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RESEARCH PAPER

The Relationship between Economic Growth and Fisheries Production in Türkiye

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Abstract

There is a lack of understanding of the fisheries production impact on the national economy, as the contribution of the industry to the Turkish economy has not been adequately reflected in the official Gross Domestic Product (GDP) statistics and economic research. Therefore, this paper aims to reveal the industry's contribution to Türkiye's economic growth. We analysed the effect of fisheries production on economic growth by employing the Auto Regressive Distributed Lag (ARDL) model from 1990-2019. The results showed a positive relationship between fisheries production and economic growth in the long-term. We hope this paper will support the policy-makers and development agencies in their efforts to reshape the industry in Türkiye towards an increased role in economic development in a sustainable manner.

Introduction

The fisheries and aquaculture (FAI) industry is acknowledged by the Food and Agriculture Organization of the United Nations (FAO) as one of the key industries regarding its contribution to sustainable food systems and economic development. Thanks to the developments in production technologies, investments in aquaculture, rising incomes per capita worldwide and awareness of healthy nutrition with fish products, the industry continues to create added-value for future generations. Today, the industry globally provides 20% of the average animal protein per capita intake for more than 3.3 billion people (FAO, 2020). According to the latest projections shared by United Nations, the global population could grow to around 8.5 billion in 2030, 9.7 billion in 2050, 10.4 billion in 2100 and more than two-thirds of all people will live in urban areas (UN, 2022). Therefore, these expectations on the world population and growing urbanization will inevitably enhance the need for protein requirements and so the demand on seafood products for adequate and balanced nutrition in the nearest future. On the other hand, the industry has created a significant economic contribution for many countries, especially through the investments in aquaculture production since the 1990s. Despite a slowdown in global production and international trade during the COVID-19 pandemic, global fisheries and aquaculture production reached an all-time record of 214 million tonnes (90.3 million tonnes from capture fisheries and 122.6 million tonnes from aquaculture) with an estimated value of USD 422 billion in 2020 (FAO, 2022). The industry has also become vital as a stable source of foreign currency for some coastal countries where the trade activities of fisheries products are indispensable for a large section of the community. The liberalization and globalization policies that enhanced the expansion of international trade also extended the international trade of fisheries and aquaculture products. In recent years, fish and aquatic products have become one of the most traded food commodities with 225 states/territories worldwide and 60 million tons of fish (38% of total production) were traded internationally with an estimated export value of USD 151 billion (FAO, 2022). Thanks to the advancements in production and trade, the industry has also created many employment opportunities for around 58.5 million people, of which 21% were women, as full-time, part-time, occasional or unspecified workers in 2020. Taking account 150 million indirect employments in the value chain from harvest to distribution, approximately 600 to 880 million people rely on the sector (Ababouch, 2015; FAO, 2022).

On the other hand, Türkiye has also a great potential for the industry thanks to its geographical position. The capture production is one of the oldest occupations in Türkiye and still maintains its importance in social and economic life. However, aquaculture production is the key production method for providing high-value-added products and industrial sustainability. Thanks to the supporting policies by Agriculture and Forestry Ministry, especially investments in aquaculture production have resulted in many significant improvements in the industry. Total production reached to 785,811 tonnes from which 364,400 tonnes of fish were captured, and 421,411 tonnes were farmed products respectively in 2020 (Institute of Agricultural Economy and Policy Development, [TEPGE], 2021). Furthermore, Turkish producers have new investments in processing facilities to boost the supply of value-added products, especially in farmed Gilthead seabream (*Sparus aurata*) and the European seabass (*Dicentrarchus labrax*). Today, Türkiye has become the largest exporter of farmed European seabass, and one of the largest producers of Gilthead seabream globally (Rad et al., 2021). According to the OECD 2021 report, export quantity and value have substantially increased since 2010. The monetary value of Turkish exports multiplied by 3.3 in nominal terms between 2010 and 2019, from about 312.93 million USD in 2000 to 1,025 billion USD in 2019. These all advancements have also enabled the employment of approximately 30,000 people directly and the employment of approximately 250,000 people indirectly (Turkish Statistical Institute [TUIK], 2020).

