Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
Financial and economic impacts of the COVID-19 pandemic on aquaculture in Türkiye and financial policy recommendations

Sercan EROL

Sarmene Faculty of Marine Sciences, Karadeniz Technical University, Trabzon, Turkey

ARTICLE INFO

Keywords:
Aquaculture
COVID-19
Blue growth
Strong financial outlook
Financial policy

ABSTRACT

The public health measures implemented to reduce the spread of the COVID-19 pandemic have had unexpected consequences in a wide range of industries worldwide including aquaculture. The first case of COVID-19 was also reported in March 2020 in Türkiye. The present study aims to determine the financial and economic effects of the COVID-19 pandemic on the aquaculture in Türkiye by analyzing consolidated financial statements of the industry released by Central Bank of the Republic of Türkiye in September 2021. Within this context, the consolidated financial statements of 2020 were examined using ratio analysis, followed by a comparison of the ratios from 2009 to 2020. As a result of the study, it was determined that the Turkish aquaculture sector continued to grow, the net profit margin improving considerably by 871% in 2020 compared to the previous year, and the year 2020 achieving the highest profitability performances in the recent 12-year period, despite the severe effects of the pandemic on several industries globally. However, the sector’s high financial leverage, inability to produce sufficient revenue to pay its debts, and reliance on foreign manufacturing costs are all concerns that must be managed to maintain economic and financial sustainability. Considering these results, some policy practices related to financial stability are advised so that aquaculture stakeholders can have a stronger financial and economic structure in the face of random shocks such as the Covid-19 pandemic.

1. Introduction

Aquaculture, as one of the main components of blue growth strategy, is recognized as a critical economic activity that has the potential to significantly contribute to income and employment in coastal and rural areas [1,2,7]. Therefore, analyzing the financial and economic structure of the sector is of critical importance for policy makers [3–5]. Due to the sector’s biological cycle of production, the cash flow required to fund investment costs may not coincide with the profit cycle. Since aquaculture firms are often small and medium-sized enterprises (SMEs), they may struggle to access financial market instruments on the same level as major corporations [6–9]. This condition increases the likelihood of encountering difficulties in debt repayment, particularly during crisis periods of random shock, and may push companies into default [6,10]. In this respect, the COVID-19 pandemic is one of the random shocks that has shaken the world recently. Türkiye reported its first positive COVID-19 case on March 11, 2020, and the Pandemic began imposing restrictions on social and economic life, as it did in many other countries.

The public health measures used to prevent the spread of the COVID-19 pandemic have had a detrimental knock-on effect on the aquaculture industry as well as a vast range of other sectors [11–16]. The closing of borders due to quarantine regulations caused timing and logistics issues in the supply of inputs, as well as delays in the delivery of final products to the market and public access to the products [17–21]. The deterioration of the supply-demand balance, the increase in input prices, and the restrictions on workplace opening and closing hours significantly impacted the cash flow balance of the companies, their profitability, and consequently their capacity to pay their debts [12,22–25]. However, according to the first reports after the pandemic, the aquaculture sector has shown to be robust, owing to its ability to access Worldwide markets as well as its local market potential [12,15,21]. However, the crucial decision that aquaculture producers must make in the long run is whether the firm can generate sufficient value to repay its debts in the face of external causes such as war, epidemic, or economic crisis. The balance sheet and income statement are the most appropriate instruments for this decision, as these tables are used to determine the financial position of a business, and the financial position is established by evaluating its strengths and shortcomings via a series of financial metrics and indicators [3].
There are studies on the capital structures, firm performance, and profitability analyses of firms in the aquaculture sector in the literature [3, 5, 26–35]. However, the economic and financial effects of COVID-19 on aquaculture companies have not been quantified in these studies, even though some of them were conducted after the pandemic. The consequences of the pandemic on the sector, on the other hand, were carried out in a small number of studies undertaken following the pandemic. In this regard, Kakoolaki et al. highlighted that due to the quarantine measures implemented under the COVID-19, challenges such as accessing the market and supplying a workforce to work on farms were encountered [18]. Their study titled ‘Impacts of COVID-19 on U.S. aquaculture, aquaponics, and allied businesses stated that the pandemic resulted in a loss of market share and income, as well as a decrease in workforce productivity due to illnesses of working personnel, which resulted in increased layoffs because the companies had already lost income [19]. On the other hand, Lebel et al. based on a survey of 1019 farmers performed in June and August 2020, revealed that measures such as stock management, reducing labour costs, finding new target markets, benefiting from auto-financing, and loan capital use were taken in coping with the conditions of the COVID-19 pandemic [12]. Kumaran et al. used an online survey method to investigate the shrimp farming business in India and found that the current year’s COVID-19 pandemic circumstances were estimated to cost the shrimp aquaculture sector 1.50 billion USD. Furthermore, the COVID-19 pandemic is projected to cause severe restrictions in shrimp seed production and supply and interruptions in the supply chain, logistics, farming, processing, marketing, and loss of jobs and income for workers [13]. Azra et al. reported that the COVID-19 pandemic has had severe consequences on the aquaculture sector in Malaysia, with market demand and logistical bottlenecks being the most significant of these effects [14]. In another study on the socioeconomic and sustainability impacts of the COVID-19 pandemic, Manlosa et al. examined the effects of the quarantine imposed during the COVID-19 pandemic in the Philippines on market and production processes, as well as the strategies used to mitigate these effects and the factors that enable these strategies [15]. Organization for Economic Co-operation and Development (OECD) reported that all aspects of fish supply chains are sharply affected by the COVID-19 pandemic, with food security, jobs, and incomes at risk [71]. In studies on the potential effects of the COVID-19 pandemic on Türkiye’s aquaculture sector, frequency analysis revealed the effects of exported aquaculture products in terms of quantity and value, and it was stated that there were issues with access to the market and raw material supply [36–38].

