Economic Activity Associated with Shellfish Aquaculture in Virginia – 2012

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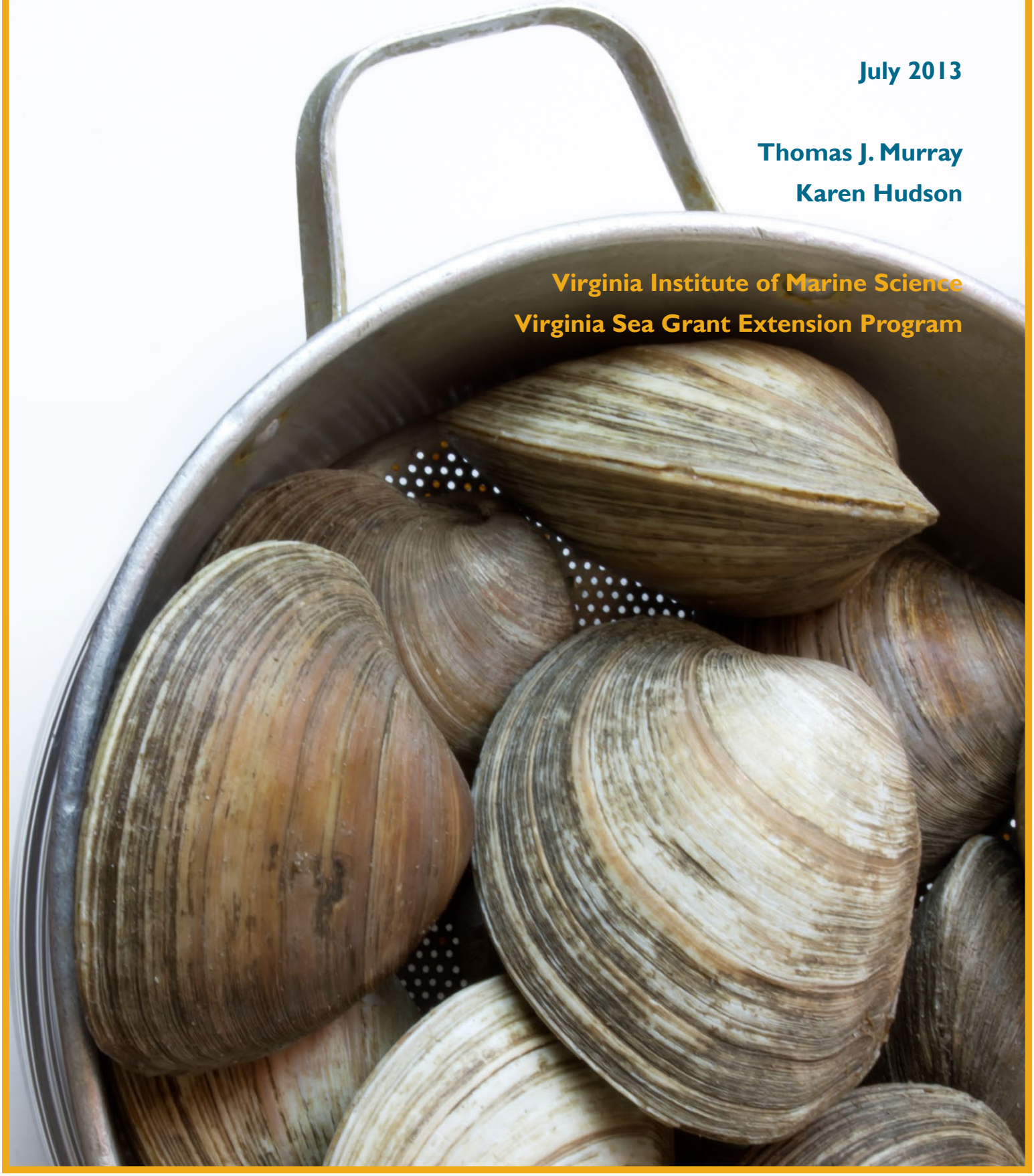

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Executive Summary

The growth of the commercial shellfish aquaculture industry in Virginia has added significant value to the state's seafood marketplace. Today, watermen continue to harvest wild clams and oysters from the state's public resources while shellfish growers provide vast quantities of quality clams and oysters to seafood consumers. This study was completed to assess the current state of the hard clam and oyster aquaculture industry in Virginia and to estimate the economic activity which arises from this growth. Table 1 summarizes four widely recognized aggregate measures of economic impact as they relate to the current impacts of the commercial shellfish aquaculture on the Commonwealth of Virginia.

