of activity can be estimated.[6] **Tables 5-8** also display these tax estimates, which show that the maximum annual estimated tax revenue that would likely arise (beginning in Year 5 of Scenarios 1-3) is $153,571.

A COST/BENEFIT ANALYSIS FOR THE STATE OF SOUTH CAROLINA

Thus far, this report has estimated each of the following: (1) the potential unmet demand for mariculture oysters in South Carolina; (2) the projected economic impact that would be generated from four hypothetical scenarios in which the state of South Carolina and/or private parties invested in new infrastructure that would allow for a substantial increase in mariculture oyster production in South Carolina to satisfy the majority of current unmet local demand; (3) the projected annual tax revenue for the state of South Carolina that would arise from these business activities. Combining these three sets of estimates provides a means by which a cost/benefit analysis can be completed to determine the net revenue gains and losses for South Carolina resulting from each of these hypothetical scenarios. **Figures 2-9** and accompanying **Tables 9-12** shown in **Appendix I** collectively summarize these results for the first ten years following initial investment and also highlight the estimated cumulative economic output for South Carolina.[7]

[5] The historical relationship between South Carolina nominal gross state product and the South Carolina general funds revenue (as measured and tracked by the South Carolina Board of Economic Advisors) was estimated by the Division of Research using industry-standard time-series regression techniques.
[6] Economic output represents the value of industry production and is therefore not synonymous with gross state product. As such, the dollar value of all intermediate inputs was subtracted from economic output before the 4.7-cent estimate was applied to estimate total tax revenue.
[7] Note that each of these scenarios reflect new production that would be above and beyond current in-state production levels. These estimates do not reflect any subsequent downstream effects that could result from increased restaurant sales. In addition, these estimates reflect conservative projections. The population of wild oysters is expected to generally decline over the next decade, with mariculture oysters serving to replace this demand. There is also a trend towards higher rates of oyster consumption in the United States.

Cost/Benefit Analysis of Scenario 1:
Land-Based Hatchery Operation w/ Land Purchase

In Year 1, the annual cost to the state of South Carolina is expected to total approximately $854,745. This significant one-time cost is largely due to the initial land purchase accompanying the construction of the hatchery. The projected tax revenue generated from all of the economic activity associated with construction-related activities in Year 1 is $41,453. This then quickly scales up in Year 3 as the mariculture oyster sales activity begins.

In this scenario, it is estimated that by Year 9, the cumulative tax revenue generated from all sales (and accompanying grant-based research and development initiatives) will begin exceeding the cumulative costs that are financed through the state of South Carolina. As such, Year 9 is considered the "break-even" year – that is – the year at which the financial benefits to the state of South Carolina in the form of tax revenue begin to exceed the costs. The cumulative economic output that will accrue to the state by Year 10 is estimated to be $47.9 million.

