Economic Contribution of Connecticut's Aquaculture Sector: Integration of Administrative Data and Trajectory

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Abstract

This study estimates the economic impact of Connecticut's aquaculture sector using input–output modeling. In 2022, the industry generated $33.5 million in output and supported 482 jobs. The analysis tracks trends from 2016 to 2023, with a focus on shellfish production and its economic effects. By combining administrative sales data with federal survey information, applying sector mapping, and converting results into constant dollars for trend analysis, the study illustrates best practices in economic impact analysis. These practices strengthen transparency and enhance the policy relevance of regional aquaculture studies.

1 Introduction

Fisheries and aquaculture play a crucial role in the livelihood, employment, and nutrition of coastal communities around the world (Food and Agriculture Organization of the United Nations, 2024). Quantifying the economic contribution of fishery and aquaculture operations and their regional trends is important to understanding how these operations, their communities, and regional economies are being impacted.

Aquaculture is a longstanding part of Connecticut's maritime economy, with oysters and clams farmed commercially for over a century. The state was among the first in the nation to legally define aquaculture as agriculture (CT Gen Stat § 22-11c), underscoring its importance within coastal livelihoods and food systems. Today, 40 shellfish businesses operate across 61,626 acres of leased waters managed at both town and state levels, alongside 17,000 acres of public oyster beds and 10,000 acres of recreational beds. Collectively, these areas represent more than one-fifth of Connecticut's portion of Long Island Sound. In recent years, aquaculture has accounted for about three percent of the state's agricultural sales (U.S. Department of Agriculture, National Agricultural Statistics Service, 2024). Despite aquaculture representing a small share of Connecticut's agricultural sector, the state ranks among the top five shellfish-producing states nationwide

and third along the U.S. Atlantic coast (East Coast Shellfish Growers Association, personal communication, 2024).

Despite its scale and history, the aquaculture sector has faced major disruptions in recent years. COVID-19 sharply reduced demand, while weather disturbances, specifically extreme storms resulting in rainfall-driven closures of shellfish beds, further constrained production and raised costs. These factors directly affected sales, jobs, and supply chains, emphasizing the need to assess not only output but also wider economic impacts to guide resilience investments. Meanwhile, small finfish farms, ornamentals, and emerging kelp ventures offer diversification potential, though they remain limited in scale. Together, these shifts highlight vulnerabilities in traditional shellfish segments and reinforce the importance of a comprehensive economic impact study.

To assess aquaculture's current contribution to and trajectory of impacts within the Connecticut economy, the analysis used input–output modeling, combining administrative shellfish sales with federal survey data for other species to estimate output and employment effects. Beyond the results, it highlights best practices in sector mapping, use of reliable administrative data, and conversion to constant dollars, offering both an empirical measure of aquaculture's role and methodological lessons for future impact studies.

2 Literature Review

Input–output modeling has been widely applied to measure the economic contributions of aquaculture and related natural resource sectors. Prior studies, including a recent national level assessment and state specific analyses for Florida, Massachusetts, Maine, Indiana, and Newfoundland and Labrador, report output multipliers between 1.57 and 1.81. (Kumar et al., 2024; Botta et al., 2021; Augusto et al., 2015; Cole et al., 2017; Broughton and Quagrainie, 2013; Newfoundland and Labrador Fisheries and Aquaculture, 2014; Lopez et al., 2017). These analyses, most of which relied on IMPLAN or similar frameworks, highlight both the economic importance of aquaculture and the sensitivity of results to data quality and sector mapping.

Several studies have emphasized the value of integrating sector-specific data with modeling frameworks. Lipton et al. (2019), in a national assessment, stress that accurate industry representation requires careful alignment between aquaculture subsectors and federal input-output accounts. Their study also underscored the need for standardized industry surveys and improved integration of administrative and survey data to ensure reliable estimates of the sector's contributions.

3 Data and Methodology

This study estimates aquaculture's contribution to Connecticut's economy using input–output modeling, with results reported in constant 2023 dollars. In addition to providing a 2022 snapshot, the analysis tracks trends from 2016 to 2023, allowing shifts within the sector to be evaluated over time.

3.1 Integration of Administrative and Survey Data

We combine two complementary sources. First, administrative data in the form of mandatory shellfish sales reports from the Connecticut Department of Agriculture. These provide a reliable benchmark for direct activity that is rarely available in state aquaculture studies (Connecticut Department of Agriculture, 2024). Second, we use survey data from the 2022 USDA Census of Agriculture for finfish and ornamentals, where reporting is voluntary and less complete (U.S. Department of Agriculture, National Agricultural Statistics Service, 2024). In Connecticut, economically relevant species include clams and oysters for shellfish; trout and European sea bass raised in finfish farms; and minor categories such as ornamental fish, sport and game fish, and aquatic plants (e.g., kelp and algae), some of which are unreported because of confidentiality or very small sales.