Hard Clams

- First in the U.S.: Virginia produces more cultured hard clams than any other state.
- Second on the Eastern Shore: Hard clam is the second most valuable crop raised on the Eastern Shore exceeding for example, the values for corn, soybeans, wheat, etc.
- 516 million seed clams were planted and 171 million market clams were sold at a value of $26.8 million from Virginia's Eastern Shore farms in 2012.
- 63 million seed clams were sold from Virginia's hatcheries in 2012, a total sales value of $1.5 million.
- 86% of clams sold in 2012 went to out-of-state buyers, a source of economic growth on the Eastern Shore and throughout the Commonwealth.
- 170 full-time and 75 part-time jobs make up the total direct employment associated with these Eastern Shore hard clam farm sales in 2012.

Single Oysters

- 66.7 million individual oysters were planted in 2012.
- 28.1 million previously planted market oysters valued at $9.5 million were sold in 2012.
- 112 million seed oysters were sold by Virginia's oyster hatcheries in 2012.
- 74% of market oysters sold in 2012 went to out-of-state buyers, a source of economic growth throughout the state.
- 70 full-time and 106 part-time jobs make up the total direct employment associated with oyster aquaculture sales in 2012.

Table 1. Total Economic Impact of Shellfish Aquaculture on Virginia – 2012

	Hard Clams	Single Oysters	Total
Output ($ millions)	$61.5	$19.7	$81.2
Employment (#)	693	232	925
Income ($ millions)	$17.1	$10.0	$27.1
Taxes ($ millions)	$2.4	$1.2	$3.6

Recent Growth in Hard Clam & Oyster Aquaculture

Aquatic harvesting and fisheries have historically been an important economic sector in Virginia, with fisheries based upon wild stocks of fish and shellfish. Historically culture techniques were employed extensively in the oyster industry prior to endemic diseases destroying the bulk of the wild oyster resource. In relatively recent years, there has been increased interest in the potential for culturing marine products, and today both hard clam and oyster aquaculture is becoming more common.

Hard clams and oysters are grown on coastal submerged lands leased from the State of Virginia. Successful oyster and clam farming requires good water quality, free from bacterial and industrial contamination. Generally the three steps of production include the (1) seed production, (2) nursery, and (3) grow-out.

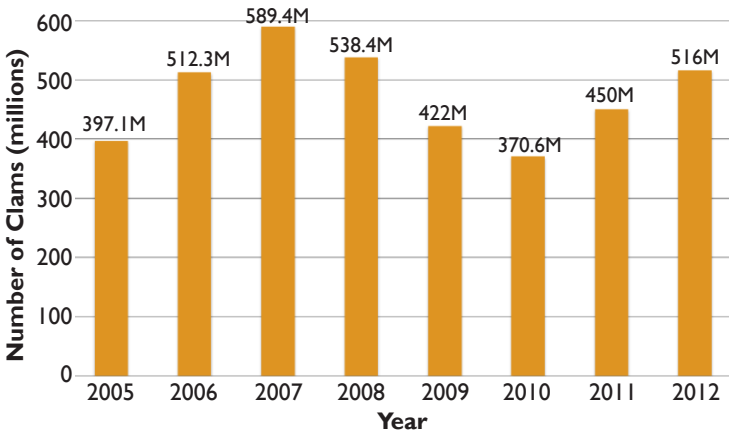
Seed production occurs in land-based hatcheries. Brood stock oysters and clams are spawned in a controlled, indoor environment. The spawned juvenile clams and oysters are kept in the hatchery until they reach a size where they can be transferred to a land based or field nursery area. The hatcheries are relatively capital intensive. There are eight active private hatcheries in Virginia.

