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EVALUATION OF FISH PRODUCTION, GROSS DOMESTIC PRODUCT AND FOOD SECURITY IN COUNTRIES BORDERING THE MEDITERRANEAN SEA

Ümüt YIGIT*

[*] *Underwater Technology Program, School of Maritime, Çanakkale Onsekiz Mart University, Dardanos Campus, Çanakkale 17020, Türkiye*

Ümüt Yigit: umutyigit@comu.edu.tr, https://orcid.org/0000-0002-1378-2422

[*] *Corresponding author: Ümüt Yigit, umutyigit@comu.edu.tr, +90-549-5350122*

Abstract
The aquaculture industry contributes significantly to the economic growth of countries, both in terms of food security and sectoral economic gains. This study examines the relationship between marine fish farming and the economic growth and food security of countries bordering the Mediterranean. Data from 10 Mediterranean countries was evaluated between 2012 and 2022. To ensure co-integration in dynamic forecasts, fish export and import values, gross domestic product, and food security index were examined by countries around the Mediterranean Sea, and the correlation between these data was assessed on a country-by-country basis. Findings in the present study addressed a strong correlation between marine fish production and gross domestic product for Türkiye (R= 0.91), Egypt (R= 0.93), and Spain (R= 0.91), with moderate correlation for Morocco (0.61), and Greece (R= 0.60). Also, high correlation was found between export and gross domestic product for Türkiye (R= 0.97) and Morocco (R= 0.78), and moderate correlation for Greece, France, Spain, and Italy (R= 0.63, R= 0.61, R= 0.60, and R= 0.55, respectively). Strong correlation between fish import and average dietary energy requirement was recorded for Morocco, Italy, France, and Spain (R= 0.85, R= 0.83, R= 0.82, and R= 0.74, respectively), whereas moderate correlation was found for Türkiye (R= 0.62), and remarkably lower correlation for Greece and Egypt (R= 0.41, R= 0.25, respectively). Results of this study provide remarkable information that may help policymakers and aquaculture managers in promoting new aquaculture investments by economic strategies for improving fish production and achieving long-term food security the Mediterranean, supplying a significant amount of the global food demand.

Keywords: Average dietary energy requirement, economic growth, fish consumption, food security, marine aquaculture, Mediterranean aquaculture

Introduction

Global aquaculture production surpassed capture fisheries yield in 2022, with 130.9 million tons and valued US$ 312.8 billion. This accounts for 59% of global fisheries and aquaculture production (Food and Agriculture Organization, 2024a). The fisheries and aquaculture sector employed an estimated 58.5 million people in 2020, working full-time, part-time, one-time, or indefinite responsibility positions. Nearly 21% of the employees were women, and out of the total 35% were involved in the aquaculture sector whereas 65% were engaged in industrial fisheries. While employment in the aquaculture sector has been stable in recent years, there has been a general decline in the number of fishing workers globally (Learnmonth, 2023). While the economic dynamics of aquaculture depend on many factors, the infrastructure, marketing networks, and human resources are important drivers for successful farm operations. Investments in infrastructure and human resources, in particular, may increase production efficiency over time, contributing significantly to business profits and economic growth (Hishamunda et al., 2009). Further, planning and management of production systems in aquaculture operations also depends on long lasting practices and are linked to skilled human resources and the availability of finance for beneficial outcomes (Verdegem et al., 2023). The shortage of manpower has been reported as one of the most significant challenges facing aquaculture producers (Engle et al., 2019; van Senten & Engle, 2017; van Senten et al., 2020a, b). The Covid-19 pandemic, in particular, has impacted employment across all value chains in fisheries and aquaculture. Restrictions on movement and disruptions in trade networks have disrupted markets and distribution systems, causing serious problems for the fisheries and aquaculture sector. Declines in trained human resources and manpower during the recent pandemic of Covid-19, for example, disrupted production processes, that in turn reduced yields and further result in food shortages and declines in food security. Lockdowns and border closures as measures for epidemic spreads, caused severe consequences for the supply chain of the food business (Maqbool et al., 2024). Dolgui and Ivanov (2020) and Mahmood et al (2022) underlined that the pandemic outbreak disrupted the global supply chain with goods shortages due to shipping delays, and increased transportation costs. Interruptions in logistics resulted in decline of manpower that further caused delays in good transportation, which broke the network of trade continuity and export distribution. The aquaculture industry supports global food security via the supply of healthy food for the increasing world populations as well as contributing to the employment. Due, the expansion of fish farming activities may offer new employment opportunities in the aquaculture sector, that in turns can boost the economy and peoples' houshold incomes, indirectly promoting food security (Khan et al., 2021). For the global food security, marine cage aquaculture industry plays an important role with remarkable economic inputs for Mediterranean countries. Hence, any disruption in the production yields of the Mediterranean aquaculture, either due to manpower shortage, trade restrictions or price fluctuations may have severe impacts on economic indicators, that may impact the global food security. Increasing food production does not stand alone as a pillar for ensuring food securityin a country. Food security is estimated with the combination of factors such as availability, accessibility, quality and safety, and sustainability and adaptation (Roberts et al., 2022).

