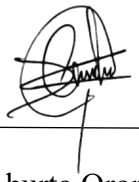
Commercial Sardine Fishing in Mexico: A Financial Perspective

Working towards the well-being of the industry, ecosystem, and community

Capstone Project by:

Mariela Rios
Candidate, Master of Advanced Studies: Marine Biodiversity and Conservation
Scripps Institution of Oceanography, UC San Diego

Capstone Advisory Committee:



Octavio Aburto Oropeza, PhD
(Capstone Committee Chair)
Scripps Institution of Oceanography

Sarah L. Mesnick, PhD
Southwest Fisheries Science Center NOAA Fisheries

Alfredo Giron Nava, PhD
Stanford Center for Ocean Solutions and World Economic Forum

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Mariela Rios-Alcubilla

Abstract:

The pacific sardine (*Sardinops sagax*) and the fishery subsidies have benefited the exponential growth of the commercial sardine fishery in Mexico where most if not all the players are for-profit organizations, and money comes up tops. Yet there is an ongoing debate on responsible fishing practices and the overall management of Mexico's ocean resources. This study focused on the profitability and financial risks associated with commercial sardine fishing practices to guide and aid in the creation of management tools that consider the industry's financial objectives, proper use of public resources, and responsible fishing practices. The study used a financial modeling research approach to determine the profitability of the commercial sardine fishing in the Gulf of California considering fuel subsidies contribution. By creating a profit and loss statement, the gross profit margin was calculated. The study shows that the sardine fishing practices in this area were profitable for the year 2015 with a gross profit margin of 36%, and that 9% are the fuel subsidies contribution, which suggests that there is a significant monetary support from the government that allows the commercial sardine fishing activity to be profitable. This work highlights the knowledge gaps in analyzing profitability of the commercial sardine fishery yet provides a financial perspective on the potential risks for the various stakeholders to make decisions in uncertain conditions like climate change, environmental variability, and a fishery subsidy reform while working for the well-being of the industry, ecosystem, and community.

Keywords: pacific sardine, fisheries finance, conservation and management, profitability, Mexico

1. Introduction

Pacific sardines (*Sardinops sagax*) are small pelagic fish that are high in nutrient and protein content (Nevárez-Martínez *et al.*, 2006). This small fish plays an important role both in the water and outside of the water. The value of the pacific sardine on ecosystem services has been widely studied (Pikitch *et al.*, 2012; Petatán-Ramírez *et al.*, 2019). Sardines are small but highly critical in marine food web interactions (Nevárez-Martínez *et al.*, 2006; Pikitch *et al.*, 2012), they are prey for larger fish species, marine mammals, and seabirds; they contribute to carbon sequestration and help maintain healthy reefs and the overall function of the marine ecosystem (Velarde and Ezcurra, 2015; Punt *et al.*, 2016; Kaplan *et al.*, 2019).

However, in Mexico the pacific sardine has been extracted and traded for money since the late 1960s when commercial operations of the pacific sardine fishery began as the perspective shifted from subsistence towards a more market-oriented operation (Nevárez-Martínez et al., 2006). Today, sardines play a role in a broad range of organizational interactions when outside of the water; they contribute to large scale operations of the sardine fishery, the food sector, agriculture, banking, international trade, food security, tourism and more (Hannesson, Herrick and Field, 2009; Cisneros-Montemayor *et al.*, 2016; Cisneros-Mata *et al.*, 2019; Petatán-Ramírez *et al.*, 2019; Arcos-Aguilar *et al.*, 2021).