Figure 2 – South Carolina Net Tax Revenue Projections for Scenario 1

in Thousands of Dollars

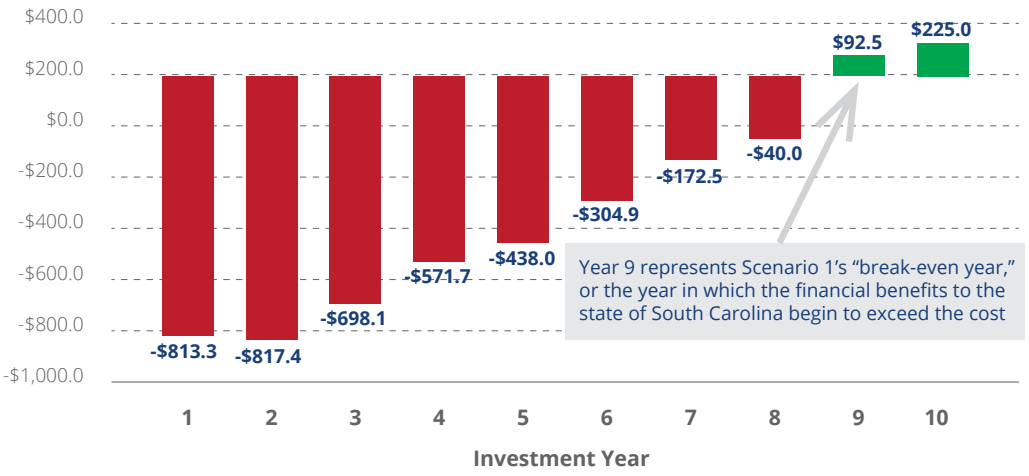
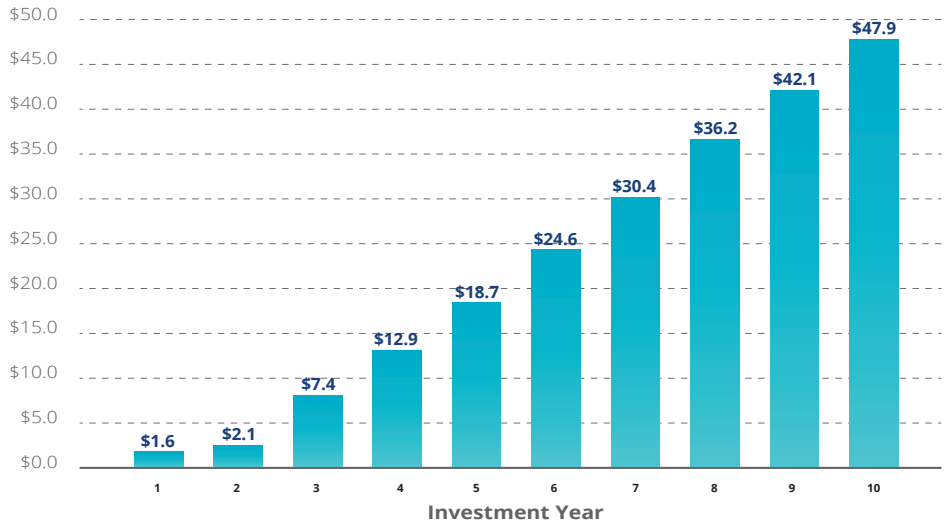


Figure 3 – South Carolina Cumulative Economic Output Projections for Scenario 1

in Millions of Dollars



The Return-on-Investment of Scenario 2:
Land-Based Hatchery Operation w/o Land Purchase

Unlike Scenario 1 where a land purchase substantially increases the upfront costs associated with infrastructure development, in Year 1 of Scenario 2 the expected annual cost to the state of South Carolina is just $464,462. However, this also means that the projected tax revenue generated from all of the economic activity associated with construction-related activities in Year 1 is lower and is specifically estimated to be $19,811. This then quickly scales up in Year 3 as the mariculture oyster sales activity begins.

In this scenario, it is estimated that by Year 6, the cumulative tax revenue generated from all sales (and accompanying grant-based research and development initiatives) will begin exceeding the cumulative costs that are financed through the state of South Carolina. As such, Year 6 is considered the "break-even" year – that is – the year at which the financial benefits to the state of South Carolina in the form of tax revenue begin to exceed the costs. Note that although the annual costs to the state of South Carolina are higher due the cost of leasing land space not present in Scenario 1, the break-even year is nevertheless three years earlier due to lower upfront costs associated with the absence of any land purchase. The cumulative economic output that will accrue to the state by Year 10 is estimated to be $47.1 million.