Given these data realities, our reconciliation is straightforward: the state shellfish reports anchor the estimates, while the Census fills the non-shellfish categories. Consistent with that approach, in 2022 the

Census overreported shellfish sales by about 6 percent ($17.36 million vs. $16.40 million), while in 2017 it underreported them by about 31 percent ($19.83 million vs. $26.03 million).

3.2 Modeling Approach

Following Lipton et al. (2019), we define aquaculture as the set of NAICS codes 112511, 112512, and 112519. In IMPLAN (2024), these NAICS codes are implemented through sector 14 ("Animal production, except cattle poultry, and eggs"), which, in Connecticut, consists mostly of aquaculture. Aquaculture accounted for about 65 percent of sector 14 sales in 2022 and more than 90 percent in 2017. However, IMPLAN production functions are derived from national input and output accounts and therefore may not reflect the input structure of aquaculture in Connecticut. Given our use of a relatively simple impact model, driven in part by limited survey responses, we adjusted the output multiplier to better represent the state's industry composition rather than estimating a customized production function. This adjustment is also important because, as noted by Steinback (2004), using output as the direct effect requires ensuring that households are not counted both as final demand and as part of the multiplier. Our procedure mitigates this form of double counting. Our adjusted multiplier (1.61) is consistent with the range of values reported in studies that do use customized or aquaculture-specific production functions based on survey data.

We estimate two indicators of the economic importance of the aquaculture production sector: (i) total economic impact, measured by statewide output (sales), and (ii) total impact on state employment, which counts full– and part–time jobs. Total impacts are the sum of direct, indirect, and induced effects. Direct effects reflect sales and jobs in aquaculture firms. Indirect effects arise from purchases of inputs from suppliers (e.g., transportation, utilities, equipment, repair). Induced effects capture household spending from wages earned in aquaculture and its supply chain.

The IMPLAN model explicitly measures the interdependencies of economic sectors as goods and services flow-through supply chains. The underlying dataset for IMPLAN analysis is constructed from annually updated data drawn from the U.S. Bureau of Economic Analysis, Bureau of Labor Statistics, Census Bureau, Department of Agriculture, and Geological Survey. Because IMPLAN treats the focal sector as the point of final demand, downstream processing and restaurant activity linked to aquaculture appear only through the indirect and induced channels. Because production and sales data are required to be reported to state agencies, they are more reliable than employment data reported by IMPLAN, Census of Aquaculture or federal reports.[1] Thus, we base impact estimates on observed sales reported to state agencies rather than reported employment.

Taken together, the data integration, sector mapping, and constant dollar reporting provide a transparent basis for both the 2022 snapshot and the multi-year trend analysis.

4 Results

4.1 Overall Impacts

In 2022, Connecticut's aquaculture industry generated $20.8 million in direct sales, producing a total impact of $33.5 million in output and supporting 482 jobs statewide (Table 1). Most of this activity stemmed from shellfish, particularly oysters.

4.2 Trends in Shellfish Production and Economic Impact

Figure 1 presents the yearly evolution of production, sales, and the direct economic impact (in constant 2023 dollars) for clams and oysters from 2016 to 2023. The figure illustrates the distinct trajectories of the two

[1]Because shellfish producers are required to report production and sales to the Connecticut Department of Agriculture, Bureau of Aquaculture, these administrative data avoid underreporting that arises in other sectors due to cash transactions or nonresponse to Census or federal surveys, (see Cleary-Morse et al., 2009; Nigel, 2019). To protect human health, shellfish must be bagged and tagged, and a receipt with the corresponding tag information must always be available for inspection. The tag is required to accompany the shellfish to the final point of sale (consumer, retail shops, and restaurants).

Table 1: Economic impact of aquaculture production in Connecticut, 2022.

	Output (2023$ Million)			
	Direct	Indirect	Induced	Total
Clams	2.03	0.14	1.09	3.27
Oysters	14.37	1.05	7.72	23.14
Finfish farms	4.35	0.31	2.34	7.00
Ornamental fish	0.07	0.01	0.03	0.11
Total aquaculture production	**20.82**	**1.51**	**11.18**	**33.52**
Multiplier per $ million in Sales	1.00	0.07	0.54	1.61
	Employment (jobs)			
	Direct	Indirect	Induced	Total
Clams	41	1	6	47
Oysters	288	6	38	332
Finfish farms	87	2	12	101
Ornamental fish	1	0	0	1
Total aquaculture production	**417**	**8**	**55**	**482**
Multiplier per $ million in Sales	20.0	0.4	2.7	23.2

Note: Other categories excluded for confidentiality reasons include sport and game fish, and other aquaculture products such as aquatic plants. However, these categories are likely to account for very small commercial sales relative to shellfish and fish farms. Direct employment is estimated via the IMPLAN model (2022), while direct sales were observed.

subsectors over this period.