Industrialization has enabled the sardine fishery to commercialize this natural resource as B2C (Business-to-consumer), directly to the end user in the form of canned, fresh, or frozen, benefiting the food sector; or as B2B (Business-to-business), by supplying sardines to other businesses that rely on this species as a raw material for their production, such as fisheries that use this species as bait to catch other pelagic species and agricultural commercialization, where sardines are a cheap raw material with high protein content used as feed to benefit the agriculture sector's mass production. The extraction of this oceanic resource also benefits coastal communities through food security, jobs, livelihoods, and ecotourism (Kent, 1986; Majluf, de la Puente and Christensen, 2017; Sardina Golfo de California, 2018; Petatán-Ramírez *et al.*, 2019; Arcos-Aguilar *et al.*, 2021).

The multiple uses of the pacific sardines due to their high nutritional value and low market prices, have increased the demand for sardines at the national and international level, especially in the form of fishmeal and oil (Ingi Einarsson -Matís *et al.*, no date; Petatán-Ramírez *et al.*, 2019). It is assumed that the reduction and transformation of sardines into fishmeal and oil has contributed to the overexploitation of this natural resource to meet global demand from the varied organizational interactions (Hannesson, Herrick and Field, 2009; Punt *et al.*, 2016; Petatán-Ramírez *et al.*, 2019; Giron-Nava *et al.*, 2021). The evolution of the pacific sardine fishery in Mexico clearly shows the rationality of the capitalist economy (Shoko Doode Matsumoto, no date). Since inception, the main objective of profit-making regardless of the costs of the impacts, has characterized the sardine exploitation in the Gulf of California (Shoko Doode Matsumoto, no date). This species reproduces at high rates and it is most productive in the Gulf of California where more than 60% of the sardine fishing activities are concentrated (Giron-Nava *et al.*, 2021).

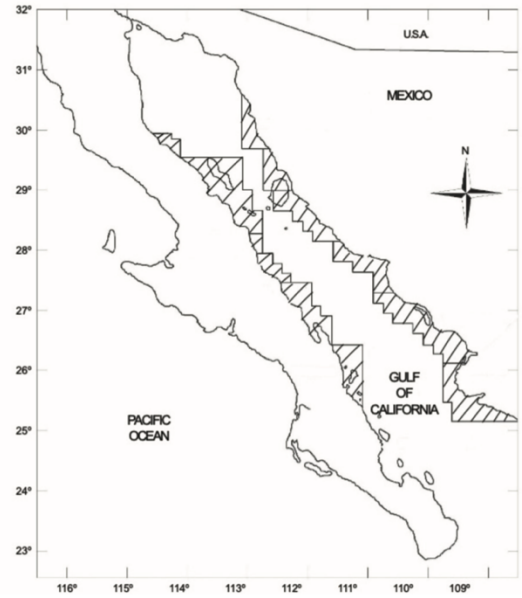

Figure 1 Map of Pacific sardine fishing zones in the Gulf of California (adapted from Lanz et al. 2008)

The pacific sardine fishery in Mexico is subsidized (Cisneros-Mata, 2016; Cisneros-Montemayor *et al.,* 2020), it receives financial contributions from the government to fund its operations across the extensive supply chain (Future of Fish, 2015).

From 2011 to 2019, the National Commission of Fisheries and Aquaculture granted 17.6 billion pesos in subsidies to the fisheries and aquaculture sector (Pescando Datos, 2021) (Fig. 2). More than 50% of the fisheries subsidies are distributed to commercial fisheries towards the modernization of fishing vessels, diesel fuel (herein after referred to as fuel), and infrastructure programs (Dominguez-Sánchez and Girón-Nava, 2017; Dominguez-Sánchez and López-Sagástegui, 2018). The pacific sardine fishery benefited from all these programs, with the fuel subsidy program accounting for the largest share of the total contribution (Dominguez-Sánchez and López-Sagástegui, 2018). While the fuel subsidies reduce the pacific sardine fishery's costs of operations, it boosts the overall profit margins (FAO Fisheries, 2003), which raises the question of how profitable is this business with and without fuel subsidies?

The pacific sardine fishery is analyzed in this study to understand this for-profit business focusing on the profitability and some of the potential financial risks associated with commercial sardine fishing practices to guide and aid in the creation of management tools that consider the industry's financial objectives to determine management strategies for the proper use of public resources, and responsible fishing practices.