Figure 4 - South Carolina Net Tax Revenue Projections for Scenario 2

in Thousands of Dollars

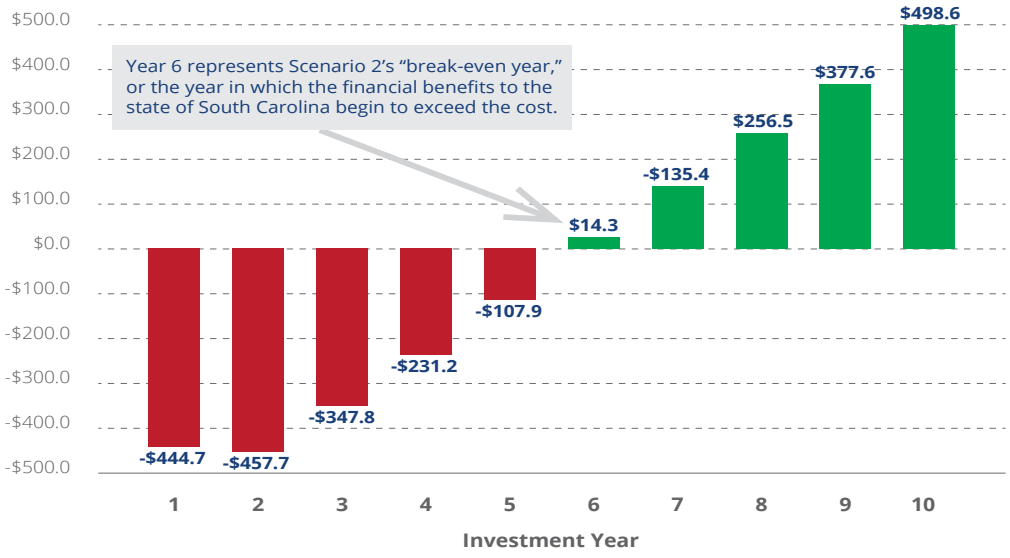
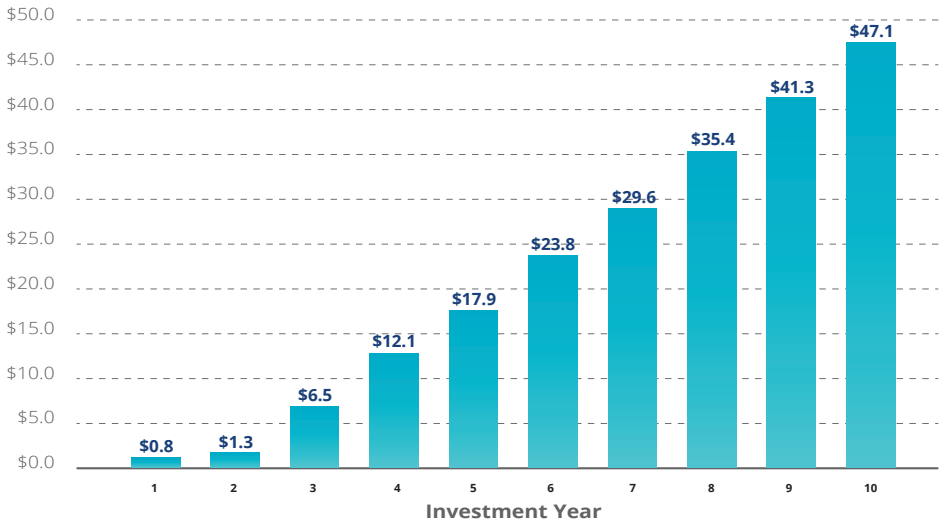


Figure 5 – South Carolina Cumulative Economic Output Projections for Scenario 2

in Millions of Dollars



Cost/Benefit Analysis of Scenario 3:
Barge Hatchery Operation

As with both Scenarios 1 and 2, Scenario 3 is also projected to have significant up-front construction-related expenditures in Year 1 that will total approximately $619,901. The economic activity resulting from these expenditures will, in turn, be accompanied by a projected tax revenue of approximately $26,393. As with both Scenarios 1 and 2, tax revenue is projected to quickly scale up in Year 3 as the mariculture oyster sales activity begins.

In this third scenario, it is estimated that by Year 8 the cumulative tax revenue generated from all sales (and accompanying grant-based research and development initiatives) will begin exceeding the cumulative costs that are financed through the state of South Carolina. As such, Year 8 is considered the "break-even" year – that is – the year at which the financial benefits to the state of South Carolina in the form of tax revenue begin to exceed the costs. Note that the break-even year for Scenario 3 falls between the break-even years of Scenarios 1 and 2 because the dollar volume of construction-related expenditures in Year 1 also falls between the comparable expenditures in Scenarios 1 and 2. The cumulative economic output that will accrue to the state by Year 10 is estimated to be $47.3 million.