Shellfish aquaculture has grown dramatically the 1991-2012 period, and oyster aquaculture is showing signs of continued growth. Such growth underscores the importance of evaluating future prospects for expansion in shellfish aquaculture. (The economic impact of the clam industry was last estimated in 2005.)

Hard Clams

The hard clam, *Mercenaria mercenaria*, is a euryhaline bivalve found along the eastern and Gulf coasts of North America ranging from the Gulf of St. Lawrence to the Yucatan Peninsula. It has been the focus of important commercial fisheries along the Atlantic coast.

Figure 1. Number of Hard Clams Planted in Virginia



Hard clams are consumed in a wide variety of ways. Generally, larger clams (>80 mm) are used in chowder and more succulent littlenecks, sometimes called "nicks" (< 60 mm), and cherrystones, referred to as "cherries" (61-80 mm), are eaten either steamed or raw on the half shell. Virtually all of the state's cultured hard clams are produced in Accomack and Northampton Counties on Virginia's Eastern Shore.

The growth of the shellfish aquaculture clam industry in Virginia has added immense value to the state's seafood marketplace.

Production increased from 30 million littleneck clams in 1991 to an estimated 171 million in 2012. Value of those harvests rose also, from $4.1 million to $26.8 million over the same period. As shown in Figure 1, the clam industry appears to have reached a sustainable level of plantings and harvests, responding as with any crop to fluctuations in the market and nature.

Oysters

The Eastern oyster, *Crassostrea virginica*, lives in estuaries along the east coast of North America from the Gulf of St. Lawrence, Canada to Key Biscayne, Florida and on through the Caribbean to the Yucatan Peninsula of Mexico and to Venezuela. Now cultured, this molluscan bivalve species has been traditionally harvested by hand tong and more recently by mechanical dredge or patent tong. Containerized culture also exists for this species, making harvests more convenient but more labor-intensive at the same time.

Eastern oysters are a valued commercial species along the Atlantic coast. They are consumed in a wide variety of ways but unlike hard clams, they are not defined by size. Rather, Eastern oysters are sold in distinct markets based on product form.

More recently the oyster aquaculture industry has diversified in much the same way as the cultured clam industry. Leading the way in hatchery production, nursery techniques, and controlled grow out, the clam industry provided a proven model for the recent expansion of oyster aquaculture. Figures 3 and 4 illustrate the recent growth in single oyster aquaculture in the Commonwealth.