Therefore, these indicators show that fish culture methods or amount of harvest yields are not enough to explain the food security level alone, but also trade flow via imports and exports, as well as consumption levels of communities. showing all the economic growth of the country. The present study aims to evaluate the relationship between marine fish farming and the economic growth and food security of countries with coast line to the Mediterranean.

Material and Method

Data collection and statistical analyses

The data set for the period 2012-2022 of 10 countries with Mediterranean coasts, namely Algeria, Egypt, France, Greece, Israel, Italy, Morocco, Spain, Tunisia, and Türkiye, was evaluated. The main variables examined in the study were marine fish production amount (MFP, tonnes), fish import value (FIV, USD, 1000), fish export value (FXV, USD, 1000), fish consumption amounts (FC), and macroeconomic variables such as global food security indices (GFSI). Total gross domestic product (GDP, USD, million) was selected as the economic growth indicator. In addition, average dietary energy requirement (ADER, kcal/capita/day) was determined as the food security factor in the study. Among the data set used in the study, data for MFP, FIV, and FXV were obtained from (Food and Agriculture Organization, 2025a, b). The rates for FC, and GDP were obtained from data provided by Food and Agriculture Organization (2024b), while the GFSI and ADER rates followed the data provided by Food and Agriculture Organization (2025c), and Economist Impact (2025a), respectively. The reason for selecting marine fish production volumes for the countries covered in this study is because the Mediterranean Sea constitutes a common marine area for these countries, further all data for the production amount of marine aquaculture is accessible as well.

The independent variables in this study are MFP, FXV, and FIV, while the dependent variables are GDP and ADER values. Countries such as Slovenia and Croatia bordering the Adriatic Sea were excluded in this study. Also, instabilities due to wars or regional conflicts may result in irregular data recording. Hence, regions such as Lebanon, Palestine and Syria were also not included in this study.

All the variables in this study are presented as means ± SD. Percent increase of marine fish production, gross domestic product, fish export value, fish import value, and average diet energy requirements of countries bordering the Mediterranean over the estimated time span from 2012 to 2022 have been calculated following the equation provided earlier by Yigit and Kusku (2022), Yigit et al. (2023), and Yigit (2025):

$$PI = \frac{(Vin - Vini)}{Vini}\ x\ 100$$

PI: percent increase of variables
Vfin: initial value
Vini: final value

Correlation between population increase and fish harvests for both countries involved in this study, has been carried out with a MacBook Pro, macOS Big Sur (11.7.3), running a Microsoft Excel program for Mac, according to the following formulae:

$$Correl\ (X,Y) = \frac{\Sigma(x - \bar{x})(y - \bar{y})}{\sqrt{\Sigma(x - \bar{x})^2\ \Sigma\ (y - \bar{y})^2}}$$

where, $\bar{x}$ and $\bar{y}$ represents the sample mean values for two different series, set as variable-1 for Serie 1, and variable-2 for Serie 2.