In conclusion, the fisheries industry has an extremely important position in terms of economic and social development for many countries, including Türkiye, due to its close relations with the food, health, and environment (Naylor et al., 2000; Diana, 2009; Lester et al., 2013; Brugère et al., 2018; Valenti et al., 2018). According to FAO (2022), the industry will continue to make a significant contribution to economic growth in the future. Therefore, it is crucial to implement research to generate data on the contribution of countries' industries to GDP to evaluate the impact of fisheries production on economic growth. Moreover, the measurement of the contribution of fisheries to the GDP is also embraced in the Sustainable Development Goals (SDGs) of Agenda - 2030[1] in the SDG indicator 14.7.1 to gain a deeper understanding of the optimum uses of resources and manage efficient strategies for sustainability. Regard to its importance, significant efforts are given to generate or compile data about the contribution of industry to GDP at the regional level (Bostock et al., 2016 for EU; Gillett, 2009, for Pacific Islands; Gillet and Lightfoot, 2002 for Pacific Island countries; Hofherr, et al., 2012, for EU; de Graaf and Garibaldi, 2014, for African countries; Guillen Garcia et al., 2015 for EU); and the national level (Oyakhilomen and Zibah, 2013 for Nigeria; Rahmizal, 2017, for Indonesia; Karataş and Karataş, 2017; Oladimeji, 2018, for Nigeria; Rehman et al. 2019, for Pakistan; Botta et al., 2021, for the US; Vega et al., 2014 for Ireland). However, although it is theoretically stated that fisheries production contributes to economic growth, very few studies empirically test the relationship between the variables. When examining the studies in Türkiye, there are also several reviews of the importance of industry in economic developments (generally on production and marketing), however, no studies carried out on the effects on GDP in Türkiye. Thus, the main objectives of this research are to denote the economic trend regarding the contribution of fisheries production to Türkiye's economic growth and to draw a meaningful conclusion by testing their relationship empirically. Hopefully, this research will support the policymakers and development agencies in their efforts to reshape the industry in Türkiye towards an enhanced role in economic development and contribute to SDG indicator 14.7.1 at an international level.

Data and Methodology

The goal of the paper was to analyze the impact of fisheries production (FP) on GDP during the period 1990–2019 in Türkiye, using the Auto Regressive Distributed Lag (ARDL) model developed by Pesaran et al. (2001). To avoid the omitted variable bias problem, the labor force (L), trade openness (TO) (Sum of export and import to GDP), and capital investment were measured by the real value of gross fixed capital formation (K) (% of GDP) were included in the model. This study utilized the logarithmic values of the series. The period of the study is dictated by the availability of the data. While L data started in 1990, FP data was available only until 2019. Data sets were taken from the

World Development Indicators (WDI) database. In this context, the model was set as follows:

$$GDP_t = f(FP_t, TO_t, L_t, K_t)$$

In the study, the stationary levels of the series were determined with the Augmented Dickey-Fuller (ADF) (1979) and Phillips-Perron (PP) (1988) unit root tests. Therefore, the ARDL Bound test is employed to examine the cointegration between FP and GDP. Unit root test results revealed that the series were integrated at different levels. ARDL model was chosen as it has numerous advantages, making it more useful than other techniques. The ARDL model is more efficient in small samples than Johansen and Juselius's cointegration methodology. Also, it can be used whether the time series variables are purely I(0), purely I(1), or a mixture of both I(0) and I(1). However, it is crucial to determine whether the variables are I (2) or not because the ARDL Bound test is invalid when the variables are I(2). (Pesaran et al., 2001). When some of the model regressors are endogenous, the ARDL generally gives unbiased estimates in the long-term and valid t-statistics (Narayan, 2005). Moreover, short-term and long-term parameters can be estimated simultaneously by ARDL. The error correction model shows short-term adjustment and long-term equilibrium without losing long-term information (Pesaran and Shin, 1995). The equation of the ARDL model is estimated in the following forms:

$$\Delta GDP_t = \alpha_0 + \sum_{i=1}^{m} b_i \, \Delta GDP_{t-i} + \sum_{i=1}^{n} c_i \Delta FP_{t-i} + \sum_{i=1}^{o} d_i \Delta TO_{t-i} + \sum_{i=1}^{p} f_i \Delta L_{t-i} + \sum_{i=1}^{r} g_i \Delta K_{t-i} + \lambda_1 GDP_{t-1} + \lambda_2 FP_{t-1} + \lambda_3 TO_{t-1} + \lambda_4 L_{t-1} + \lambda_5 K_{t-1} + \varepsilon_t \quad (2)$$

Where $t, \Delta, \text{and } \varepsilon$ represent time, the first difference, and the white noise error term. The null hypothesis can be accepted or rejected based on the examined value of F-statistics critical values. If the calculated F-Statistic is higher than the upper critical values, the null of no co-integration is rejected. Thus, we can conclude long-term cointegration among the variables. If the F-statistic is below the lower critical value, there is no long-term nexus between the variables. If the F-statistic is between the critical values, then the cointegration test becomes inconclusive.