The first step is to identify the elements of the financial statement which vary depending on the structure of the business. The main elements are assets, liabilities, equity, revenue, and expenses. In the commercial sardine fishery, the financial statement elements can be as wide and complex as its supply chain which is organized based on the different forms of the product being offered (i.e., fishmeal, canned, fresh, and oil) and the market uses (i.e. petfood, food security, agriculture). Thus, understanding the supply chain can guide in the identification of the financial

statement elements. The predictive power of financial information can aid in predicting future economic events primarily because these variables are the closest indicators of the expectations and activities of investors and other economic agents (Edirisuriya, 2015).

The goal of this paper is to analyze from a financial perspective the commercial sardine fishery in Mexico to provide managers and government the tools to make decisions in uncertain conditions based on profitability and risks. The analysis of the allocation and use of the fisheries subsidies is fundamental to achieve financial understanding of the business and the responsible management of Mexican fisheries as subsidies are imbedded in the structure of this business (Dominguez-Sánchez and Girón-Nava, 2017). The questions addressed in this analysis were the following:

What is the profit margin of commercial sardine fishing?

What is the contribution of fuel subsidies to the margin?

2. Methods

A financial modeling research approach was used to determine the profitability of the commercial sardine fishing in the Gulf of California considering fuel subsidies contribution. The approach was segmented into: (1) understanding the structure of the business (2) building a profit and loss statement in excel (3) analyzing the risks associated with the commercial sardine fishing practices in Mexico.

The profit and loss statement was built to calculate the gross profit margin of the commercial sardine fishing in the Gulf of California for the year of 2015. The gross profit margin is one of the most widely used profitability ratios, it is the difference between revenue and the costs of production, called cost of goods sold (COGS). The gross profit margin is used to assess the business ability to generate income after accounting for COGS using data from a specific point in time ("Modelo para la estimación de costos de producción en plantas pesqueras," 1998; FAO Fisheries, 2003). The analysis was conducted based on the availability of fishery reports, economic variables, and financial statement characteristics. The set of parameters determined as closest indicators of the financial operations of this fishery were the following:

p = unit price of landed fish (MXN/t)
S = sales revenue = total catch x p (t/year)
P = gross profit = $S - COGS$
$COGS$ = cost of goods sold = fixed costs + variable costs

Sales Revenue is referred to as the income received from the sales of the sardine catch in a certain year. This metric quantifies the gross activity generated by the commercial sardine fishing activity and it is computed as the product of the total catch in tons and the price per ton of sardines for a specific point in time. The total catch and the price per ton for the year 2015 were taken from official fishery reports data by the Mexican government (FAO Fisheries, 2003; CONAPESCA, 2017)(dataMares).

$$S = \text{sales revenue} = total\ catch\ \times\ p$$

The costs incurred in commercial sardine fishing relate to the cost of the materials and labor directly used to fish for sardine, referred to as Cost of Goods Sold (COGS) and divided into fixed and variable. To compute for the COGS, the elements identified were number of vessels, number of trips, fixed costs per vessel, fishing effort, cost of labor, price per liter of diesel, fuel consumption, and supplies. The elements were allocated based on fixed and variable costs of the sardine fishing operations.

The number of commercial sardine vessels that were in operations for the year 2015 in the Gulf of California were 49 vessels(Comisión Nacional de Acuacultura y Pesca, 2017). Note that in the sardine fishery some of the vessels are used mainly but not solely in the sardine fishing practice (Shoko Doode Matsumoto, no date; Sardina Golfo de California, 2018).

A fishing effort metric was used to understand the number of fishing days in an average trip of a sardine fishing vessel (Cisneros-Mata, 2016). The fishing effort is key to calculate other financial variables like supplies, fuel consumption, and other costs incurred while the vessel is out at sea. This analysis uses a fishing effort metric of 2.5 based on previous studies of the sardine fishery (Cisneros-Mata, 2016). The number of trips recorded for the fishing season together with the fishing effort metric represent the total fishing effort.