Variables of Serie 1 and Serie 2 this study where;
(a) marine fish production (MFP in tons) vs gross domestic product (GDP)
(b) fish export value (FXV in $US) vs gross domestic product (GDP)
(c) fish import value (FIV in $US) vs average diet energy requirement (ADER as kcal/capita per day), respectively.

Results and Discussion

The overall average GDP in 2022 for the countries bordering the Mediterranean Sea was recorded as 244,730 US $, with lowest for Morocco (7,360 US $) in 2012, and highest for France (39,080 US $) in 2019. Considering the average dietary energy requirement, the overall ADER level for all countries bordering the Mediterranean Sea was estimated as 24,123 kcal/capita/day, with lowest ADER (2,289 kcal/capita/day) for Algeria in 2019-2020, and highest rate of ADER (2,529 kcal/person/day) for Italy in 2022. Considering the MFP statistics, the overall average for the entire Mediterranean countries involved in this study was estimated as 815,424.7 in year 2022, with lowest MFP recorded for in Morocco (142 tons) in 2016 and highest for Türkiye (368,721 tons) in 2022. Analyzing the economic data of the Mediterranean aquaculture industry, the overall average for FXV was recorded as $15,182,645,900, with lowest of $5,758,000 recorded in Algeria in 2013 and highest with $5,887,865,670 for Spain in 2022. The overall average for FIV was estimated as $29,749,969,300, with lowest of $66,714,000 recorded for Algeria in 2012 and highest rate of $9,539,685,590) for Spain in 2022. Spain is the leading country of both export and import in the Mediterranean, when clustering the export and import data among the 10 countries evaluated in this study. The basic variables and statistical data used in the study are presented in Table 1.

Table 1. Basic variables and statistical data for countries bordering the Mediterranean Sea, with correlations between MFP-GDP, and FXV-GDP. Country list in table has been given in alphabetical order.

Algeria	**Mean**	**Std dev**	**Min**	**Max**
MFP (tons)	1,616.90	1,134.6	353.21	3,487.41
FIV (US$,1000)	117,571.66	22,235.8	66,714.0	143,639.24
FXV (US$,1000)	12,862.21	8,120.1	5,759.0	31,664.31
GDP (US$)	13,730.91	371.1	13,090.0	14,200.0
FC (kg/capita)	3.78	0.6	2.79	4.36
ADER (kcal/capita/day)	2,300.45	12.3	2,289.0	2,325.0
Correlation: MFP / GDP (2012-2022)	*-0.365987381*			
Correlation: FXV / GDP (2012-2022)	*-0.395383405*			
Correlation: FIV / ADER (2012-2022)	*-0.713386655*			
Egypt	**Mean**	**Std dev**	**Min**	**Max**
MFP (tons)	89,645.91	39,687.80	41,678.00	146,813.00
FIV (US$,1000)	800,670.75	133,357.20	600,332.00	1,089,806.79
FXV (US$,1000)	32,946.54	6,674.70	18,542.80	42,415.00
GDP (US$)	11,782.73	777.90	10,770.00	13,210.00
FC (kg/capita)	21.98	1.90	19.03	25.72
ADER (kcal/capita/day)	2,333.18	5.4	2,327.0	2,345.0
Correlation: MFP / GDP (2012-2022)	*0.930724917*			
Correlation: FXV / GDP (2012-2022)	*0.349003978*			
Correlation: FIV / ADER (2012-2022)	*0.253806815*			
France	**Mean**	**Std dev**	**Min**	**Max**
MFP (tons)	17,545.98	4,046.70	13,212.09	26,576.90
FIV (US$,1000)	6,768,860.96	693,525.70	5,802,808.00	8,202,627.54
FXV (US$,1000)	1,867,398.43	222,722.40	1,642,327.00	2,306,766.39