Clam production declined sharply, falling from about 402,000 bags in 2016 to about 67,000 bags in 2023. Clam sales dropped from $13.3 million to $1.83 million (2023 dollars). This downturn is consistent with declines observed in other states in the region (National Oceanic and Atmospheric Administration, 2024). Although the reasons for the decline in Connecticut are unclear and may be unrelated to developments in nearby states. In contrast, oyster production remained close to 300,000 bags in most years, with a noticeable dip in 2020 followed by a partial rebound. Oyster sales decreased from $21.4 million to $14.6 million (2023 dollars). For both subsectors, 2020 marked the lowest production levels due to stay-at-home orders and the temporary closure of restaurants and other marketing channels during COVID.

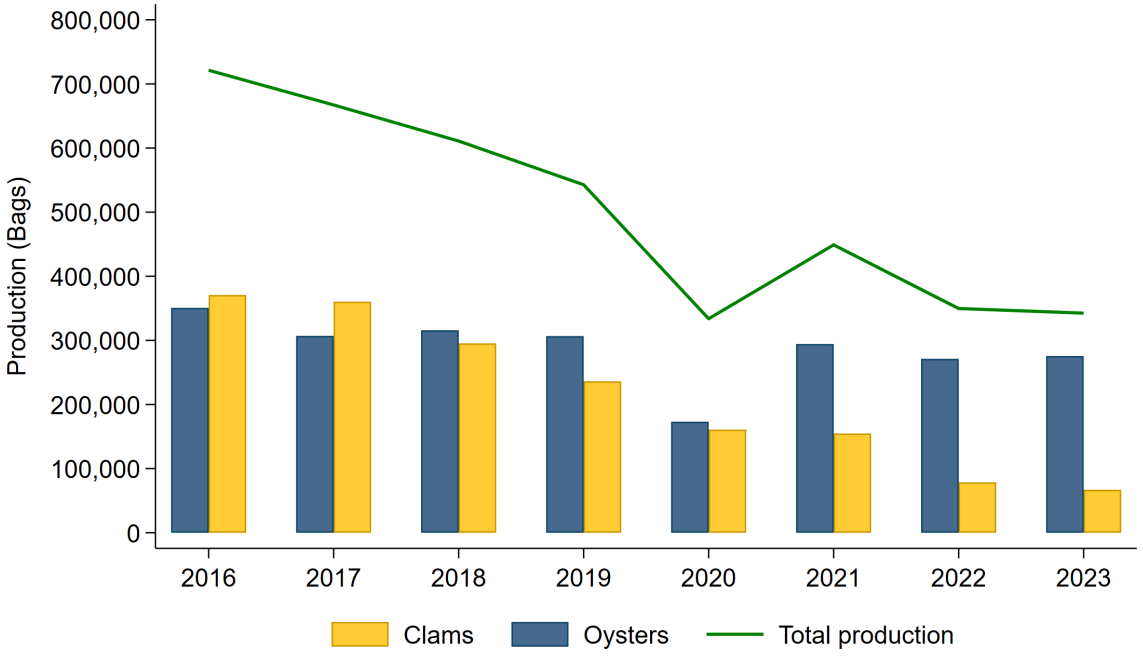
Overall, the total number of bags produced shows a downward trend over the period, with a short-lived rebound in 2021. Consistent with this decline in production, jobs supported by shellfish decreased from 752 in 2016 to 377 in 2023.