This research aims to determine the financial and economic impacts of the COVID-19 pandemic on Türkiye’s aquaculture industry. In this process, the consolidated financial statements published by the Central Bank of the Republic of Türkiye were utilized. This article also provides advice on financial and economic policies during random shocks such as the epidemic. First, the ratio analysis method was used to analyze the consolidated balance sheet and income statement of 274 companies that were founded after the pandemic and for the year 2020. Following that, sector-specific ratios from 2009 to 2020 were evaluated using the trend analysis technique. This is the first study to explore at the financial and economic impacts of the pandemic on Türkiye’s aquaculture sector. Additionally, no other research in the literature has examined the financial structure of the Turkish aquaculture sector. In this regard, the research is expected to offer a unique contribution to the current body of literature since it is the first to analyse the industry historically and quantify the pandemic’s financial and economic impact on the industry. In addition, the data and results of this research may well be valuable in a comparative analysis of aquaculture enterprises in other countries.

The paper is structured as follows: First, an overview of the recent evolution and the present situation of the aquaculture industry and markets is provided. Second, the materials and methods section describes the data collection process, the method and the financial and economic performance indicators used in the analyses. Then, in the result and discussion section, the ratio analysis outputs for the Turkish aquaculture industry are presented and discussed. Finally, a conclusions section is included, which summarizes the findings on financial and economic structure, profitability, production and aquaculture markets in Türkiye.

2. Overview of the aquaculture industry and markets

Aquaculture accounted for 54.1 % of world fisheries and aquaculture production [39]. In 2019, total aquaculture production was reported as 85.4 million tons, and the total first-sale value of the production was estimated at USD 260 billion. Also, the production consisted of 56.3 million tons of finfish (66 %), 17.6 million tons of molluscs (20.6 %), 10.5 million tons of crustaceans (12.3 %) and 977 thousand tons of other aquatic animal species (1.1 %). Excluding aquatic plants and non-food products, the top ten aquaculture producers were China (48.2 million tons), India (7.8 million tons), Indonesia (6.0 million tons), Viet Nam (4.4 million tons), Bangladesh (2.5 million tons), Egypt (1.6 million tons), Norway (1.5 million tons), Chile (1.4 million tons), Myanmar (1.1 million tons) and Thailand (1 million tons); in totals 75.4 million tons, contributing 88.4 % to the world’s total aquaculture production by quantity in 2019. Türkiye, on the other hand, is ranked 18th with approximately 0.4 million tons of production [40].

Aquaculture is a relatively young business in Türkiye in comparison to Europe, yet it has enormous growth potential [41]. As such, Türkiye is the leading European country in terms of both freshwater and marine Mediterranean production. As seen in Fig. 1, Türkiye accounts for 49 % of marine Mediterranean production, followed by Greece at 28 % and Spain at 12 %. Seabass is the most produced species in marine Mediterranean production, accounting for 49 % of total production, and Türkiye is the biggest producer of seabass in Europe [42]. Besides, Türkiye leads the freshwater production with a 29 % share, followed by Poland with 13 % and France with 12 %. Trout is the most produced species in freshwater production, accounting for 75 % of total production [43]. Additionally, the expenses of processing, marketing, and transportation are greater in the EU than in Türkiye, and the Turkish Aquaculture industry exports the majority of its products to EU nations due to the EU-Türkiye customs union agreement [5].

According to scientific studies, aquaculture investment will continue to rise in the next years, the supply of water products provided through aquaculture will equal the amount obtained through fishing in 2030, and the aquaculture sector will eventually overtake the fisheries sector [44]. So, the global significance of oceans and inland waters continues to grow, signaling that aquaculture is the future industry.

Türkiye has 2139 farms in sea and inland waters, with a total annual capacity of 516,784 tons [45]. Fig. 2 below shows the amount of aquaculture in Türkiye and its comparison to the amount of production coming from capture fisheries.

When the production amounts of the fisheries and aquaculture sectors in Türkiye are analyzed, it is clearly seen that production from fishing has a fluctuating structure with a falling tendency, but the production amount in the aquaculture sector has a consistent rise trend compared to the preceding year.

Türkiye’s overall fisheries production declined by 6 % in 2020 compared to the previous year, to 785 thousand 811 tons. The reduction in the overall quantity is a result of decreased fishing activities. Specifically, fishing production fell by 21 % in 2020, to 364 thousand 400 tons, the previous year. This decline is due to the Ministry of Agriculture and Forestry suspending anchovy during the fishing season in order to safeguard spawning stock biomass in the Eastern Black Sea Region. Aquaculture production, on the other hand, increased by 13 %, to 421 thousand 411 tons, compared to the previous year. In 2020, aquaculture production was 293 thousand 175 tons in the seas and 128 thousand 236 tons in inland waters. In inland waters, the most widely cultivated aquatic animal species were trout (127 thousand 905 tons), seabass (148 thousand 907 tons), and sea bream (109 thousand 749 tons) [46].
3. Data set

The data set presented in this study was collated from the official records obtained from the Central Bank of the Republic of Türkiye (TCMB) [47]. The data set includes the consolidated income statement and balance sheet of 274 companies for the financial year 2020 that are classified as "A-032 Aquaculture" under the broader sector A-Agriculture, Forestry, and Fisheries as defined by TCMB system. The scale distribution of these enterprises is given in Table 1 below.

The majority of enterprises included in the study are small and medium-sized. 71.2% of these companies are micro-scale, with 59 being joint stock companies, 199 being limited companies, and 16 being...
into the following five broad groups in Table 4.

### 4. Method

Theoretically, the financial and economic performance of farms are measured in a variety of ways and three critical components comprise a comprehensive financial analysis: financial situation, profitability, and liquidity/cash flow [3]. Thus, profitability, liquidity, and solvency are frequently employed to describe the financial and economic success of aquaculture farms [3,5,12,28,35,48–51]. The ratio analysis technique is used in this study, as it is one of the financial analysis strategies used in financial structure analysis. Ratio analysis is a straightforward and predictive technique that investors, managers, financiers, and credit institutions use to assess a firm’s financial status [3,52,53]. The fundamental factor that influenced the development of ratio analysis in general was Euclid’s careful examination of the characteristics of ratios in Book Vo of his Elements [52]. The use of ratios as a tool for financial statement analysis, on the other hand, dates back to the early twentieth century. William M. Rosendale coined the term “ratio analysis” in his article “Credit Department Methods” in 1908 [54].

Ratios used in financial analysis allow for a horizontal and vertical evaluation of an organization’s profit and loss accounts and the establishment of various correlations between balance sheet items. These ratio relations are used to calculate and interpret the companies’ Liquidity (Fluidity) Ratios, Financing Structure Ratios, Activity Ratios, Profitability Ratios, and Growth and Capital Market Performance Ratios [3,54,55]. Various types of indicators can be used to assess the performance of companies or industries. So, the ratio analysis is categorized into the following five broad groups in Table 4.