Figure 2. Number of Hard Clams Sold in Virginia

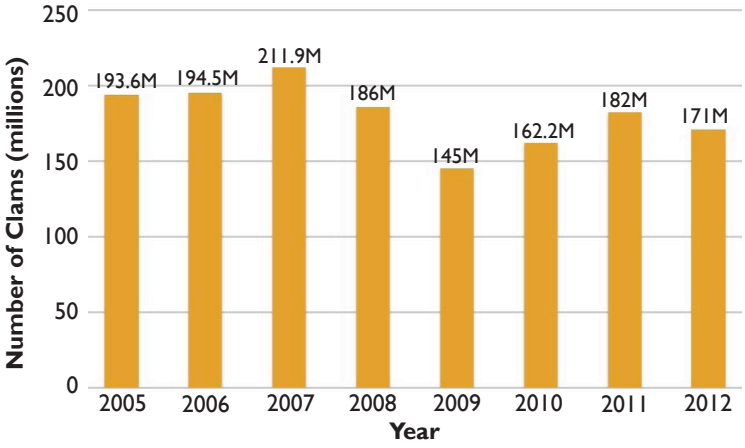


Figure 3. Number of Single Oysters Planted by Virginia Aquaculturists

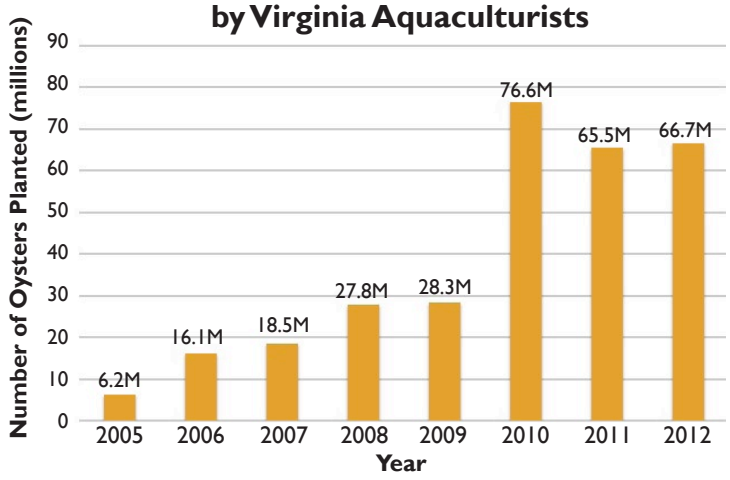
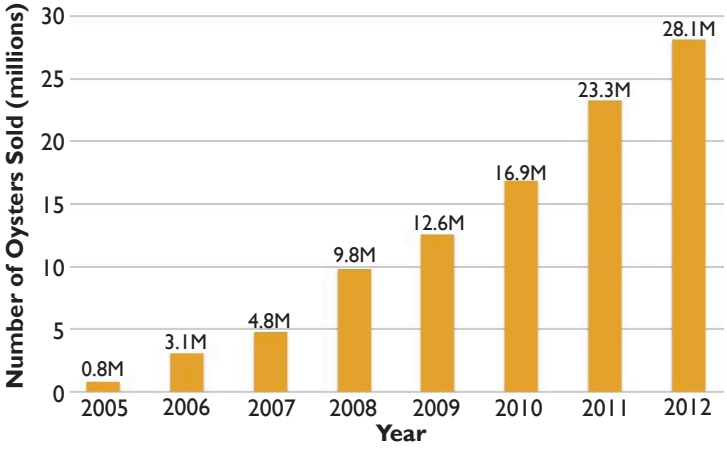


Figure 4. Number of Aquacultured Market Oysters Sold by Virginia Growers



Methodology

Survey

Since 2006 the authors have conducted crop surveys resulting in the annual report entitled "Virginia Shellfish Aquaculture Situation & Outlook Report," based upon an annual survey of licensed commercial shellfish growers. A mail-and internet-based survey is used to collect information from Virginia commercial clam and oyster growers known to be active in the industry. It is believed that the survey is representative of overall trends and reflects the majority of active commercial growers. For confidentiality reasons, the information collected is aggregated and the total represents both the Eastern and Western Shores of Virginia.

Economic Impact Analysis

Economic impact analysis begins with introducing a change in the output of goods and using the multiplier model to analyze the effects on a region's economic base. The standard input-output model estimates the direct, indirect, and induced economic implications of some basic economic activity. Taken together, these provide an estimate of the multiplier effects from the basic activity.

In the standard input-output model, measures of aggregate economic activity are used as a basis for estimating the total economic impact of the subject activity. For example, measures of direct employment or total sales in an industry are obtained, and these are then used as a basis for evaluating the total impact. In these report estimates of the initial shellfish sales by Virginia firms were obtained and used as the base measure for estimating the direct economic impact of the industry.

Given this measure of the direct purchases of the shellfish farming-related industry, an estimate is made of the indirect impacts using information on the interactions between these industry sectors and other economic sectors that are, to varying extent, dependent upon such aquaculture-related industry.

For example, suppliers of materials into the clam and oyster products, transportation, storage, marketing and distribution are also dependent upon the sales of farm-raised clams. These added sales or impacts are referred to as the indirect impacts. Such indirectly dependent sectors include hundreds of other types of manufacturing, trade, for which industrial classifications range from freight and shipping to containers and packaging.