GDP (US$)	37,586.36	1,049.20	35,910.00	39,080.00
FC (kg/capita)	33.52	0.70	32.72	34.65
ADER (kcal/capita/day)	2,492.36	2.40	2,490.00	2,497.00
Correlation: MFP / GDP (2012-2022)	*-0.465644849*			
Correlation: FXV / GDP (2012-2022)	*0.616691237*			
Correlation: FIV / ADER (2012-2022)	*0.821239767*			
Greece	**Mean**	**Std dev**	**Min**	**Max**
MFP (tons)	120,892.82	12,985.10	101,858.40	140,423.12
FIV (US$,1000)	726,545.52	121,236.40	567,082.00	1,003,704.42
FXV (US$,1000)	805,870.64	93,663.30	661,958.00	987,562.85
GDP (US$)	23,098.18	921.40	21,770.00	25,280.00
FC (kg/capita)	18.44	1.6	15.68	21.07
ADER (kcal/capita/day)	2,518.82	1.00	2,518.00	2,521.00
Correlation: MFP / GDP (2012-2022)	*0.606725743*			
Correlation: FXV / GDP (2012-2022)	*0.651006557*			
Correlation: FIV / ADER (2012-2022)	*0.414230844*			
Israel	**Mean**	**Std dev**	**Min**	**Max**
MFP (tons)	2,326.91	504.20	1,700.00	3,545.00
FIV (US$,1000)	599,639.64	164,734.00	385,798.00	966,633.00
FXV (US$,1000)	27,473.73	5,167.90	21,379.00	37,216.00
GDP (US$)	30,042.91	8,952.7	3,032.00	36,650.00
FC (kg/capita)	23.85	1.30	21.11	25.71
ADER (kcal/capita/day)	2,290.36	2.60	2,287.00	2,295.00
Correlation: MFP / GDP (2012-2022)	*-0.061169479*			
Correlation: FXV / GDP (2012-2022)	*-0.660312957*			
Correlation: FIV / ADER (2012-2022)	*-0.13948971*			
Italy	**Mean**	**Std dev**	**Min**	**Max**
MFP (tons)	72,541.76	5,302.10	61,082.05	78,134.00
FIV (US$,1000)	6,460,459.53	744,976.00	5,537,243.00	7,803,782.27
FXV (US$,1000)	853,593.27	103,349.20	689,929.00	1,050,582.38
GDP (US$)	34,284.55	1,081.9	32,390.00	36,220.00
FC (kg/capita)	28.73	1.30	26.10	29.90
ADER (kcal/capita/day)	2,522.45	4.40	2.517.00	2,529.00
Correlation: MFP / GDP (2012-2022)	*0.436685348*			
Correlation: FXV / GDP (2012-2022)	*0.558130074*			
Correlation: FIV / ADER (2012-2022)	*0.830125310*			
Morocco	**Mean**	**Std dev**	**Min**	**Max**
MFP (tons)	304.48	178.20	142.00	681.97
FIV (US$,1000)	211,687.75	52,981.50	143,670.00	319,463.62
FXV (US$,1000)	2,260,266.99	348,251.70	1,767,536.00	2,889,797.42
GDP (US$)	8,030.00	375.50	7,360.00	8,540.00