Figure 6 – South Carolina Net Tax Revenue Projections for Scenario 3

in Thousands of Dollars

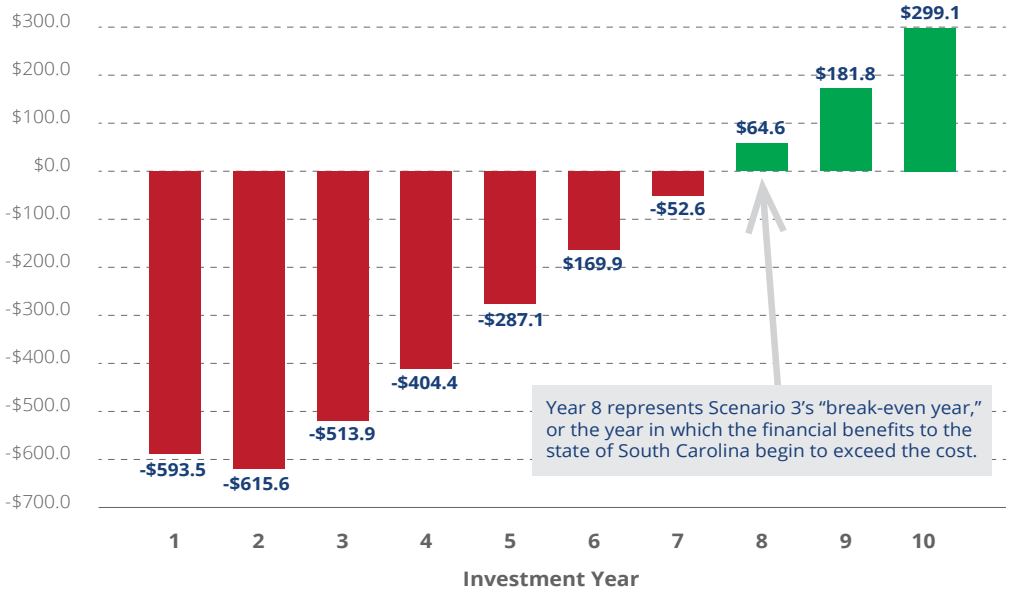
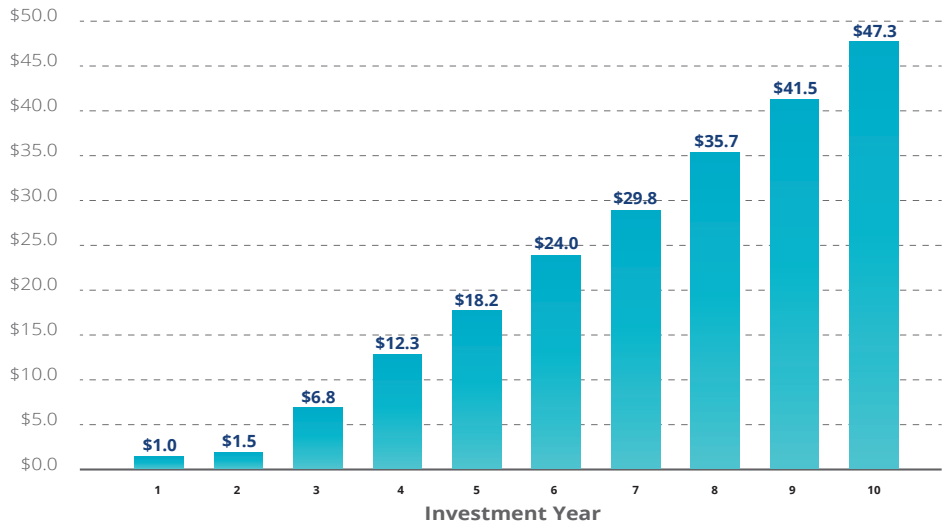