Ultimately, the direct sales activity, and the resulting indirect activity, generates some increases in the general level of employment and income in the Eastern Shore and throughout the Commonwealth. The extra income generated in this way leads to a third wave of economic impact through greater household expenditures on goods and services. Much of this additional re-spending will also occur within the local area, further expanding economic activity. These effects are referred to as the induced impacts of the industry.

Economic Input-Output Model Application

Most regional input-output studies attempt to characterize either (1) the economic impacts of specified changes in final demand for a given set of products, services, and industries, or (2) the economic significance of specific industries in a regional and national economy. The research described herein accomplishes the latter task. It assesses the economic significance of the clam farming upon related industries located in the Eastern Shore and the State of Virginia.

Because of the interrelationships among the many sectors of an economy, any new basic economic activity, such as increasing clam sales to out-of-state buyers, will generate additional waves of economic impact. By stimulating the expenditures by out-of-region customers for the export sale of marine products, shellfish aquaculture initiates such expanding rounds of economic impact. These impacts occur first within the Eastern Shore communities and then throughout the Commonwealth.

For example, the marketing of clams from the Eastern Shore and Virginia calls forth additional activity among the suppliers of necessary inputs as well as among distributors of shellfish aquaculture-related products, warehouses, and retailers. The impact of the sale of a dollar of shellfish farming-related goods and services generates activity not only for the retail sector but also indirectly generates economic activity for suppliers, accountants, and programmers whose employment supports the operation of the retail enterprise. In an analogous way, the activities of shellfish-related marketers and consumers will generate multiple rounds of economic activity.

As mentioned above, economic impact analysis is an attempt to provide an estimate of the total impact of any economic activity in any region, including, not only the primary economic impact, but also secondary and tertiary impacts.

The IMPLAN Model

Many economic impact studies use information from the Regional Inter-industry Impact Model (IMPLAN). This model was developed using a combination of direct survey data obtained through national surveys of inter-industry interaction, and then, "shares down" the inter-industry relationships to the local or regional level, based upon the structure or employment structure of industries under consideration. The IMPLAN model used herein includes industry linkages specific to the Eastern Shore and State of Virginia.

From these government derived regional inter-industry relationships, output, income, and employment multipliers are estimated.

Thus, in terms of simple analysis of the aggregate impacts of activity on the regional economy, published government estimates of the multiplier are used. The use of the IMPLAN multipliers for the present analysis is considered reasonable.

To perform the impact analysis, initial information on the level of primary or basic economic activity for the industry studied is needed. As mentioned above, measuring the total economic impact of any product, good, or service such as clam aquaculture first requires an estimate of the initial (farm level) value of the goods sold.

While the IMPLAN database system includes a commercial fisheries category it does not fully represent the characteristics of clam farming. The model was adjusted to reflect the specific characteristics of the Virginia shellfish culture industry based upon grower income and expenditures identified in the grower survey.

Results

Survey – Clams

Eastern Shore hard clam farms sold 171 million market clams valued at $26.8 million during 2012 at an average price of $0.16 per clam. Virginia hard clam hatcheries produced 670 million seed clams and sold 63 million. Overall clam sales bring economic growth to the Eastern Shore and the state as growers report that 86% of market clams are sold to out-of-state buyers. Not only does the clam industry contribute to the economy in terms of employment and sales of products, it produces greater economic benefit to the state because of the economic activity it generates among the firms that provide inputs to clam culture.