On the other hand, in order to conduct a healthy evaluation of the results of the ratio analysis, the calculated financial ratios:

- should be compared with the company’s rates in the previous operating period,
- should be compared with the ratios or sector averages of other companies in the same sector as the companies, and
- should be compared with the rates found as a result of experience [53,57].

### 5. Results and discussion

The consolidated financial statements’ and common-size percentage (vertical analysis) results are summarized in Tables 5 and 6.

Current assets accounted for 70.7% of the economic structure in 2020, while fixed assets accounted for 29.3% (Table 5). The average ratio of fixed assets to total assets in Mediterranean aquaculture enterprises spanning Croatia, France, Greece, Italy, and Spain is 27% [35]. Additionally, as seen in Table 5, current assets increased by 26.39% and fixed assets increased by 57.58% over the previous year. Similarly, when the financial structure of the sector in 2020 is analyzed, it is observed that the sector’s share of short-term foreign resources is 56.1%, the share of long-term foreign resources is 14.1%, and the share of equity resources is 29.8%, with foreign resources accounting for 70.2% of total financial resources. Short Term Foreign Resources raised by 24.05%, Long Term Foreign Resources increased by 69.33%, and Equity Resources increased by 42.09% in the passive structure over the previous year. Additionally, the Long Term Foreign Resource component of total resources reached to 27.03% in 2020. On the other hand, the percentage of Short-Term Foreign Resources in total resources declined by 7.58%.

When the equity structure is examined, all elements show an increase compared to the previous year. Profit for the financial year 2020 increased by 97.20% over the past year. However, the share of income reserves in the equity structure declined by 24.34% from the prior period. When these findings are combined, it is clear that the role of long-term resources in asset financing has increased significantly, while the share of short-term debt has dropped in the financial structure in 2020.

Table 6 presents a comparative analysis of Turkish aquaculture companies’ consolidated income statements for 2020 in comparison to the prior year. Compared to the previous year, net sales increased by 24%, financing costs by 31%, and net profit by 97%. The rise in financial expenses can be attributed to the financial structure’s increased long-term resources [57].

On the other hand, Table 7 and Table 8 show the financial ratios calculated for 2020 using the aquaculture sector’s first consolidated balance sheet and income statement following the COVID-19 pandemic.

Liquidity is a financial indicator that indicates an aquaculture operation’s capacity to satisfy current financial obligations to creditors, most notably feed and seed suppliers [48,51]. In this regard, the relevant sector’s liquidity ratios for 2020 are computed as follows: Current Ratio = 1.5, Acid-Test Ratio = 0.53, and Cash Ratio = 0.08. Theoretically, a current ratio of 2 is desired [54]. In this context, it is clear that the aquaculture sector lacks the capacity to pay its debts in the short term. The average current ratio of Mediterranean aquaculture companies covering Croatia, France, Greece, Italy, and Spain is 1 [35]. Thus, Turkey’s current ratio of 1.5, as a Mediterranean country, shows that it performs better in terms of liquidity than other Mediterranean countries. However, a study on Norwegian salmon aquaculture showed that the current rate is greater than 2 [28].

Evaluating liquidity just on the basis of the current ratio is insufficient. When the acid test and cash ratio values of Turkish aquaculture companies in 2020 are analyzed, the acid test ratio is calculated as 0.53, which is lower than the theoretical value of 1, and the cash ratio is calculated as 0.08, which is lower than the theoretical value of 0.2. Despite the low performance of liquidity ratios in comparison to theoretical values, the cash ratio is the liquidity ratio that increased the greatest, by 54%, in 2020 over the previous year. On the other hand, the share of stocks in total assets decreased by 13% in 2020. However, the...
### Consolidated Balance Sheet of the Aquaculture Sector from 2009 to 2020 in Turkey

**BALANCE SHEET (000 ₺)**

| Year | Current Assets | Passive Structure | Equity Structure |
|------|----------------|-------------------|-----------------|
| 2009 | 309,378.6      | 85,202.5          | 3,809.1          |
| 2010 | 333,914.0      | 243,768.1         | 119,386.2        |
| 2011 | 468,520.6      | 334,086.5         | 219,365.3        |
| 2012 | 542,437.5      | 21,428.4          | 14,071.1         |
| 2013 | 751,815.9      | 94,845.2          | 226,985.9        |
| 2014 | 1,058,331.8    | 36,627.0          | 294,125.2        |
| 2015 | 1,426,847.3    | 21,434.2          | 342,212.9        |
| 2016 | 1,084,422.3    | 10,052.3          | 373,663.2        |
| 2017 | 1,179,724.6    | 11,923.4          | 467,563.6        |
| 2018 | 1,708,427.7    | 9,378.9           | 202,246.9        |
| 2019 | 1,925,369.8    | 13,982.3          | 236,826.5        |
| 2020 | 2,010,741.1    | 33,982.4          | 256,634.3        |

### Income Statement

**INCOME STATEMENT (000 ₺)**

| Year | Sales | Discounts (-) | Cost of Sales (-) | Operating Expenses and Losses (-) | Operating Profit or Loss |
|------|-------|---------------|------------------|----------------------------------|-------------------------|
| 2009 | 299,861.5 | 4,265.2       | 235,942.9        | 12,676.8                         | 64,565.8                |
| 2010 | 334,086.5 | 3,492.8       | 282,232.4        | 17,547.8                         | 126,306.9               |
| 2011 | 468,520.6 | 3,128.3       | 362,671.0        | 43,833.0                         | 26,616.3                |
| 2012 | 542,437.5 | 2,183.4       | 435,949.6        | 33,496.0                         | 23,918.0                |
| 2013 | 751,815.9 | 3,048.3       | 520,455.1        | 22,997.4                         | 35,672.3                |
| 2014 | 1,058,331.8| 9,267.0       | 719,015.7        | 66,307.9                         | 31,046.6                |
| 2015 | 1,426,847.3| 13,045.9      | 959,660.5        | 91,951.0                         | 43,710.2                |
| 2016 | 1,084,422.3| 21,428.4      | 899,211.1        | 73,088.5                         | 25,039.0                |
| 2017 | 1,179,724.6| 29,052.3      | 979,015.7        | 85,055.0                         | 32,954.4                |
| 2018 | 1,708,427.7| 33,982.4      | 1,124,922.0      | 100,932.5                        | 63,505.2                |
| 2019 | 1,925,369.8| 33,982.4      | 1,256,563.3      | 115,922.0                        | 70,447.8                |
| 2020 | 2,010,741.1| 33,982.4      | 1,274,985.5      | 122,097.0                        | 77,644.1                |