FC (kg/capita)	18.14	1.50	16.04	20.41
ADER (kcal/capita/day)	2,375.09	4.10	2,372.00	2,384.00
Correlation: MFP / GDP (2012-2022)	*0.612478884*			
Correlation: FXV / GDP (2012-2022)	*0.780261073*			
Correlation: FIV / ADER (2012-2022)	*0.852406236*			
Spain	**Mean**	**Std dev**	**Min**	**Max**
MFP (tons)	37,883.33	4,664.60	31,420.74	46,893.07
FIV (US$,1000)	7,650,029.69	1,042,398.50	6,412,813.00	9,539,685.59
FXV (US$,1000)	4,607,735.40	691,149.10	3,807,001.00	5,887,856.67
GDP (US$)	32,528.18	1,662.10	30,330.00	34,960.00
FC (kg/capita)	41.40	1.50	39.82	44.09
ADER (kcal/capita/day)	2,500.00	4.30	2,496.00	2,508.00
Correlation: MFP / GDP (2012-2022)	*0.914505758*			
Correlation: FXV / GDP (2012-2022)	*0.60187552*			
Correlation: FIV / ADER (2012-2022)	*0.749852214*			
Tunisia	**Mean**	**Std dev**	**Min**	**Max**
MFP (tons)	16,747.42	5,987.10	7,130.00	24,709.57
FIV (US$,1000)	92,099.98	23,950.10	60,376.00	136,147.15
FXV (US$,1000)	194,063.43	37,302.70	159,730.00	281,191.71
GDP (US$)	10,985.45	304.70	10,350.00	11,450.00
FC (kg/capita)	14.20	1.50	12.38	16.75
ADER (kcal/capita/day)	2,346.82	9.70	2,338.00	2,366.00
Correlation: MFP / GDP (2012-2022)	*0.051049949*			
Correlation: FXV / GDP (2012-2022)	*-0.129148038*			
Correlation: FIV / ADER (2012-2022)	*-0.537838858*			
Türkiye	**Mean**	**Std dev**	**Min**	**Max**
MFP (tons)	205,998.92	91,724.70	101,248.00	368,721.00
FIV (US$,1000)	469,218.48	124,543.80	321,554.00	809,124.75
FXV (US$,1000)	937,018.09	357,913.40	447,879.40	1,700,787.61
GDP (US$)	22,737.27	2,557.00	18,540.00	27,360.00
FC (kg/capita)	5.41	0.50	4.79	6.72
ADER (kcal/capita/day)	2,405.73	4.70	2,392.00	2,411.00
Correlation: MFP / GDP (2012-2022)	*0.941484216*			
Correlation: FXV / GDP (2012-2022)	*0.975395686*			
Correlation: FIV / ADER (2012-2022)	*0.622925160*			

MFP: Marine fish production in tons; FIV: Fish import value in US$, x1000; FXV: Fish export value in US$, x1000; GDP: Gross domestic product in US$; FC: fish consumption as kg per capita; ADER: Average diet energy requirement as kcal/capita per day.

In the present study, a strong correlation between MFP and GDP from high-to-low for Türkiye (R= 0.91), Egypt (R= 0.93), and Spain (R= 0.91), followed by moderate correlation for these variables for Morocco (0.61), and Greece (R= 0.60). Low correlations were found in Italy

(0.43), while for the remaining countries the correlation was negligible. Some countries exhibited a negative correlation, exhibiting trends in completely different directions, meaning that while MFP increased, GDP declined or vice versa. Regarding the relation between FXV and GDP, Türkiye and Morocco demonstrated relatively high correlation (R= 0.97, and R= 0.78, respectively) among these variables. The results in this study were in close agreement with the report of Elzaki (2024), who addressed that fish exports have a significant impact on gross domestic product. Greece, France, Spain, and Italy however, presented a moderate correlation (R= 0.63, R= 0.61, R= 0.60, and R= 0.55, respectively), and Egypt a remarkable low correlation (R= 0.34) between FXV and GDP in this study. Results also revealed strong correlation between fish import and the country's average dietary energy requirement for Morocco, Italy, France, and Spain (R= 0.85, R= 0.83, R= 0.82, and R= 0.74, respectively), and moderate correlation for Türkiye (R= 0.62). Positive relationship between FXV and GDP, and a positive relationship between FIV and ADER, which is also in line with earlier reports (Elzaki, 2024). In contrast however, Greece and Egypt showed a low correlation of R= 0.41 and R= 0.25, while the remaining three countries of Israel, Algeria, and Tunisia demonstrated a negative correlation between FIV and ADER.

The percent increase of ADER, that is the food security factor and expressed as the kcal unit per capita in a day, was highest in Türkiye (0.79%), followed by Morocco (0.51%), Italy (0.48%), Egypt (0.43%), Spain (0.40%), France (0.20%), and Greece (0.04%). Declining trends for ADER over the last two decades were recorded in Israel (-0.09%), Tunisia (-1.06%), and Algeria (-1.33%). Percent increase of fish consumption as kg per capita, was highest in Greece (23.15%), followed by Israel (19.19%), Tunisia (15.62%), Italy (12.38%), Egypt (7.26%), and Morocco (0.42%). Declining trends for fish consumption over the last two decades from 2012 to 2022 were noted in France (-1.09%), Spain (-1.17%), Türkiye (-20.68%), and Algeria (-31.62%). Percent increases for variables of ADER, MFP, FIV, FXV, GDP, and fish consumption for the last two decades are given in Table 2.