The short-term relationship can be estimated with the following ARDL-ECM model:

$$\Delta GDP_t = \gamma_0 + \sum_{i=1}^{a} \beta_i \, \Delta GDP_{t-i} + \sum_{i=1}^{b} \gamma_i \Delta FP_{t-i} + \sum_{i=1}^{c} \theta_i \, \Delta TO_{t-i} + \sum_{i=1}^{d} \vartheta_i \Delta L_{t-i} + \sum_{i=1}^{e} \mu_i \Delta K_{t-i} + \gamma ECT_{t-i} + u_t \quad (3)$$

Where γ symbolizes error-correction term (ECT). If there will be a disturbance in the system, how much time it will take to reach its equilibrium path in the long-term. The coefficient of γ is expected to be negative and significant.

Results

In Table 1, the descriptive statistics of the variables were given, the mean of GDP, FP, TO, L, and K in the natural logarithm of the level form were 9.17, 13.29, 3.83, 16.98 and 3.21, respectively.

The ADF and PP unit root test results were presented in Table 2. The results showed that only the FP variable was stationary at level, and all other variables were stationary at first differences.

The next step is to exhibit a long-term trade-off between the variables by applying the ARDL model.

Table 1. Descriptive Statistics

	lnGDP	lnFP	lnTO	lnL	lnK
Mean	9.179	13.293	3.833	16.986	3.218
Median	9.152	13.330	3.874	16.916	3.232
Maximum	9.628	13.637	4.138	17.323	3.396
Minimum	8.811	12.807	3.416	16.772	2.887
Std. deviation	0.269	0.171	0.188	0.163	0.133
Skewness	0.301	-1.040	-0.828	0.782	-0.673
Kurtosis	1.751	4.810	3.135	2.330	2.775

Table 2. Dickey-Fuller (ADF) and Phillips-Perron (PP) Unit Root Tests

Variables	I (0)				I (1)			
	ADF		PP		ADF		PP	
	Constant	Constant & Trend	Constant	Constant & Trend	Constant	Constant & Trend	Constant	Constant & Trend
lnGDP	0.135	-2.495	0.485	-2.534	-5.427[a]	-4.048[b]	-6.037[a]	-6.436[a]
lnL	1.474	-1.988	2.180	-0.620	-2.501	-6.186[a]	-5.172[a]	-6.215[a]
lnTO	-0.810	-3.843[b]	-1.691	-2.590	-4.682[a]	-3.698[b]	-5.330[a]	-5.546[a]
lnK	-2.029	-2.395	-2.052	-2.395	-5.443[a]	-5.325[a]	-5.443[a]	-5.326[a]
lnFP	-2.750[c]	-3.367[c]	-2.508	-3.588[c]	-4.365[a]	-3.981[b]	-5.868[a]	-5.870[a]

[a,b] and [c] denote significant levels at 1%, 5% and 10% respectively.

Then, the optimal lag order of each variable is determined according to the AIC information criterion in the model. The results were presented in Table 3. As Table 3 illustrated, there was cointegration among variables. Moreover, diagnostic tests such as heteroscedasticity, normality, and serial correlation indicate that the model is valid, as denoted in Table 3. The cointegrated relationship of the variables means that there is a long-term joint movement among the variables. That is, the variables GDP, L, TO, K, and FP move together in the long-term.

The long-term estimation results were presented in Table 4. According to the results, all variables affect GDP positively and except TO all variables were statistically significant. This finding, which showed that the coefficient of FP was positive and statistically significant, indicated the concision that FP had an impact on GDP. Long-term coefficients were found to be 0.636 for FP. This implies that a 1% enhancement in FP raises the GDP by about 0.63%. Similarly, Rehman et al. (2019) and Oladimeji (2018) studied found that FP positively impacted GDP. According to this, it is seen that the increase in fisheries production, which has an increasing share in the agricultural sector, is necessary to "move the economy".

Table 5 reported the results in terms of the short-term coefficients. The coefficient of ECT was negative and statistically significant. Moreover, it also emphasized adjustment speed towards long-term equilibrium. The short-term coefficients indicated that FP, L, and K affect GDP positively and significantly. Therefore, in the short-term, changes in fisheries production, labor force and physical capital will affect GDP in the same way. In addition, TO was affected negatively, and according to Wald test results, TO was significant at 1% in the short-term. Haussmann et al.