Figure 7 – South Carolina Cumulative Economic Output Projections for Scenario 3

in Millions of Dollars



The Return-on-Investment of Scenario 4:
Offshore Mariculture Operation

Scenario 4 offers a very different set of estimates relative to Scenarios 1-3. Under a situation in which offshore mariculture oyster production is deemed feasible from a biological and regulatory standpoint, and private investment in offshore production is present, there would be no capital investment costs to the state of South Carolina. However, it can be reasonably expected that some level of incidental monitoring and administrative costs would be incurred by the state as it relates to regulating a new segment of an industry. As such, virtually all of the state tax revenue generated through new economic activity associated with Scenario 4 would represent a net gain for the state. As with Scenarios 1-3, the initial construction-related expenditures in Year 1 are relatively high compared to subsequent years with production increasing rapidly beginning in Year 2. In sum, by Year 10, the total net benefit to the state of South Carolina in new tax revenue is estimated to be $673,815. This represents the highest net benefit across all four hypothetical scenarios. The cumulative economic output that will accrue to the state by Year 10 is estimated to be $25.6 million.

Figure 8 – South Carolina Net Tax Revenue Projections for Scenario 4

in Thousands of Dollars

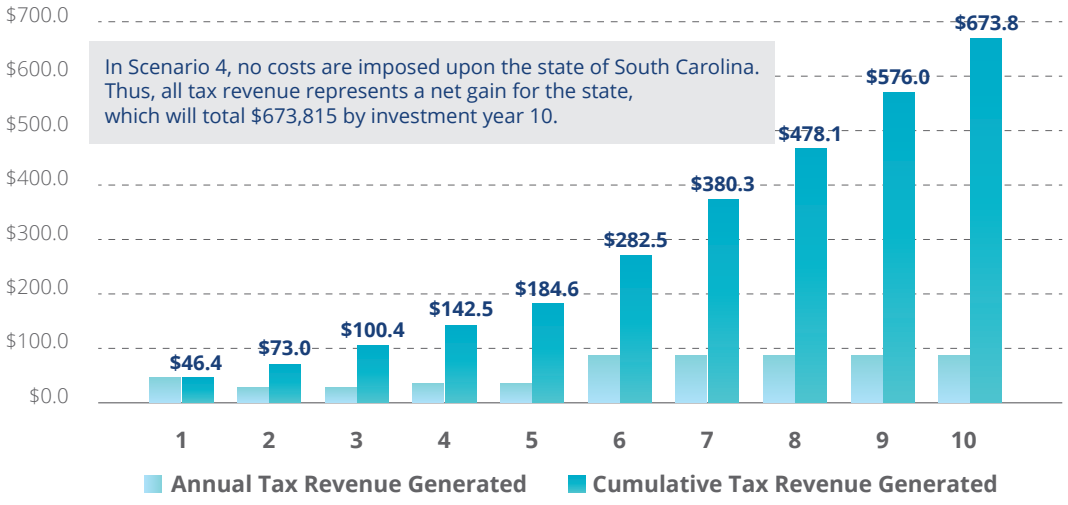
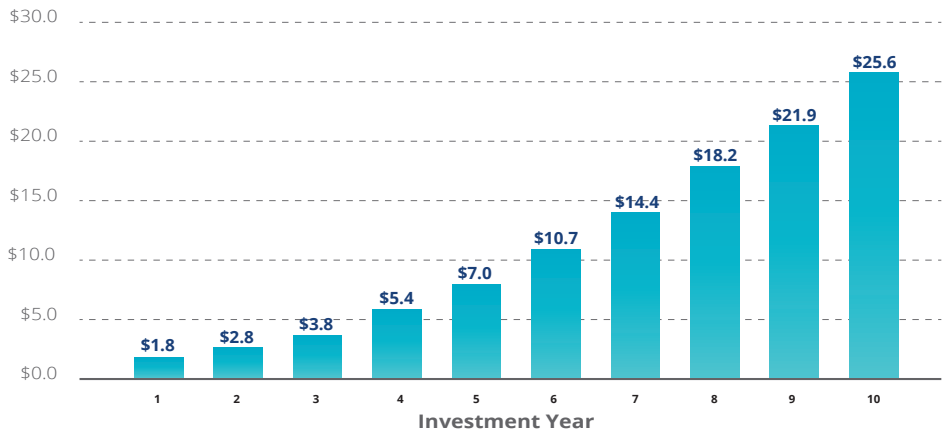


Figure 9 – South Carolina Cumulative Economic Output Projections for Scenario 4

in Millions of Dollars



SECTION FOUR

Conclusion

The current demand for mariculture oysters in South Carolina is over three times larger than the current supply produced in South Carolina via in-state oyster farms. Such a significant supply and demand mismatch represents an opportunity for the state to expand its mariculture oyster production and generate a sizable volume of new economic activity. This study has specifically quantified the total unmet demand that currently exists for local producers of mariculture oysters in South Carolina and has evaluated four hypothetical investment scenarios that are currently being proposed by the South Carolina Sea Grant Consortium (SCSGC) and their partners that would expand local production over the next decade.