As can be seen in Table 2, the inputs necessary to produce hard clams and oysters for market constitute another level of economic

Table 2. Virginia Hard Clam and Oyster Aquaculture Expenditures*

	Clams	Oysters
Cost of Purchased Seed	0.25	0.06
Purchased Ice	0.01	0.01
Containers & Packaging	0.02	0.01
Wages & Employee Compensation	0.22	0.60
Payroll Taxes	0.01	0.03
Employee Benefits Health Insurance	0.01	0.01
Freight & Shipping	0.04	0.04
Miscellaneous Supplies	0.03	0.01
Equipment Repair & Maintenance	0.01	0.01
Truck & Auto Expense	0.01	0.01
Advertising/Marketing	0.01	0.01
Broker Fees	0.01	0.01
Building & Equipment Rent or Depreciation	0.02	0.03
Utilities, Phone	0.01	0.01
Insurance	0.01	0.01
Warehouse Cold Storage	0.01	0.01
Interest & Property Taxes	0.01	0.00
Other Expenses (i.e. Payments to Other Growers)	0.16	0.06
Total Costs	0.85	0.87
Income Before Taxes	0.15	0.13

* per $1.00 of sales.

activity from suppliers of these inputs. The cost breakdown summarized here illustrates the local impact of the shellfish aquaculture industry as all of the seed, labor and cooperative purchases are made in the local area. While individual firm costs may vary from those reflected in the Table, these allocations are believed to be representative overall and were developed from industry reporting.

The economic base multipliers for hard clam aquaculture are broadened by the fact that much of the grow-out capital and fabrication is locally completed, adding significant value to the local economy as well. In addition to this direct impact, employees within the shellfish aquaculture industry generate economic activity when they spend their income on housing, food, and other goods and services. In this way the economic benefits resulting from shellfish culture extend beyond the local culture area to the general Virginia economy.

With this in mind, this study was completed to utilize data collected from shellfish growers in an effort to benchmark the extent of the industry and estimate it economic linkages and impact to Virginia. The impact methods section of this report further details the regional economic modeling that translated the direct farm level activity to local and regional economies.

Survey – Oysters

Virginia oyster growers sold 28.1 million single market oysters valued at $9.5 million during 2012 at an average price of $0.34 per oyster. Virginia oyster hatcheries produced 2 billion "eyed larvae" and sold 112 million individual seed oysters. Overall oyster sales bring economic growth to the Commonwealth as 74% of market oysters sold went to out-of-state buyers. As with clam culture, the oyster aquaculture industry contributes in terms of employment and sales of products. It produces greater economic benefit to Virginia because of the economic activity it generates among the firms that provide inputs to the oyster culture firms. Table 2 shows the inputs necessary to produce market oysters constitute another level of economic activity in suppliers of these inputs.

Direct Economic Impacts

The initial sales of farm-raised shellfish by Virginia growers generated a combined direct impact on local economic output of an estimated $36.3 million in 2012. This direct economic impact of the shellfish aquaculture manifests itself in other economic growth measures as well. For example, the total direct employment associated with these shellfish farm sales was estimated to be 925 (full and part time jobs) in 2012.

Table 3 summarizes three standard measures of direct economic impacts of Virginia's shellfish aquaculture.

Table 3. Direct Economic Impact of Shellfish Aquaculture on Virginia

	Hard Clams	Single Oysters	Total
Output ($ millions)	$ 26.8	$ 9.5	$ 36.3
Employment (fte)	190	138	328
Income ($ millions)	$ 17.1	$ 10.0	$ 27.1

Table 4. Indirect Economic Impact of Shellfish Aquaculture on Virginia

	Hard Clams	Single Oysters	Total
Output ($ millions)	$ 22.7	$ 3.1	$ 25.7
Employment (fte)	407	34	441
Income ($ millions)	$ 6.3	$ 1.2	$ 7.5

Table 5. Induced Economic Impact of Shellfish Aquaculture on Virginia

	Hard Clams	Single Oysters	Total
Output ($ millions)	$ 11.5	$ 7.0	$ 18.5
Employment (fte)	96	60	156
Income ($ millions)	$ 3.7	$ 2.3	$ 5.9

Indirect Economic Impacts

Having calculated the first, direct effects of aquaculture on various measures noted above, the further ripple effect arising from the initial impact was quantified using an input-output model.