*Number of Firms: 226*
### Financial ratio formulae and description [56].

| Group               | Code No | Ratio                        | Formula                                                                 | Description                                                                 |
|---------------------|---------|------------------------------|--------------------------------------------------------------------------|----------------------------------------------------------------------------|
| **Liquidity Ratios (L)** |         |                              |                                                                          |                                                                            |
| L1                  | L1      | Current Ratio                | Current asset/ current liabilities                                      | Measures the amount of liquidity available to pay for current liabilities   |
| L2                  | L2      | Acid Test Ratio             | (Current asset - inventory)/ current liabilities                        | Strong indicator of whether a firm has sufficient short-term assets to cover its immediate liabilities, |
| L3                  | L3      | Cash Ratio                  | Cash & Cash equivalents / Current Liabilities                           | If the company has a higher cash ratio, it is more likely to be able to pay its short-term liabilities, |
| F1                  | F1      | Debt Ratio                  | Total Foreign Assets / Total Asset Ratio                                | Shows the extent to which management is willing to fund operations with debt, rather than equity, |
| F2                  | F2      | Times Interest Earned       | EBIT / Interest expense                                                 | A metric used to measure a company’s ability to meet its debt obligations, |
| **Financial Leverage Ratios (F)** |         |                              |                                                                          |                                                                            |
| F3                  | F3      | Short Term Debt Ratio       | Short term debt/ Total asset                                            | Comprised of any debt incurred by a company that is due within one year, |
| F4                  | F4      | Long Term Debt Ratio        | Long term debt/ Total asset                                             | A measurement representing the percentage of a corporation’s assets that are financed with loans and financial obligations lasting more than one year, |
| F5                  | F5      | Interest Coverage Ratio     | EBITDA** / Interest Expense                                             | The Interest Coverage ratio signifies the ability of the firm to pay interest on the assumed debt, |
| **Turnover Ratios (T)** |         |                              |                                                                          |                                                                            |
| T1                  | T1      | Stock Turnover Ratio        | COGS/Average stock                                                      | Measures the amount of inventory needed to support a given level of sales, |
| T2                  | T2      | Receivable Turnover Ratio   | Sales/Average receivable                                                | Activity ratio measuring how efficiently a firm uses its assets, |
| T3                  | T3      | Payable Turnover Ratio      | Cost of Goods Sold/Average payables                                     | Measures the speed with which a company pays its suppliers, |
| T4                  | T4      | Days Receivables            | Number of Days in Year/Accounts Receivables Turnover                    | Days receivables express the same information but in terms of the number of days in a year, |
| **Profitability Ratios (P)** |         |                              |                                                                          |                                                                            |
| P1                  | P1      | Gross Profit Margin         | (Sales-COGS*)/ Sales                                                    | Shows revenues minus the cost of goods sold, as a proportion of sales, |

Companies with lower current ratios and net worth to debt ratios are more likely to default on loans [52]. In this context, the relevant sector’s Shareholders Equity / Total Foreign Resources Ratio was 47 % in 2020, and the debt / asset ratio (Total Foreign Resources / Total Asset) was 69.9 %. The debt/asset ratio, alternatively referred to as financial leverage ratio, indicates the percentage of assets financed with foreign resources, and is generally desired to be 0.50 [57]. If this ratio exceeds 0.60, it can be viewed as an indication that the business is beginning to face depth strain with increasing risk [53]. The industry’s financial leverage ratio was reported to be 69.9 % indicates that the sector is under pressure from lenders and faces the risk of default in loan repayments. Engle (2012) computed a debt/asset ratio of 0.67 in his study in 256-acre catfish farm and stated that obtaining the credit required to finance the assets would be challenging [3]. Asche et al. (2018) estimated that Norwegian salmon farming had a financial leverage ratio of 39.2% [28].

When the financial structure ratios between 1 and 6 in 2020 are compared to the previous year, it is seen that total foreign resources decreased, the share of equity capital in the financing structure increased relatively, short-term liabilities decreased, and long-term foreign resources increased (Table 7). This situation can be interpreted as short-term obligations being decreased to prevent default in 2020 and assets being funded with a constant capital increase in response to probable cash inflow concerns due to the pandemic impact. However, it is necessary to consider the ability to pay in order to determine the measure’s sufficiency. Solvency is defined as the ratio of debt to equity. It refers to a farm’s ability to meet financial obligations and is also used as a proxy for economic sustainability [51,58,59]. The higher the solvency ratio, the less capable the company is of paying off debt. This rate was estimated to be 2.32 in the Turkish aquaculture sector in 2020. The Bank Loans / Total Foreign Assets Ratio (%) was 42.3 % in 2020, up 22 % from the previous year. It is apparent that the Turkish aquaculture sector faces difficulties in gaining access to capital market instruments. Indeed, Mitra et al. revealed in their study that the aquaculture sector has limited access to capital when compared to other industries [7].

| Group               | Code No | Ratio                        | Formula          | Description                                                                 |
|---------------------|---------|------------------------------|------------------|----------------------------------------------------------------------------|
| P2                  | P2      | Operating Profit Margin      | EBIT**/Sales     | A margin ratio used to measure a company’s pricing strategy and operating efficiency, |
| P3                  | P3      | Net Profit Margin            | Net income/Sales | Calculates the amount of profit after taxes and all expenses have been deducted from net sales, |
| P4                  | P4      | Total Asset Turnover         | Sales/Total assets| The value of a company’s sales or revenues generated relative to the value of its assets, |

Solvency Ratios S1 Return on Equity (ROE) Net Income /Shareholder’s Equity Shows company profit as a percentage of equity, |
S2 Return on Asset (ROA) Net profit/total asset Shows company profits as a percentage of fixed assets and working capital,
Otherwise, listed firms may increase profitability by financial structure optimization, and they are more adversely affected by financial leverage and liquidity [10].