Table 3. Bound Test

Dependent Variable	Independent Variables	F-statistic
lnGDP	lnFP,lnL,lnTO,lnK	17,55[a]
Critical Values	3.29-4.37 (%1)	
Optimal lag (2,4,1,4,4)	R^2 = 0.999 LM(1) = 0.378 ARCH(1) =0.335	
	Normality = 3.635 RESET=0.213	

[a] indicates significance at %1.

Table 4. The estimation results of the long-term model of ARDL

Dependent Variable: LGDP		
Variables	Coefficient	t- statistic
lnFP	0.636[a]	4.013
lnL	1.068[a]	9.042
lnTO	0.160	0.652
lnK	0.361[b]	3.141
c	-19.165[a]	-6.711

[a,b] denote significance at 1% and 5% respectively.

Table 5. The estimation results of the short-term model of ARDL

Variables	Model	Coefficient	t - statistic
ΔlGDP(-1)		-0.259[b]	-2.959
ΔlnFP		0.060[b]	3.519
ΔlnFP(-1)	ARDL(2,4,1,4,4)	0.233[a]	9.750
ΔlnFP(-2)		-0.148[a]	-5.367
ΔlnFP(-3)		-0.099[a]	-4.320
ΔlnL		0.308[a]	4.067
ΔlnTO		-0.003	-0.105
ΔlnTO(-1)		-0.032	-1.102
ΔlnTO(-2)		-0.095[a]	-5.054
ΔlnTO(-3)		-0.080[b]	-3.650
ΔlnK		0.410[a]	16.479
ΔlnK(-1)		0.160[a]	3.750
ΔlnK(-2)		0.113[a]	4.837
ΔlnK(-3)		0.130[a]	6.192
ECT(-1)		-0.553[a]	-13.897

[a,b] and [c] denote significance at 1%, 5% and 10% respectively.

(2007) stated that trade openness can negatively affect economic growth for countries that specialize in the production of low-quality products. Berçintürk (2022) stated that the negative impact of trade openness on income at the provincial level in Türkiye may require some measures to be taken and policies to benefit from trade openness.

Figure 1 illustrates CUSUM and CUSUMQ graphs were used to see whether the coefficients were stable. The CUSUM and CUSUMSQ statistics were within the critical limits at 5% significance. Accordingly, it is understood that the long-term coefficients calculated according to the ARDL model are stable.

Discussion

The contribution of a sector to GDP reveals the importance of a particular sector for the country. Research examining the contribution of the natural resource industries to GDP is one of the valuable indicators to monitor the progress of sustainable resource management and attract the attention of decision-makers (de Graaf and Garibaldi 2014). The fisheries and aquaculture industry has become one of the drivers of economic growth in many countries, thanks to its contribution to employment, trade, and investment. Therefore, fisheries production represents a significant contribution to GDP in many coastal countries. The industry is also a growing industry in Türkiye and makes a significant contribution to the economy with new investments, employment of thousands of people and increasing trade potential. However, limited economic studies have been conducted on industrial contribution to Turkish economy. Rad and Köksal (2000) drew attention to the biotechnical and economic aspects of important areas such as the European seabass and the Gilthead seabream production and presented the current