Based upon information on the interrelationships among the sectors of the regional economy, the values of the inter-industry multipliers are generated by the IMPLAN input output model. That is, quantifying from which industries the clam aquaculture sector buys its production inputs, and to which sectors its final products are sold, enables estimates of the multiplier effects to be made. Understanding both the purchases of inputs and sale of goods and services by the marine products sectors allows the forward and backward linking of the clam farming sector's economic activity. This permits the tracing of expenditures as they multiply throughout directly and indirectly impacted sectors. The indirect impact measures are show in Table 4.

The initial sales of shellfish growers generated further indirect impact on local economic output of an estimated $25.7 million in 2012. As with the direct impacts the indirect economic impact of the hard clam aquaculture manifests itself in other economic growth measures as well. For example, the total indirect employment associated with firms providing necessary inputs to the Eastern Shore hard clam farm sales was estimated to be 441 (full and part time jobs) in 2012.

Additionally the output by firms selling to Eastern Shore clam farms generated additional increases in personal incomes earned throughout the region. For the Eastern Shore personal income associated with the indirect support sectors of the hard clam aquaculture industry was $7.5 million over the same period.

Induced Economic Impacts

As a result of the added employees' compensation and personal income directly generated from clam farm sales, and similar growth in indirect, supply industries, overall income levels rise, with further expansion of expenditure and economic activity in the region. The direct and indirect increases in household incomes noted above bring about economic activity in non-clam aquaculture industry sectors such as retail trades, eating and drinking establishments, banking, hospitals, real estate, etc. The induced or third round economic impacts, which result from the direct and indirect economic activity are summarized in Table 5.

Total Economic Impact

To summarize, in addition to direct impacts, indirect and induced impacts are estimated and defined as:

- Indirect impacts measure the change in production in backward linked industries caused by the changing input needs of directly effected industries;
- Induced impacts measure the change in regional household expenditure patterns caused by changes in household income arising in the direct and indirect sectors.

When taken together the economic impacts resulting from commercial shellfish aquaculture result overall in increases in: economic output of $81.2 million; added employment of 925 individuals, accompanied by an overall increase in personal labor incomes of $27.1 million. These total economic impacts are summarized in Table 6.

Table 6. Summary Economic Impacts of Virginia Commercial Shellfish Culture

		Clams	Oysters	Total
Labor Income Impacts	Direct Impacts	$7.1	$6.6	$13.7
	Indirect Impacts	$6.3	$1.2	$7.5
	Induced Impacts	$3.7	$2.3	$5.9
	Total	$17.1	$10.0	$27.1
Indirect Business Tax Impacts	Direct Impacts	$0.7	$0.6	$1.3
	Indirect Impacts	$0.7	$0.1	$0.8
	Induced Impacts	$1.0	$0.5	$1.5
	Total	$2.4	$1.2	$3.6
Other Property Income Impacts	Direct Impacts	$1.8	$2.4	$4.2
	Indirect Impacts	$1.8	$0.4	$2.3
	Induced Impacts	$2.4	$1.6	$4.0
	Total	$6.0	$4.5	$10.5
Total Value Added Impacts	Direct Impacts	$9.6	$9.6	$19.2
	Indirect Impacts	$8.8	$1.7	$10.5
	Induced Impacts	$7.0	$4.3	$11.4
	Total	$25.4	$15.7	$41.1
Output Impacts	Direct Impacts	$27.4	$9.6	$36.9
	Indirect Impacts	$22.7	$3.1	$25.7
	Induced Impacts	$11.5	$7.0	$18.5
	Total	$61.5	$19.7	$81.2
Employment Impacts	Direct Impacts	190	138	328
	Indirect Impacts	407	34	441
	Induced Impacts	96	60	156
	Total	693	232	925