Fig. 3 examines the trends in some ratios from 2009 to 2020 in order to more clearly illustrate the impact of the COVID-19 pandemic on the Turkish aquaculture sector’s financial and economic structure.

Fig. 3 illustrates a shifting pattern in the financial structure ratios of the Turkish aquaculture sector between 2009 and 2020. While the debt/asset ratio peaked at 79.1% in 2015, the Shareholders Equity / Total Asset Ratio (%) bottomed out at 20.5%. However, when the 2009–2020 period is discussed, it has been observed that the COVID-19 pandemic did not cause a significant change in the sector’s financial structure. However, the cash ratio, which had been declining since 2015, rebounded by 54% in 2020 as compared to the previous year. This condition can be interpreted as an increase in working capital to maintain cash flow continuity throughout the pandemic period.

Return on assets, on the other hand, can be used as a measure for solvency [51]. In this context, another critical issue that must be addressed is whether the companies in the sector generate enough value to cover their debts. Turnover Ratios and Profitability Ratios are

| Table 5 | A comparative table of the consolidated balance sheet and percentage analysis. |
|-------------------------|-----------------|-----------------|-----------------|------------------|-----------------|
| Balance sheet (000 $) | 2019 (%) | 2020 (%) | Annual change % | % change of rates |
| **Asset Structure** | | | | |
| Current Assets | 1925,585.8 | 75.0 | 2433,690.2 | 70.7 | 26.39 | -5.73 |
| Fixed Assets | 641,391.3 | 25.0 | 1010,714.1 | 29.3 | 57.58 | 17.20 |
| **Passive Structure** | | | | |
| Short Term Foreign Resources | 1557,666.1 | 60.7 | 1932,346.9 | 56.1 | 24.05 | -7.58 |
| Long Term Foreign Resources | 286,025.4 | 11.1 | 484,318.3 | 14.1 | 69.33 | 27.03 |
| **Equity Structure** | | | | |
| Capital Receipts | 303,136.4 | 41.9 | 403,655.2 | 39.3 | 33.16 | -6.21 |
| Capital Reserves | 171,709.0 | 23.7 | 223,315.8 | 21.7 | 30.05 | -8.44 |
| Income Reserves | 110,001.3 | 15.2 | 118,399.3 | 11.5 | 7.63 | -24.34 |
| Retained Earnings | 226,363.1 | 31.3 | 373,815.6 | 36.4 | 65.14 | 16.29 |
| Retained Losses (%) | 152,982.8 | 21.2 | 219,743.6 | 21.4 | 43.64 | 0.94 |
| Profit (Loss) for Financial Year | 65,058.7 | 9.0 | 128,296.8 | 12.5 | 97.20 | 38.89 |
| Period Income | 120,775.8 | | 236,523.1 | | 95.84 |
| Period Loss | 55,717.2 | | (108,226.3) | | 94.84 |
| **Number of Firms** | 240 | 274 |

| Table 6 | A comparative table of the consolidated income statement. |
|-------------------------|-----------------|-----------------|-----------------|------------------|-----------------|
| Income statement (000 $) | 2019 | 2020 | Annual change % | |
| **A- Gross Sales** | 2060,498.3 | 2568,500.3 | 25 |
| **B- Sales Discounts (-)** | 26,031.2 | 37,100.0 | 43 |
| **C-Net Sales** | 2034,467.1 | 2531,400.4 | 24 |
| **D- Cost of Sales (-)** | 1724,799.2 | 2080,885.5 | 21 |
| **GROSS PROFIT OR LOSS** | 309,667.9 | 450,514.8 | 45 |
| **E- Operating Expenses (-)** | 177,246.8 | 223,284.6 | 26 |
| **OPERATING PROFIT OR LOSS** | 154,211.1 | 227,230.2 | 72 |
| **F- Other Ordinary Income and Profits** | 154,787.8 | 269,870.7 | 74 |
| **G- Other Ordinary Expenses and Losses (-)** | 146,967.5 | 252,070.9 | 72 |
| **H- Financial Expenses (-)** | 63,707.2 | 83,146.2 | 31 |
| **ORDINARY PROFIT OR LOSS** | 76,534.3 | 161,883.8 | 112 |
| **I-Extraordinary Income and Profits** | 25,550.9 | 29,713.7 | 16 |
| **J-Extraordinary Expenses and Losses (-)** | 17,030.1 | 15,823.0 | -7 |
| **PROFIT OR LOSS FOR THE FINANCIAL YEAR** | 85,055.0 | 175,774.6 | 107 |
| **K-Period Income Tax Provision (-)** | 19,996.3 | 47,477.7 | 137 |
| **NET PERIOD PROFIT OR LOSS** | 65,058.7 | 128,296.8 | 97 |
| **Number of Firms** | 240 | 274 |