Before the onset of the COVID-19 pandemic, approximately 1.2 million mariculture oysters were being produced in South Carolina annually while total demand exceeded 5.3 million. The four scenarios being proposed by the SCSGC and their partners to increase production include (1) a land-based hatchery operation with an accompanying land purchase, (2) a land-based hatchery operation without an accompanying land purchase, (3) a barge hatchery operation, and (4) an offshore mariculture operation. At full capacity, Scenarios 1-3 are projected to produce 4.5 million mariculture oysters annually while Scenario 4 would produce 2.7 million annually.

The total annual economic impacts of these scenarios are estimated to be approximately $5,834,767 for Scenarios 1-3 and $3,717,157 for Scenario 4 once operational capacity is fully scaled up. Moreover, each scenario will ultimately generate a net gain in tax revenue for the state of South Carolina. The "break-even" years – defined as the years in which the cumulative financial benefits to the state of South Carolina in the form of tax revenue begin to exceed the cumulative costs – will occur in Years 6, 9, and 8 for Scenarios 1, 2, and 3, respectively. Scenario 4 will not face a break-even year since it does not require any state-level funding. Thus, each of these investment scenarios presents a means through which the SCSGC can enable greater economic opportunities for new and existing South Carolina-based oyster farms.

These estimates for economic output and tax revenue generation are conservative in nature as they are based on wholesale revenue. Subsequent sales of mariculture oysters produced in South Carolina and sold in South Carolina restaurants generate additional economic impacts for the state that are not captured in this analysis. Moreover, fish and shellfish consumption are both on the rise in the USA, increasing from 14.2 pounds per capita in 2012 to 16.1 pounds per capita in 2018. Specifically, per capita consumption of fresh and frozen shellfish has increased from 4.9 pounds to 6.0 pounds (a 22% increase).[8] In South Carolina, recent survey results indicate that younger consumers (aged 25-54) are the most frequent consumers of oysters.[9] It is likely that as these consumption trends continue, younger people gain more purchasing power, and as the population continues to grow in South Carolina, future demand for mariculture oysters will exceed current demand.

[8] Source: USDA Economic Research Service. 2021. "Food availability (per capita) data system." Fish and Shellfish dataset. https://www.ers.usda.gov/data-products/food-availability-per-capita-data-system/

[9] Source: Richards, S. and M. Motallebi. 2021. "New survey shows COVID-19's impacts on South Carolina oyster farmers and offers hope for recovery." Journal of Agriculture, Food Systems, and Community Development 10(2): 309-312. https://doi.org/10.5304/jafscd.2021.102.016

Appendix I

Table 9 – South Carolina Cost/Benefit Estimates for Scenario 1

Investment Year	Annual Economic Output	Cumulative Economic Output	Annual Tax Revenue Generated	Annual Costs to State of S.C.	Cumulative Tax Revenue Generated	Cumulative Costs to State of S.C.	Net Revenue Gain for S.C.
1	$1,574,962	$1,574,962	$41,453	$854,745	$41,453	$854,745	-$813,292
2	$540,740	$2,115,703	$14,232	$18,339	$55,685	$873,084	-$817,398
3	$5,246,542	$7,362,245	$138,089	$18,837	$193,774	$891,921	-$698,147
4	$5,540,655	$12,902,900	$145,830	$19,360	$339,604	$911,281	-$571,677
5	$5,834,767	$18,737,667	$153,571	$19,910	$493,175	$931,191	-$438,016
6	$5,834,767	$24,572,435	$153,571	$20,486	$646,746	$951,678	-$304,931
7	$5,834,767	$30,407,202	$153,571	$21,092	$800,318	$972,770	-$172,452
8	$5,834,767	$36,241,970	$153,571	$21,092	$953,889	$993,862	-$39,973
9	$5,834,767	$42,076,737	$153,571	$21,092	$1,107,460	$1,014,954	$92,506
10	$5,834,767	$47,911,505	$153,571	$21,092	$1,261,031	$1,036,046	$224,985