Fishing effort = Pacific Sardine Unit effort (days/trip)

To account for the total costs of commercial sardine fishing for 2015, the fixed and variable costs were analyzed and determined based on the science available on financial indicators for this fishery. Fixed costs are costs that do not vary with output in the short term, these often include overhead costs. The amount of fixed costs used in the profit and loss statement was determined based on previous research by Cisneros-Mata (2016) where calculations for the fixed costs are the product of a fixed amount per vessel for fishing season (includes maintenance, gear, and cost of raw material prorated per fishing trip), complexity of the business index (includes administration and extraction intensiveness), and the days of fishing effort of 2.5. The fixed cost per vessel and the number of vessels were multiplied to account for the total fixed costs for the year 2015.

For variable costs, the data collected was based on the previous identification of sardine fishing metrics for measuring the costs of supplies, labor, and fuel consumption. At the commercial scale, the fuel consumption is key to undergo operations, in this case “fishing effort”. The cost of fuel is determined by multiplying the average price per liter of diesel in 2015 MXN 14.2 (USD 0.71) by the average liters consumed (900 liters) per day by a commercial vessel (Cisneros-Mata, 2016). In addition, as fuel consumed by commercial sardine fishing is subsidized by the government, a separate calculation was conducted with a subsidized fuel average of MXN 10.00 (USD 0.50) per liter (World Wildlife Fund (WWF), 2013; Cisneros-Mata, 2016). Supplies are referred to as the food supplies required per trip along with the fishing effort. The daily cost of food supplies in a fishing trip was assumed to be MXN 150.00 USD (USD 7.50) (Cisneros-Mata, 2016). The salaries or cost of labor were considered as part of variable costs, the number of fishers per boat were an average number of crew members in a fishing vessel for the commercial sardine fishery registered in previous literature and through informal interviews among vessel owners and

fishers, the salaries were estimated to be 60% of the sales recorder for every trip(Cisneros-Mata, 2016).

Based on the gathered information, the gross profit was calculated with the goal of acquiring a quick overview of the profitability of commercial sardine fishing including the amount of subsidies that businesses receive for their operations. the primary goal of any business is to earn money; therefore, a business performance is based on profitability, in its various forms. The gross profit is a basic profitability ratio, it is used to describe the financial benefit realized by commercial sardine fishing after accounting for the COGS which reflects the solvency to support further business operations like selling and administrative expenses, depreciation, and taxes.

$$\mathrm{P} = S - COGS$$

To analyze the amount of fuel subsidy contribution a comparative table was created calculating the difference of the realized profits including the fuel subsidies and removing the subsidies contribution. The difference was calculated to address the question: What is the contribution of fuel subsidies to the margin?

In addition, a sensitivity analysis on the fishing effort metric was also computed to understand the impact of the increase of fishing effort with all other elements remaining unchanged for the year 2015. With the intention of understanding the risks of increasing the extraction of this oceanic resource.

3. Results

The study shows that the fishing practices in this area were profitable for the year 2015 with a gross profit margin of 36%, and that 9% correspond to contribution of the fuel subsidies program. This suggests that there is a significant monetary support from the government that allows the commercial sardine fishing activity to be profitable, meaning that for every MXN 20.00 (USD 1.00) generated from the sale of commercial sardine fishing there are MXN 7.20 (USD 0.36) of profit that enables the fishery to financially support other processes within the supply chain. Thus, the extraction of the pacific sardine in the Gulf of California together with the financial support by the fuel subsidy program from the National Commission of Fisheries and Aquaculture allow the commercial sardine fishery to operate as a for-profit business.