Table 2. Percent increase of variables tested over the time span from 2012 to 2022. Country list in table has been given in alphabetical order.

	Percent increase rate (2012-2022)					
	ADER	**MFP**	**FIV**	**FXV**	**GDP**	**Consumption**
Algeria	-1.33	699.27	75.80	444.06	0.90	-31.62
Egypt	0.43	239.15	13.28	64.35	22.66	7.26
France	0.20	-42.93	34.56	29.22	6.66	-1.09
Greece	0.04	28.91	56.29	25.22	11.12	23.15
Israel	-0.09	0.61	150.55	-7.51	23.90	19.19
Italy	0.48	4.83	40.93	52.27	6.50	12.38
Morocco	0.51	303.53	122.36	63.49	14.13	0.42
Spain	0.40	49.24	48.76	49.48	11.32	-1.17
Tunisia	-1.06	178.75	65.25	49.72	1.49	15.62
Türkiye	0.79	264.18	151.63	279.74	47.57	-20.68

MFP: Marine fish production (tons); FIV: Fish import value (US$); FXV: Fish export value (US$); GDP: Gross domestic product (US$); ADER: Average diet energy requirement (kcal/capita per day)

It has been reported that population growth directly triggers food demand, including the consumption of fish and fisheries products (Ibrahim, 2015). Changes in behavior and lifestyle as an effect of urbanization for instance may affect global demand for fish, hence the fish consumption patterns in a society. Earlier studies found strong relationship between fish consumption, and behavioral and lifestyle changes, which show variations based on healthy diets (Oken et al., 2008), cultural and social influences (Cornelsen et al., 2015), or sustainability concerns with environmental awareness (De Boer et al., 2014).

Increase in fish production may support food security by increasing consumption of healthy fish (Akpalu and Okyere, 2023). It is interesting to see that the Türkiye, as the main producer of marine fish with a harvest of 368,721.00 tons in 2022, showed a relatively low performance in fish consumption rate (5.41±0.50 kg/capita) over the last ten years, compared to the other countries in the Mediterranean. The "availability" pillar of the Turkish GFSI showed an increasing score by 10.8 from 2018 to 2022, a possible reflection of its high export and import values, which however did not increase the national fish consumption rates, a possible indication that most of the Turkish production was linked to export rather to domestic demands. The "overproduction - underconsumption" phenomenon observed in Türkiye can be attributed to factors such as cultural preferences, pricing policy, foreign trade pressures, consumption habits, etc. Here, the consistently increasing export figures over the years indicate a growing demand for Turkish fish in the international market. It appears that factors such as bulk purchasing from foreign demand and the lack of price uncertainty do not provide incentives for the Turkish aquaculture industry to focus on the domestic market. In countries with high production, but sales dependent on exports, like the Turkish aquaculture sector for instance, any disruption due to unexpected shock waves such as the recent Covid-19 pandemic, may cause difficulties in the sales network. Hence, developing strategies to increase domestic consumption is crucial for the sustainability of high production capacity, particularly as government policies.

In earlier investigations, E-Jahan et al. (2010) and Obiero et al. (2019) underlined that the fish consumption rate per capita and food security rates could be increased with the increase of the import values and the fish supply from aquaculture activities. Considering the impact of fish production and import on food security, Ghanem et al. (2020) assessed that food security can be increased by increasing the production for the national market as well as imports. Based on earlier reports, it can be underlined that there is a strong relationship between fish production and economic growth, and food security (Elzaki, 2024).

The Global Food Security Index (GFSI) addresses four main topics, namely (a) affordability: refers to consumers' ability to purchase the food, and is a measure of vulnerability of consumers to price fluctuations and the existence of programs and policies that support consumers when price fluctuations occur; (b) availability: stands for the measure of food production and farm capacities and risks of supply disruptions, capacity of the country to distribute food, and research efforts to increase harvest yields; (c) quality and safety: a measure for the average food diversity and nutritional quality, and the safety degree of food; (d) sustainability and adaptation: figures the exposure of the country to climate change impacts, its vulnerability to natural resource risks, and how the country is adapting to these risks at the national level (Economist Impact (2025b). Global food security indexes for countries bordering the Mediterranean Sea in 2022 are given in Table 3.