| Table 7 | Liquidity and financial structure ratios [47]. |
|-------------------------|-----------------|-----------------|-----------------|------------------|-----------------|
| Ratios | 2019 Q | 2020 Q | Annual change % | |
| **A- Liquidity Ratios** | | | | |
| 1- Current Ratio (%) | 135.2 | 150.6 | 11 |
| 2-Acid-Test Ratio (%) | 38.8 | 53.3 | 37 |
| 3-Cash Ratio (%) | 5.2 | 8.0 | 54 |
| 4-Stocks / Current Assets (%) | 62.3 | 58.2 | -7 |
| 5-Stocks / Total Assets (%) | 50.5 | 44.0 | -13 |
| 6-Stocks Dependency Ratio (%) | 95.3 | 92.0 | -3 |
| 7-Short Term Receivables / Current Assets Ratio (%) | 26.5 | 30.9 | 17 |
| 8-Short Term Receivables / Total Assets Ratio (%) | 18.1 | 23.2 | 28 |
| **B- Financial Structure Ratios** | | | | |
| 1-Total Foreign Resources / Total Asset Ratio (%) | 71.5 | 69.9 | -2 |
| 2-Shareholders Equity / Total Asset Ratio (%) | 28.5 | 30.1 | 6 |
| 3-Shareholders Equity / Total Foreign Resources (%) | 37.6 | 47.0 | 25 |
| 4-Short Term Foreign Resources / Total Resources Ratio (%) | 60.7 | 56.1 | -8 |
| 5-Long- Term Foreign Resources / Total Passive Ratio (%) | 17.5 | 21.2 | 21 |
| 6-Long- Term Foreign Resources / Constant Capital Ratio (%) | 51.4 | 29.0 | -44 |
| 7-Tangible Fixed Assets (Net) / Shareholders Equity Ratio (%) | 47.4 | 29.9 | -37 |
| 8-Tangible Fixed Assets (Net) / Long-term Liabilities Ratio (%) | 123.5 | 85.0 | -31 |
| 9-Tangible Fixed Assets / Total Foreign Assets Ratio (%) | 29.6 | 37.2 | 26 |
| 10-Tangible Fixed Assets / Shareholders Equity Ratio (%) | 43.5 | 70.5 | 62 |
| 11-Tangible Fixed Assets / Constant Capital Ratio (%) | 63.5 | 45.0 | -29 |
| 12-Bank Loans / Total Assets Ratio (%) | 27.4 | 31.1 | 14 |
| 13-Bank Loans / Total Foreign Assets Ratio (%) | 34.8 | 42.3 | 22 |
| 14-Current assets / Total Assets Ratio (%) | 75.0 | 70.7 | -6 |
| 15-Tangible Assets (Net) / Total Assets Ratio (%) | 13.8 | 11.9 | -14 |
| Q, Weighted average of the ratios of companies in the sector according to assets | | | | |

| 7 |
Table 8

| Ratios | 2019 Q | 2020 Q | Annual change % |
|--------|--------|--------|-----------------|
| **C- Turnover Ratios** | | | |
| 1- Stock Turnover (Times) | 1.7 | 1.8 | 6 |
| 2- Receivable Turnover Rate (Times) | 5.7 | 5.6 | -2 |
| 3- Working Capital Turnover (Times) | 1.2 | 1.0 | -17 |
| 4- Net Working Capital Turnover (Times) | 3.8 | 2.9 | -24 |
| 5- Tangible Fixed Asset Turnover Rate (Times) | 8.2 | 9.0 | 10 |
| 6- Fixed Asset Turnover Rate (Times) | 6.1 | 6.0 | -2 |
| 7- Equity Turnover Rate (Times) | 5.1 | 2.9 | -43 |
| 8- Asset Turnover (Times) | 0.9 | 0.8 | -11 |
| **D- Profitability Ratios** | | | |
| 1- Ratios Showing Relationship Between Profit and Capital | | | |
| a) Net Profit (Loss) / Equity Ratio (%) | 20.8 | 19.7 | -5 |
| (return on equity) | | | |
| b) Profit (Loss) Before Taxes / Equity Ratio (%) | 23.4 | 22.9 | -2 |
| c) Economic Profitability (%) | 7.7 | 12.9 | 68 |
| d) Net Profit (Loss) / Total Assets Ratio (%) | 1.6 | 4.1 | 156 |
| (return on assets) | | | |
| e) Operating Profit (Loss) / Ratio of Assets | 4.2 | 6.2 | 48 |
| Used in the Realization of the Activity (%) | | | |
| f) Cumulative Profitability Ratio (%) | 1.2 | 1.5 | 25 |
| 2- Ratios Showing Relationships Between Profit and Sales | | | |
| a) Operating Profit (Loss) / Net Sales Ratio (%) | 6.7 | 9.5 | 42 |
| b) Gross Sales Profit (Loss) / Net Sales Ratio (%) | 13.0 | 21.8 | 68 |
| c) Net Profit (Loss) / Net Sales ratio (Net Profit Margin) | 0.7 | 6.8 | 871 |
| d) Cost of Goods Sold / Net Sales Ratio (%) | 87.1 | 78.2 | -10 |
| e) Operating Expenses / Net Sales Ratio (%) | 8.7 | 8.9 | 2 |
| f) Interest Expenses / Net Sales Ratio (%) | 2.1 | 3.0 | 43 |
| 3- Ratios Showing the Relationship Between Profit and Financial Liabilities | | | |
| a) Profit (Loss) Before Interest and Taxes / Interest Expenses Ratio (%) | 1993.4 | 1100.4 | -45 |
| b) Net Profit (Loss) and Interest Expenses / Interest Expenses Ratio (%) | 1710.0 | 915.5 | -46 |

*Firms with zero numerator and denominator are excluded when calculating the ratios.

Table 8 shows the first consolidated financial sheet created following the COVID-19 pandemic, and the overall turnover rates are noticed to drop. In 2020, the asset turnover rate was 0.8 times, and the average asset turnover rate from 2009 to 2020 was 0.75 times. Thus, the low turnover rates in the aquaculture sector are not the result of insufficient sales volume despite large investments but rather of the biological cycle of production in the aquaculture sector. However, the 43 % decline in the Equity Turnover Rate from the previous year to 2020 indicates a lack of equity. This circumstance indicates the lenders’ increased pressure on the sector during the pandemic period.

Return On Equity (ROE) is 19.7 %, Economic Profitability is 12.9 %, and Net Profit (Loss) / Total Assets ratio is 4.1 %. In terms of opportunity cost, the Central Bank of the Republic of Türkiye’s interest rate for a one-year time deposit in TL was 16.79% for 2020 [60]. In this context, ROE was 19.7 % in 2020 indicates that the earning capacity of equity capital in the sector is significant despite the COVID-19 pandemic conditions. Additionally, Economic Profitability improved by 68 % in 2020 compared to the previous year, Return On Assets (ROA) climbed by 156%, and the Net Profit (Loss) / Net Sales ratio increased by 871 %. This demonstrates that the sector’s profitability has increased significantly over the preceding time, despite the limits imposed during the pandemic.