5 Best Practices and Discussion

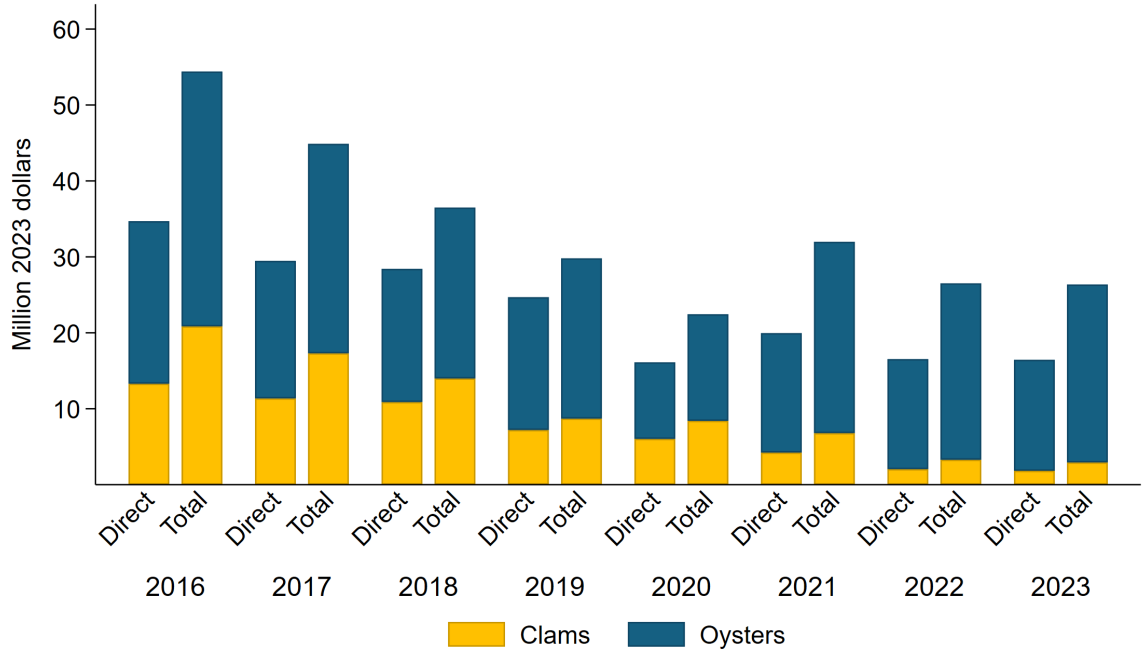
Best practices in economic impact analysis emphasize clear sector definition, reliable data sources, and transparent reporting of assumptions (Clouse et al., 2023). In this study, aquaculture subsectors were mapped to national industry codes to ensure alignment with the modeling framework, a step that strengthens comparability with other regions. The integration of administrative sales reports with federal survey data further improves reliability, since shellfish production is documented through mandatory state reporting while finfish and ornamentals rely on voluntary Census responses.

Another best practice is the use of constant dollars to allow trends to be interpreted over time. Presenting both the 2022 snapshot and longitudinal results from 2016 to 2023 provides a fuller picture of the sector's trajectory than a single year estimate alone. This dual perspective shows how the sharp contraction in clam sales contrasts with relative stability in oyster sales and emerging activity in kelp and finfish.

Figure 1: Shellfish aquaculture in Connecticut: production and economic impact.



(a) Shellfish Aquaculture Production, 2016 to 2023.



(b) Shellfish Aquaculture Output: Economic Impact, 2016 to 2023.

Source: IMPLAN (2024); 2022 Census of Agriculture (USDA, 2024); Connecticut Department of Agriculture (2024).

5.1 Policy Implications

The collapse of clam production documented in the previous section and illustrated in Figure 1, driven by causes that remain unclear, poses a structural challenge that threatens the stability of the sector. Addressing this decline will require ecological research, sustained monitoring, and targeted support programs. At the same time, oyster production remains relatively resilient, while emerging kelp and finfish ventures point to opportunities for diversification. Expanding these activities will depend on workforce development, particularly at the post-secondary level, and on strengthening market connections that can support new entrants. It will also be dependent on the sector's capacity to adapt to changing environmental conditions, including extreme weather events that increases rainfall-driven closures of shellfish beds and warming waters, which heightens the risk of diseases, and non-native pests, and predators. Building resilience will therefore require investment in climate-adapted species, improved coastal infrastructure, and adaptive management strategies that can sustain aquaculture while enabling the sector to diversify and respond to shifting environmental conditions.

5.2 Limitations

As with all input–output models, our estimates rely on a static framework with fixed technical coefficients and no substitution across inputs, price adjustments, or behavioral responses (Clouse et al., 2023).These assumptions make the model appropriate for short-run analysis but limit its ability to capture longer-term structural change.

In Connecticut, aquaculture constitutes most of IMPLAN sector 14; however, we acknowledge that the sector's national production function reflects a broader mix of activities, particularly hog and pig farming, and may not fully capture aquaculture specific input structures. To address this limitation, we compare our adjusted multiplier with the range reported in earlier aquaculture studies and find that our result, 1.61, falls comfortably within those published estimates that do use customized or aquaculture-specific production functions based on survey data.

Finally, the underrepresentation of smaller aquaculture subsectors in voluntary survey responses likely means that the estimated impacts are conservative.

5.3 Conclusion

Economic impact analysis is most useful when it applies best practices of data integration, sector mapping, and transparency. By following these standards, studies can provide clearer guidance for policy and support the resilience of regional industries such as aquaculture. In addition, given the multitude of factors affecting the productivity of aquaculture sectors and the sensitivity of different species to these factors, economic impact analysis should be cast not as a case in point but rather a series of consecutive analyses to capture economic losses due in part to the various factors, environmental or otherwise, as well as the effectiveness of mitigation policies and strategies to address them.

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