Table 3. Mediterranean country-performance of global food security indexes in 2022. Changes in scores for previous years in comparison to 2022 are given in italic. Country list in table has been given by rank from high-to-low as for the overall food security index for 2022.

	Global Food Security Index (GFSI)					
	Plummets / improvement	Affordability	Availability	Quality and Safety	Sustainability and Adaptation	**Overall**
France	**2022**	91.3	69.0	87.7	70.3	**80.2**
	2021	*+1.1*	*+5.8*	*+0.2*	*nc*	*+1.9*
	2020	*+2.2*	*+5.8*	*+0.2*	*nc*	*+2.2*
	2019	*+2.4*	*+5.9*	*+0.3*	*nc*	*+2.3*
	2018	*+2.0*	*+3.7*	*+1.3*	*nc*	*+1.8*
	2017	*+0.2*	*+2.4*	*+1.0*	*+3.3*	*+1.6*
Spain	**2022**	89.0	63.1	81.2	66.4	**75.7**
	2021	*+0.7*	*-4.4*	*nc*	*-0.1*	*-0.9*
	2020	*-0.7*	*-0.9*	*-5.5*	*-0.1*	*-1.7*
	2019	*+0.4*	*-1.4*	*-5.7*	*-0.2*	*-1.5*
	2018	*-0.3*	*-2.6*	*-6.7*	*-0.2*	*-2.3*
	2017	*-0.2*	*+1.1*	*-6.8*	*-0.3*	*-1.4*
Israel	**2022**	88.6	67.2	87.4	52.2	**74.8**
	2021	*-1.8*	*+1.4*	*nc*	*+8.2*	*+1.7*
	2020	*+0.7*	*-2.9*	*+2.3*	*+8.2*	*+1.9*
	2019	*-0.7*	*-3.5*	*+2.4*	*+8.2*	*+1.3*
	2018	*-1.9*	*-3.7*	*+1.6*	*+8.2*	*+0.7*
	2017	*-2.4*	*-2.4*	*+6.1*	*+12.9*	*+2.9*
Italy	**2022**	89.5	68.7	75.9	57.3	**74.0**
	2021	*+0.5*	*-0.9*	*nc*	*nc*	*-0.1*
	2020	*-0.5*	*+0.2*	*-4.5*	*nc*	*-1.1*
	2019	*+0.3*	*+1.1*	*-4.5*	*-0.1*	*-0.6*
	2018	*+0.9*	*+1.3*	*-3.3*	*-0.1*	*-0.2*
	2017	*-1.2*	*+3.5*	*-5.6*	*-0.1*	*-0.8*
Greece	**2022**	88.5	58.3	80.8	57.3	**72.2**
	2021	*-0.5*	*+2.3*	*nc*	*-3.3*	*-0.3*
	2020	*-1.8*	*-3.6*	*-5.6*	*-3.4*	*-3.4*
	2019	*-0.4*	*-3.3*	*-7.8*	*-3.4*	*-3.5*
	2018	*-1.0*	*-4.7*	*-8.7*	*-3.5*	*-4.2*
	2017	*-1.1*	*-4.3*	*-9.0*	*-3.5*	*-4.2*
Türkiye	**2022**	58.4	65.3	78.5	61.2	**65.3**
	2021	*-7.4*	*+5.6*	*+0.6*	*+1.6*	*-0.3*
	2020	*+3.7*	*+5.8*	*+4.0*	*+1.5*	*+3.8*
	2019	*-3.2*	*+5.9*	*+1.7*	*+0.1*	*+0.9*
	2018	*-9.0*	*+10.8*	*nc*	*+0.5*	*+0.1*
	2017	*-17.5*	*+4.5*	*+0.9*	*+8.2*	*-2.0*
Morocco	**2022**	74.6	42.9	73.1	60.0	**63.0**
	2021	*+0.2*	*-5.8*	*+0.8*	*-0.4*	*-1.3*
	2020	*-1.8*	*-7.0*	*+1.0*	*+1.0*	*-1.9*
	2019	*-0.5*	*+3.2*	*+1.0*	*+3.5*	*+1.6*
	2018	*-1.9*	*-7.3*	*+5.0*	*+3.9*	*-0.5*
	2017	*+1.0*	*-2.3*	*+13.8*	*+10.6*	*+5.1*
Tunisia	**2022**	75.4	54.1	58.8	49.7	**60.3**
	2021	*-2.0*	*+6.9*	*-6.0*	*+0.7*	*-0.1*
	2020	*+0.9*	*+7.1*	*-4.9*	*nc*	*+1.0*
	2019	*+0.9*	*+4.8*	*-4.8*	*+3.2*	*+1.1*
	2018	*-2.2*	*+5.5*	*-0.4*	*+2.4*	*+1.2*
	2017	*-3.8*	*+2.3*	*+1.0*	*+1.2*	*-0.1*