According to the arguments given above, despite the poor performance indicators in Turkish aquaculture firms’ liquidity and financial structure ratios, the performance in profitability ratios is significantly better. Financial leverage and liquidity ratio, on the other hand, have been found to have no significant impact on profitability [28]. When the profitability ratios and financial structure ratios are analyzed combined in this context, the companies in the relevant sector have not been able to produce enough value to pay their debts. This condition is also explicable in terms of production costs. Specifically, although the Cost of Goods Sold / Net Sales Ratio fell by 10% compared to the previous year, it was 78.2 % in 2020. Although production costs in EU countries are higher than in third-world countries such as Türkiye [5], production costs in Türkiye are also high. The most significant cost components in the aquaculture industry are fish egg and feed expenses [61]. For these expenses, the Turkish aquaculture business is reliant on foreign sources. The interruption of fish egg and feed supplies during random shock periods such as pandemic and Russia-Ukraine conflict also high inflation and exchange rate are thus among the most serious concerns that must be addressed for the sector’s long-term viability. As a matter of fact, the COVID-19 pandemic harmed farmer mobility and caused disruptions in input and product logistics [11,12,17].

As shown in Table 9, the Net Profit (Loss) / Net Sales ratio (%), which averaged 2.1 % from 2009 to 2019, increased by 231 % in 2020. Similarly, ROA climbed by 216 % in 2020 from an average of 1.3 % from 2009 to 2019, while Economic Profitability improved by 71 % from 7.5 % in the same time. As a result, 2020 achieved the highest profitability levels in the preceding 12-year period.

The sudden and drastic decline in consumer expenditures in China, the USA, and Western Europe, combined with the restrictions imposed by pandemic conditions, caused a sudden cessation of face-to-face services such as travel, entertainment, and food, resulting in an 11–26 % decline in demand [62]. Indeed, during the pandemic, the frequency of fish consumption, an essential component of Bangladeshi diets, decreased significantly [8,21,63]. Also, Lebel et al. found that the COVID-19 pandemic reduced consumer demand, which, in turn, decreased net income relative to expectations and raised the risk of a net loss in the first half of 2020 [12]. Profitability rates in the Turkish aquaculture sector have increased dramatically. Increased profitability levels can also be explained by the growth rate of the sector [64]. That is, factors such as special production processes, product diversification, and technological advancements boost competitiveness [44,65,66]. The effort to preserve the market in the face of increased competition has increased focus on the continuous growth of companies operating in this sector [33–35]. In this context, the Turkish aquaculture sector’s annual growth figures are quite high compared to the main sector and GDP statistics. In other words, the Turkish aquaculture industry is growing at a rapid pace [5].

In light of the explanations provided, Fig. 5 below demonstrates the development of the aquaculture sector’s active structure between 2009 and 2020, as well as the relationship between this development and the main sector and GDP.

The aquaculture sector’s total assets have consistently increased by double digits compared to the preceding year (Fig. 5). While the most significant improvement occurred in 2018, with a 47 % increase, the most significant decrease occurred in 2016, with a – 19 % decrease. The
A drop in 2016 compared to other years can be attributed to the economic impact of Türkiye’s coup attempt on the entire country. GDP at current prices by the production method increased by 17% in 2020 compared to the previous year. Using the same method, the GDP of the main sector of Agriculture, Forestry, and Fishing increased by 22% over the previous year, while the change in total assets in the Aquaculture sector increased by 34% over the previous year. So, the aquaculture sector has grown at a much faster rate than both the main sector and the country’s GDP. As a result, aquaculture is the subsector of agriculture that is growing the fastest compared to the total agricultural products sector [67]. Similarly, the aquaculture sector is expanding at a rapid pace in global markets [1, 51, 68]. Although COVID-19 pandemic is strongly affected all aspects of fish supply chains such as employment [71], it can be said that there is no loss of employment in the aquaculture sector in Türkiye. On the
contrary, with increasing investments, new employment fields have been provided.

The Turkish aquaculture sector is reliant on foreign sources of feed and eggs and has a growth structure that is both import- and export-oriented [38]. Thus, in conditions such as the COVID-19 pandemic, uncontrollable growth and volatility in feed and egg supply/prices pose a significant risk to sustainability [12,17,19,69]. In other words, given the effects of the COVID-19 pandemic on the global supply chain [70, 71], there may be issues with the supply of fish egg and feed, which are the primary input items for aquaculture production. Regarding the Turkish aquaculture sector’s rapid growth, steps should be taken to reduce the country’s dependency on imported fishmeal and feed. In fact, Genç et al. considered the inability to achieve appropriate feed requirements due to supply constraints as a limiting factor in aquaculture production’s sustainability [36].

### 6. Conclusion and suggestions

Given the importance of the aquaculture industry, which is regarded as a high-potential sector under the Blue Growth Strategy in terms of food supply and safety, it is critical to conduct a financial and economic structure analysis of the sector. This research aims to determine the financial and economic consequences of the COVID-19 pandemic in the Turkish aquaculture industry. In this regard, the ratio analysis approach was used to study the first consolidated balance sheet and income statement, which belonged to 274 enterprises in 2020 and were formed following the pandemic. The ratios between 2009 and 2020 were also evaluated. The results of the financial and economic structural analysis of the Turkish aquaculture sector in 2020 and the effect of the pandemic are summarized below.

While current assets’ share of total assets declined by 5.73 % in 2020, fixed asset share climbed by 17.20 %. A rise in working capital has been noticed in order to assure cash flow continuity during the pandemic period. That is, the cash ratio, which has been declining since 2015, increased by 54 % in 2020 over the prior year. The high-leverage sector is under pressure from lenders. While the rate of short-term assets in the capital structure decreased in 2020, the rate of long-term assets increased to avoid a debt default. An increase in financing costs accompanied the increase in long-term resources. Furthermore, when the sector’s financing structure is examined, it is found that they primarily finance their activities with bank loans, vendor debt, and equity capital, and they are insufficient in accessing/using capital market instruments. This condition poses a significant risk of debt default in depressing circumstances, which may lead to chain crises such as the COVID-19 pandemic.

Regarding opportunity cost, ROE was 19.7 % in 2020 indicates that the sector’s earning potential of equity capital is high despite the COVID-19 pandemic conditions. The best profitability results in the preceding 12-year period were recorded in 2020, and the Net Profit Margin improved by 871 % in 2020 compared to the previous year. However, when the profitability and financial structure ratios in the relevant industry are evaluated holistically, it is clearly seen that the ability of the companies to pay their debts is insufficient. Despite the COVID-19 pandemic, the sector continued to see rapid growth. However, the uncontrolled growth of Türkiye’s aquaculture industry, which is heavily dependent on imported feed and eggs, poses a significant risk to sustainability that must be addressed.