The 36% profit margin with subsidies was obtained in this analysis, this result translates into a good financial standing that is attractive to investors and managers as the can benefit significantly from the pacific sardine when outside of the water from the continued commercialization of this natural resource.

Table 1 Profit and loss statement of the commercial sardine fishing in the Gulf of California, Mexico for the year of 2015

P&L 2015 (MXN)	W/ Subsidies	W/o Subsidies	Variance
Sales Revenue	468,401,072	468,401,072	
Operating Costs			
Fixed	490,000	490,000	
Variable	300,130,618	343,848,118	
	300,620,618	344,338,118	
Profit	167,780,454	124,062,954	43,717,500
Profit Margin	36%	26%	9%

However, the analysis conducted when removing the contribution of the fuel subsidies program showed a 9% decrease in profit margin to 26%. This means that 9% is the contribution of subsidies to the business' profitability when extracting pacific sardine. This basic metric allows for the understanding of how the commercial sardine fishery operates and its dependence on the government's financial support as the fishing activity is profitable despite the decrease in margin. The results show that 9% is a significant contribution which in turn represents a risk to the financial standing of the business and to the stakeholders involved.

Table 2 Analysis of the effect of fishing effort metric on the profitability of commercial sardine fishing in Mexico

P&L 2015 (MXN)	Fishing Effort (days/trip)	W/ Subsidies	W/o Subsidies	Variance
Profit Margin	2.5	36%	26%	9%
Profit Margin	5	32%	13%	19%

An analysis of the change in the fishing effort metric results in significant variance in the contribution of fuel subsidies. A fishing effort metric of 5 tells us that for every trip recorded for the commercial sardine fishing in 2015 were assumed to be five days long, it would result in a significantly decrease in profit margins in both scenarios. The 19% variance in profitability reflects the impact that fuel subsidies have on the profit, this provides information on the effect of increasing the fishing effort metric and removing the fuel subsidies on the financial performance of the business. The initial 2.5 metric was assumed based on the data available from one of the studies identified that addressed the financial variables of this activity, considering the lack of information from official fishery reports and industry players, this translates into risks inherent in the process of sardine fishing in the Gulf of California and the potential risks to the organizational interactions that could be affected by the overall increase in fishing efforts.

4. Discussion

While conducting the financial modeling research it was identified that a vast amount of data was unavailable, unclear, and inconsistent which was required for the creation of a comprehensive financial statement to find more precise profitability ratios that reflect the financial benefits realized when the revenue generated exceeds the expenses, costs, and taxes involved in

sustaining the commercial sardine fishing practice. The primary goal of any business is to earn money; therefore, a business performance must account for the metrics that are most representative of its operations. While the majority if not all the sardine companies that operate in the northwestern part of Mexico are private entities, the goal of assessing the profitability and financial risks of the commercial sardine fishery in Mexico is convoluted. Moreover, the official fishery reports data by the Mexican government showed inconsistency across the information provided annually, as the species description and category allocation vary year on year. This study focused on the information available for the year 2015, due to the inability to assess financial variables based on the lack of information from primary sources, official fishery reports, and undisclosed financials from private entities.

In addition, this study analyzed solely the fuel subsidy program as there is limited information on the other fishery subsidy programs like the vessel modernization, eco-friendly equipment, and infrastructure programs that are relevant to the financial understanding of this business as these subsidized purchases are allocated in the purchase of property, plant, and equipment (PP&E) element in the fixed costs calculation. The subsidies related to costs that are generally fixed for at least one year but exclude measures affecting basic investments and financial costs are classified in this group (FAO Fisheries, 2003).