Algeria	**2022**	66.8	57.3	54.7	54.2	**58.9**
	2021	*-12.1*	*nc*	*+0.2*	*-0.1*	*-3.6*
	2020	*-13.3*	*+6.9*	*+0.2*	*nc*	*-2.2*
	2019	*-9.3*	*+8.6*	*+5.2*	*+11.4*	*+0.8*
	2018	*-7.1*	*+8.1*	*-10.9*	*+13.1*	*+0.4*
	2017	*-9.0*	*+8.4*	*-8.0*	*+13.1*	*+0.6*
Egypt	**2022**	65.2	54.2	45.9	55.8	**56.0**
	2021	*-7.7*	*-0.1*	*-0.8*	*+0.1*	*-2.5*
	2020	*+1.0*	*+0.5*	*-6.9*	*+7.4*	*+0.5*
	2019	*+7.7*	*-7.3*	*-6.8*	*+9.8*	*+1.2*
	2018	*+13.8*	*-0.5*	*-7.9*	*+12.7*	*+5.1*
	2017	*+9.8*	*-0.9*	*-13.1*	*+13.2*	*+2.8*

Scores are normalized 0-100, where 100 stands for best condition. nc: no change in score. Data retrieved from Economist Impact (2025a).

In regards to the overall values among the countries examined in this study, France and Israel recorded an increasing performance from 2017 to 2022 in terms of the GFSI scores, while Spain, Italy, and Greece showed a steady decline over the past five years. Even though, Egypt, Algeria, and Morocco showed a general upward trend from 2017 to 2022, all countries except France and Israel underperformed in terms of GFSI from 2021 to 2022. GFSI reports by Economist Impacts (2025a) underlined that the food environment in the world is deteriorating and as a result sensitivity to shock waves. Despite the fact that food scores increased by six-fold from 2012 to 2015, the global food system slowed down recently, that might be linked to several factors such as the affordability, which was influenced by severe increases in food prices, that eventually might have affected the food quality and safety pillars, triggering the availability and sustainability and adaptation pillars (Economist Impact, 2025a). As a result, the findings in this study build a strong foundation for addressing critical issues that need further focus in more details with other factors involved, affecting the sustainable development of the aquaculture industry in the Mediterranean.

Conclusion

The Mediterranean marine aquaculture, which is rapidly expanding with technological infrastructure, has the capability of meeting the food demand of a rapidly growing global population. The growth trend of fish production is strongly linked to the countries' economic growth performance, and food security. Further, results in this study highlights evidence that fish exports and gross domestic product, and fish imports and average dietary energy requirements have positively related. These are important indicators for policymakers and aquaculture managers in promoting new aquaculture investments by economic strategies for improving fish production and achieving long-term food security. In Future, new investigations are encouraged to evaluate other factors such as marketing strategies, consumer preferences, equipment or operational costs etc., that may help to support the sustainable growth of the Mediterranean aquaculture in long run.

Ethical approval

Not applicable as no humans or animals were involving in this study.

Informed consent

Not available as single author is present in this study.

Data availability statement

The author declares that data can be provided by corresponding author upon reasonable request.

Conflicts of interest
There is no conflict of interests for publishing this study.

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Contribution of authors
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