To manage the risks outlined above, capital market instruments should be leveraged and the diversity of financial instruments expanded. Many financial instruments, such as next-generation loans, Euro-Dollar market orientation, financial leasing, currency-based option contracts, interest-based futures contracts, syndicated loans, junk bonds, special funds (equity, private investments), securitization, and public offerings (Initial Public Offerings-IPO), can be used in this context. Furthermore, written financial derivatives can be used for fish egg and feed, which are the key components in production, to implement future-oriented cost optimization and hedging techniques. Additionally, access to capital market instruments can be offered through mergers and the listing of companies in the sector, which is primarily composed of small and medium-sized enterprises. Thus, in cases such as the COVID-19 pandemic, where financial uncertainty is high, profitability can be maximized by optimizing the financial structure. Also, the sector may be less affected by financial leverage and lack of liquidity which is linked to the biological cycle of production.

### Table 9

| Profitability ratios | Mean of 2009–2019 | 2020 | Change % |
|---------------------|------------------|------|----------|
| Net Profit (Loss) / Net Sales ratio (%) | 2.1 | 6.8 | 231 |
| Economic Profitability (%) | 7.5 | 12.9 | 71 |
| ROA | 1.3 | 4.1 | 216 |
Data Availability

English language, Ekrem EYÜBO and Prof. Dr. Fatma Telli Karakoç for thoughtful comments, which have helped me significantly improve the quality.

References

[1] M.A. Klasra, H. Fidan, Competitiveness of major exporting countries and Türkiye in the world fishery market: a constant market share analysis, Aquac. Econ. Manag. 9 (3) (2005) 317–330, https://doi.org/10.1007/s10488-005-00423-5.

[2] M. Annesen, E. Mikkelsen, Cost-benefit analysis of aquaculture expansion in Arctic Norway, Aquac. Econ. Manag. 24 (1) (2020) 20–42, https://doi.org/10.1007/s10488-019-1641570.

[3] D. Laborde, W. Martin, J. Swinnen, R. Vos, COVID-19 risks to global food security, aquaponics, and allied businesses, J. World Aquac. Soc. 51 (3) (2020) 574–577, https://doi.org/10.1111/jwao.12715.

[4] J. Adhikari, J. Timsina, R. Nepal, R. Vos, COVID-19 pandemic in South Asia: emerging risks and growing challenges, Front. Sociol. 6 (2021), 102990, https://doi.org/10.3388/f soc.6.2021.102990.

[5] J. Grillo-Núñez, T. Mendo, R. Gozzer-Wuest, J. Mendo, Impacts of COVID-19 on the value chain of the hake small scale fishery in northern Peru, Mar. Policy 124 (2021), 102990, https://doi.org/10.1016/j.marpol.2020.104080.

[6] K. Want, H. Fazhan, S.D. Ishak, N.A. Kasan, H.J. Liew, M.H. Noraini, M. Ikhwanuddin, Potential impacts of COVID-19 on the aquaculture sector of Malaysia and its coping strategies, Aquac. Rep. 18 (2020), 100450, https://doi.org/10.1016/j.aquacultureresearch.2020.100450.

[7] S. Kakoolaki, S.A.M. Ebne Al-Torab, A. Ghajari, A.A. Anvar, A. Sepahdari, H. Ahari, H. Hoseinzadeh, Socio-economic impacts of Coronavirus (COVID-19) outbreak on world shrimp aquaculture sector, Iran. J. Aquat. Anim. Health 6 (1) (2020) 1–18, https://doi.org/10.29252/ijazh.6.1.1.

[8] V.J. Senten, M.A. Smith, C.R. Engle, Impacts of COVID-19 on U.S. aquaculture, aquaponics, and allied businesses, J. World Aquac. Soc. 51 (3) (2020) 574–577, https://doi.org/10.1111/jwao.12715.

[9] V. Juri Hori, M. Makino, How has Corona virus disease (COVID-19) related lockdown on shrimp aquaculture sector in India - a sectoral assessment, Aquaculture 531 (2021), 735922, https://doi.org/10.1016/j.aquaculture.2020.735922.

[10] J. Grillo-Núñez, T. Mendo, R. Gozzer-Wuest, J. Mendo, Impacts of COVID-19 on the finfish aquaculture industry of Bangladesh: a case study, Mar. Policy Volume 137 (2022) (2022), 104972, https://doi.org/10.1016/j.marpol.2021.104972.

[11] A. Y Capt, S.A. Mamun, S.M. Mominul, M. Kamarudin, H. Maraiki, A review of production frontier research and policy recommendations, Mar. Policy Volume 137 (2022) (2022), 104972, https://doi.org/10.1016/j.marpol.2021.104972.

[12] A. Illyasu, Z.A. Mohamed, M.M. Ismail, A.M. Abdullah, S.M. Kamarudin, H. Maraiki, A review of production frontier research and policy recommendations, Mar. Policy Volume 137 (2022) (2022), 104972, https://doi.org/10.1016/j.marpol.2021.104972.

[13] J. Adhikari, J. Timsina, S.R. Khadka, Y. Ghale, H. Ojha, COVID-19 impacts on the finfish aquaculture sector of Malaysia and its coping strategies, Aquac. Rep. 18 (2020), 100450, https://doi.org/10.1016/j.aquacultureresearch.2020.100450.

[14] J. Adhikari, J. Timsina, S.R. Khadka, Y. Ghale, H. Ojha, COVID-19 impacts on the finfish aquaculture sector of Malaysia and its coping strategies, Aquac. Rep. 18 (2020), 100450, https://doi.org/10.1016/j.aquacultureresearch.2020.100450.

[15] R.J. Angel, D. De, M. Muralidhar, P.K. Patil, K.K. Vijayan, Prospective impact of COVID-19 on the finfish aquaculture sector of Malaysia and its coping strategies, Aquac. Rep. 18 (2020), 100450, https://doi.org/10.1016/j.aquacultureresearch.2020.100450.

[16] J. Grillo-Núñez, T. Mendo, R. Gozzer-Wuest, J. Mendo, Impacts of COVID-19 on the value chain of the hake small scale fishery in northern Peru, Mar. Policy 124 (2021), 102990, https://doi.org/10.1016/j.marpol.2020.104080.