Table 10 – South Carolina Cost/Benefit Estimates for Scenario 2

Investment Year	Annual Economic Output	Cumulative Economic Output	Annual Tax Revenue Generated	Annual Costs to State of S.C.	Cumulative Tax Revenue Generated	Cumulative Costs to State of S.C.	Net Revenue Gain for S.C.
1	$752,694	$752,694	$19,811	$464,462	$19,811	$464,462	-$444,651
2	$540,740	$1,293,434	$14,232	$27,274	$34,043	$491,736	-$457,693
3	$5,246,542	$6,539,976	$138,089	$28,219	$172,132	$519,955	-$347,823
4	$5,540,655	$12,080,631	$145,830	$29,211	$317,962	$549,166	-$231,204
5	$5,834,767	$17,915,399	$153,571	$30,253	$471,533	$579,420	-$107,886
6	$5,834,767	$23,750,166	$153,571	$31,347	$625,104	$610,767	$14,338
7	$5,834,767	$29,584,934	$153,571	$32,496	$778,675	$643,262	$135,413
8	$5,834,767	$35,419,701	$153,571	$32,496	$932,247	$675,758	$256,488
9	$5,834,767	$41,254,469	$153,571	$32,496	$1,085,818	$708,254	$377,564
10	$5,834,767	$47,089,236	$153,571	$32,496	$1,239,389	$740,750	$498,639

Table 11 – South Carolina Cost/Benefit Estimates for Scenario 3

Investment Year	Annual Economic Output	Cumulative Economic Output	Annual Tax Revenue Generated	Annual Costs to State of S.C.	Cumulative Tax Revenue Generated	Cumulative Costs to State of S.C.	Net Revenue Gain for S.C.
1	$1,002,771	$1,002,771	$26,393	$619,901	$26,393	$619,901	-$593,508
2	$540,740	$1,543,512	$14,232	$36,332	$40,625	$656,233	-$615,607
3	$5,246,542	$6,790,054	$138,089	$36,332	$178,714	$692,565	-$513,851
4	$5,540,655	$12,330,709	$145,830	$36,332	$324,544	$728,897	-$404,353
5	$5,834,767	$18,165,476	$153,571	$36,332	$478,115	$765,229	-$287,113
6	$5,834,767	$24,000,244	$153,571	$36,332	$631,686	$801,561	-$169,874
7	$5,834,767	$29,835,011	$153,571	$36,332	$785,257	$837,893	-$52,635
8	$5,834,767	$35,669,779	$153,571	$36,332	$938,829	$874,225	$64,604
9	$5,834,767	$41,504,546	$153,571	$36,332	$1,092,400	$910,557	$181,843
10	$5,834,767	$47,339,314	$153,571	$36,332	$1,245,971	$946,889	$299,082

Table 12 – South Carolina Cost/Benefit Estimates for Scenario 4

Investment Year	Annual Economic Output	Cumulative Economic Output	Annual Tax Revenue Generated	Cumulative Tax Revenue Generated
1	$1,763,964	$1,763,964	$46,428	$46,428
2	$1,011,321	$2,775,284	$26,618	$73,045
3	$1,040,732	$3,816,016	$27,392	$100,438
4	$1,599,546	$5,415,562	$42,100	$142,538
5	$1,599,546	$7,015,108	$42,100	$184,638
6	$3,717,157	$10,732,265	$97,836	$282,473
7	$3,717,157	$14,449,422	$97,836	$380,309
8	$3,717,157	$18,166,578	$97,836	$478,144
9	$3,717,157	$21,883,735	$97,836	$575,980
10	$3,717,157	$25,600,892	$97,836	$673,815

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