The analysis of the extensive supply chain of the commercial sardine fishery can provide a clearer view of where the sardines are going after they are extracted from the water. This study only focused on the costs associated with the fishing operations and does not address other processes before the sardine reaches the end consumer such as canned sardine and reduction into fishmeal and oil processes which play an important role for supplying the world demand of this marine species. Sardines are highly specialized, while 20% of the sardine production is destined towards direct human consumption in the form of frozen and canned products, the other 80% of the production is used towards indirect consumption where the raw material is transformed into fishmeal and oil and it is used primarily to produce balanced feed for the poultry, pork, and aquaculture industries as they provide good quality protein (Cisneros-Mata, 2016; CONAPESCA, 2017). The commercial sardine fishery in Mexico has grown into a vertically integrated industry where most if not all supply chain functions are under a single ownership, with one player controlling most major steps in the supply chain, resulting in operations that are relatively capital intensive (Kent, 1986; Future of Fish, 2015). Commercial sardine companies have been able to structure their operations in a way of optimizing and minimizing costs ("Modelo para la estimación de costos de producción en plantas pesqueras," 1998; FAO Fisheries, 2003). In general, as a supply chain lengthens, the margins get slimmer, and players become motivated to do whatever is necessary to cut costs (including, at times, committing fraud), as their customer (each player down the chain) is always looking to pay the lowest price possible (Future of Fish, 2015). And although vertically integrated companies tend to perform better, both from an economic and a financial perspective as costs and financial expenses are reduced, the higher profitability, the higher financial risk and commercial credit fees. (Gallizo, Moreno and Salvador, 2019). Thus, more comprehensive analyses allow to better understand the vertically integrated industry to create accurate and efficient management plans that target responsible fishing practices.

5. Conclusion

In Mexico, the commercial sardine fishery is the largest in terms of catch volume and has been operating for many decades as a for-profit business resulting in a complex supply chain with varied organizational interactions. The pacific sardines have been widely studied when they are in the water from the ecological and biological perspectives. However, there is limited information on the financial perspective of this business when the pacific sardines are extracted from the water and commercialized for profit. The commercial sardine fishery functions with the financial support from fishery subsidy programs provided by the National Commission of Fisheries and Aquaculture, especially in the form of fuel subsidies. Thus, this work highlights the knowledge gaps for analyzing the profitability of the commercial sardine fishery yet provides a financial perspective on the potential risks for various stakeholders to make decisions in uncertain conditions as demand for responsible fishing practices arise due to concerns the overexploitation of this natural resource. Science is telling us that the health of the oceans is being under stress and depleting at an alarming rate and the shift from subsistence to more market-oriented has potentially led to the overexploitation of the pacific sardine in the Gulf of California. This study shows that the sardine fishing practices in this area were profitable for the year 2015 with a gross profit margin of 36%, and that 9% are the fuel subsidies contribution, which suggests that there is a significant monetary support from the government that allows the commercial sardine fishing activity to be profitable. This work highlights the knowledge gaps in analyzing profitability of the commercial sardine fishery yet provides a financial perspective on the potential risks for the various stakeholders to make decisions in uncertain conditions like climate change, environmental variability, and a fishery subsidy reform while working for the well-being of the industry, ecosystem, and community.

Better understanding of the business practices that result from extraction of pacific sardines is telling us that global supply chains keep extending and profit-making continues to be the focal point. Yet, our ocean is still largely treated as a public good, not as a valuable oceanic natural asset that could result in risks to all the parties involved if not properly managed. Thus, it is highly important to reveal the metrics as a starting point for the analysis of the financial standing of the industry and the risks associated with the fishery subsidies that are likely to impact one of the most important of the Mexican fisheries and its organizational relationships. Investment and business decisions that aim at finding balance between the ecosystem, the industry, and the community can be better determined by understanding the profitability and the risks of the sardine in and out of the water. Thus, investors and stakeholders can work towards the adaptation of business practices across global supply chains mitigating costs and redirecting funding towards ocean positive outcomes by looking into the commercial sardine fishery from a financial perspective targeting nature-based solutions while building trust with stakeholders and This study provides a starting point in that direction.

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Appendix A. Supporting information

Figure 2. Total fisheries subsidies disbursed from 2011 to 2019 by geographic region (Source: Pescando Datos)

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