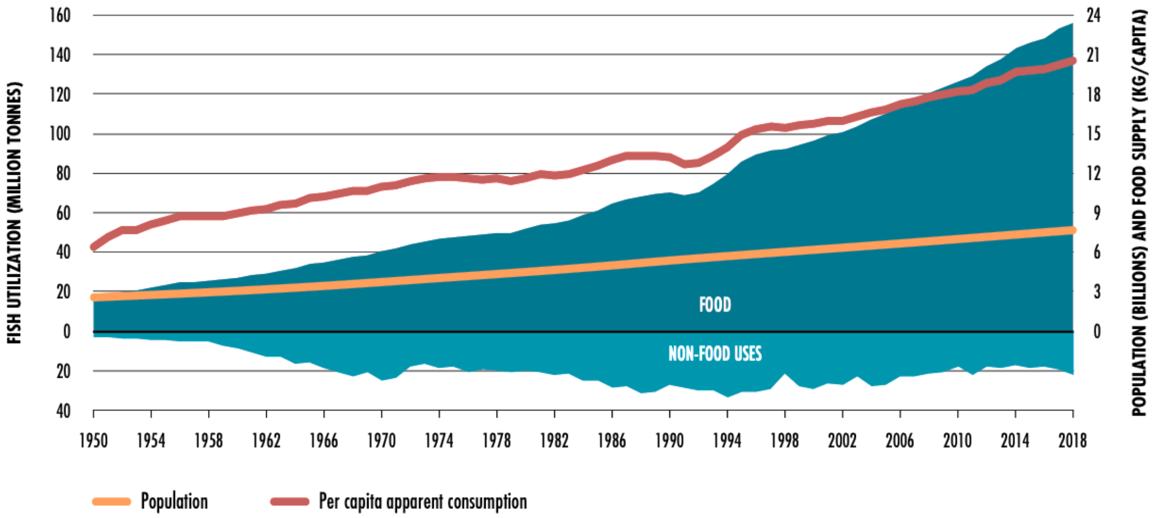

Figure 1. World fish utilization and supply (source: FAO,2020)

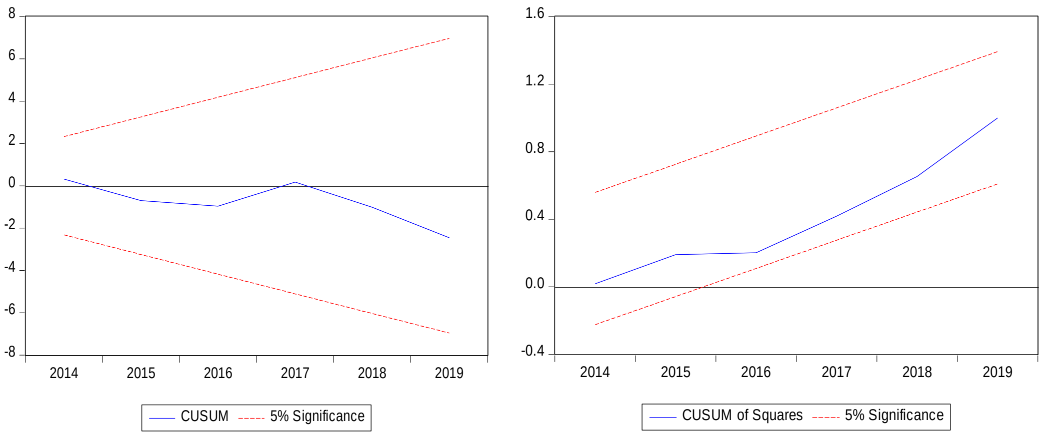

Figure 2. CUSUM and CUSUM of Squares

outlook of the Turkish aquaculture sector. Bjørndal et al. (2019) analyzed whether Türkiye's export of farmed European seabass affects the prices of farmed European seabass in the European Union (EU), taking into account the market integration between the prices of farmed European seabass exports from Türkiye to the EU and the prices of farmed European seabass commercialized in wholesale markets in Barcelona, Madrid, and Paris. Llorente et al. (2020) tested the economic performance of EU companies (including Turkish companies) farming Gilthead seabream and European seabass, utilizing economic and financial data during the period 2008-2016. Çelik and Akmermer (2021) focused on target market selection for priority aquaculture products to support Türkiye 's export potential. In case, this research focus on examining the economic trend regarding the contribution of fisheries production to Türkiye's economic growth and drawing a meaningful conclusion by testing their relationship empirically.