Table 7. Spending by IMPLAN Sector – Clams

	IMPLAN sector	Description
$11.5	17	Commercial fisheries
$7.1	Custom	Wages
$2.0	319	Wholesale trade distribution services
$1.7	335	Truck transportation services
$0.8	110	Paper and paperboard stationary products
$0.6	360	Real estate buying and selling, leasing, managing, and related services
$0.6	357	Insurance
$0.5	108	Coated and laminated paper, packaging paper and plastics film
$0.3	Custom	Vehicle expense
$0.3	439	Employment and payroll only (federal govt, non-military)
$0.3	437	*Employment and payroll only (state & local govt, non-education)
$0.3	417	Commercial and industrial machinery and equipment repairs and maintenance
$0.3	377	Advertising and related services
$0.3	351	Telecommunications
$0.3	340	Warehousing and storage services
$0.3	70	Soft drinks and manufactured ice
$0.0	332	Air transportation services
$0.0	333	Rail transportation services
$0.0	334	Water transportation services
$27.4		

Table 8. Spending by IMPLAN Sector – Oysters

	IMPLAN sector	Description
$0.6	17	Commercial fisheries
$6.6	Custom	Wages
$0.5	335	Truck transportation services
$0.3	439	Employment and payroll only (federal govt, non-military)
$0.2	319	Wholesale trade distribution services
$0.2	360	Real estate buying and selling, leasing, managing, and related services
$0.2	357	Insurance
$0.1	Custom	Vehicle expense
$0.1	437	* Employment and payroll only (state & local govt, non-education)
$0.1	417	Commercial and industrial machinery and equipment repairs and maintenance
$0.1	377	Advertising and related services
$0.1	351	Telecommunications
$0.1	340	Warehousing and storage services
$0.1	108	Coated and laminated paper, packaging paper and plastics film
$0.1	110	Paper and paperboard stationary products
$0.1	70	Soft drinks and manufactured ice
$0.0	332	Air transportation services
$0.0	333	Rail transportation services
$0.0	334	Water transportation services
$9.6		

Glossary of Input-Output Terms

Direct effects/impacts: Direct impacts represent the revenues, value-added, income, or jobs that result directly from an economic activity within the study area or a regional economy.

Employment or jobs: Represents the total numbers of wage and salaried employees as well as self-employed jobs. This includes full-time, part-time, and seasonal workers measured in annual average jobs.

Indirect business taxes: Include sales, excise, and property taxes as well as fees and licenses paid by businesses during normal operations. It does not include taxes on profits or income.

Indirect effects/impacts: Indirect effects or impacts occur when businesses use revenues originating from outside the region, or study area, to purchase inputs (goods and services) from local suppliers. This secondary, indirect business generates additional revenues, income, jobs, and taxes for the area economy.

Induced effects/impacts: Induced effects or impacts occur when new dollars, originating from outside the study area, are introduced into the local economy. Induced economic impacts occur as the households of business owners and employees spend their earnings from these enterprises to purchase consumer goods and services from other businesses within the region. This induced effect generates additional revenues, income, jobs, and taxes for the area economy.

Input-output analysis: Input-output models are used to estimate how revenues or employment for one or more particular industries, businesses, or activities in a regional economy impact other businesses and institutions in that region.

Input-output models: A mathematical representation of economic activity within a defined region using inter-industry transaction tables or matrices where the outputs of various industries are used as inputs by those same industries and other industries as well.

Labor income: All forms of employment compensation, including employee wages or salaries and proprietor income or profits.

Local/resident revenues/expenditures: Local revenues represent simple transfers between individuals or businesses within a regional economy. These transactions do not generate economic spin-off or multiplier (indirect and induced) effects.

Margins: Represent the differences between retail, wholesale, distributor, and producers prices.

Non-resident /non-local revenues/expenditures: When outside or new revenues flow into a local economy either from the sale of locally produced goods and services to points outside the study area, or from expenditures by non-local visitors to the study area, additional economic repercussions occur through multiplier (indirect and induced) effects.

Other property type income: Income in the form of rents, royalties, interest, dividends, and corporate profits.

Output: Revenues or sales associated with an industry or economic activity.

Total impacts: The sum of direct, indirect and induced effects or economic impacts.

Value-added: Includes wages and salaries, interest, rent, profits, and indirect taxes paid by businesses. In the IMPLAN results tables, Value-added equals the sum of Labor Income, Other Property Type Income, and Indirect Business Taxes.

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