We investigated the trade-off between FP and GDP in Türkiye by using time series data from 1990-2019. According to the ARDL test, there is a causality between FP and GDP in Türkiye. The results show a positive long-term relationship between FP and GDP. Our results were similar to other studies in the literature that found a relationship between FP and GDP (e.g., Cai and Leung, 2019; Guillen Garcia et al. 2015; Rahmizal, 2017; Rehman et al., 2019; Sarpong et al., 2005; Vega et al. 2014). As opposed to Oyakhilomen and Zibah (2014) and Oladimeji (2018), this study revealed a positive statistical nexus between FP and GDP in the short-term. This implies that the deviation of FP over long-term equilibrium would have a significant impact on the growth of Türkiye. In addition, there was a causal relationship between FP and GDP, as FP had a positive and statistically significant effect on GDP in the short-term. The results showed that FP had strong links with the economy's growth and thus had a significant economic impact on the policy. As supporting the results of this study, Kale (2020) monitored FP with trend analysis and future forecast for Türkiye and, stated that the increase in FP can contribute to social welfare and economic growth by providing commercial or business opportunities for related sectors. In addition, the aquaculture sector, which has a great advantage with its geographical location and rich biodiversity, should be one of Türkiye 's priority sectors in order to develop the production potential that will support sustainable economic growth. In this regard, to protect/increase biodiversity, it is important to develop control mechanisms for the habitats of fishery products and to use resources efficiently by considering ecological criteria initially. Kale (2020) also stated that factors such as climate change, fisheries management strategies, rules of practice, and overexploitation affect the amount of FP. Therefore, policymakers need to focus on appropriate strategies and codes of conduct for fisheries management to improve production. Furthermore, marketing channels should be developed to increase the foreign trade potential and ensure economic efficiency and sustainability. To increase export, new markets should be tried, especially for priority species. For example, in the last thirty years, Türkiye has achieved success in the production of Rainbow trout, *European seabass and Gilthead seabream* (Massa et al., 2021). Çelik and Akmermer (2021) conducted an important study using different criteria to determine the right target countries for these priority products to be exported. Conducting these kinds of studies will also provide important market information to sector representatives. In addition, it is seen that Türkiye does not have a national brand known in international markets. Therefore, starting national brand studies as soon as possible will support the sector and increase its exporting capacity. Moreover, the findings of our study showed that the labour force, physical capital, and trade openness are other important inputs to increase GDP in the long-term. Similar findings were found in the literature for labour force (eg., Clark et al., 2016; Novid and Sumarsono 2018; Wijaya et al., 2021), physical capital (eg., Xu and Xie, 2018; Pomi et al., 2021), and trade openness (eg. Kong et al., 2021; Rodrik, 1988).

On the other hand, foreign dependency on raw material supply is among the sector's important problems. Therefore, it is important to carry out studies to produce alternative fish feeds that can reduce foreign dependency on raw materials. In addition, diseases are one of the important factors limiting the development of aquaculture and causing losses. Therefore, research and development (R&D) studies to reduce the negative effects of these factors on the industry should be supported by financial support mechanisms. Besides, the universities should lead these R&D studies and contribute to educating human resources, especially on new technologies which are reconstructing the industry nowadays. In this sense, education and employment policies are also very important and should be reviewed according to the needs of the industry.

The recommendations given here have been formed within the framework of the issues that are shown as obstacles to sectoral development in the sectoral reports published by the relevant public institutions and organizations in Türkiye. As a result, since there is a positive long-term relationship between FP and GDP, it is thought that the steps expressed here for the sector will contribute significantly to Türkiye 's economic growth.

Conclusion

In the scope of this research, we showed the economic trend regarding the contribution of the FP to Türkiye's GDP and provide an overview to national and regional policy institutions about the importance of the industry. We know that the increasing need for food and food safety awareness due to rapid population growth and urbanization are expected to increase the global demand for seafood and thus the production of fishery products. Therefore, Türkiye, as one of the main producers of some species, can gain a crucial place in this growing industry in the next 30 years. In this regard, although there is a general awareness that industry needs to be reformed to optimize its economic performance in the last 20 years, it is important to pay closer attention to the industry to increase the welfare level in Türkiye. Through the use of modern fishing/processing technologies, supporting R&D, and designing new regulations on trade, production, and employment, Türkiye can gain more advantages from the opportunities that exist in the industry. On the other hand, central to estimating the value of sustainable fisheries is the biological sustainability of stocks (FAO, 2022). The authorities should manage the fishery stocks in a sustainable manner to meet the needs of today without compromising future generations. However, the FAO's long-term monitoring of assessed marine fishery stocks confirms that marine fishery resources have continued to decline. Thus, ensuring the fishery resources are safeguarded is one of the priority steps for industrial sustainability and its continued contribution to economic development. The following suggestions will be effective in increasing the production level in the sector and thus contributing to the Turkish economy.

- Using modern fishing/processing technologies,
- Supporting R&D,
- Ensuring that fisheries resources are safeguarded for biological sustainability of stocks.
- Encouraging sustainable production for capture fisheries in seas and inland waters.
- More support to the producers in the sector in the financing and marketing stages
- Designing new regulations on product diversification and employment

Therefore, national and regional action plans need to be prepared to improve and sustain its economic performance and environmental sustainability with the contribution of an accurate management approach. Thus, the findings will contribute to raising the awareness of policymakers and development agencies. In this sense, we think the study findings will remind us of the need to reshape the industry in Türkiye towards an enhanced role in economic development. Future studies may explore the links between FP and GDP for different countries or regional groups. The increase in such studies will also contribute to the enrichment of the theoretical and empirical literature.

Highlights

Fisheries production has a significant effect on economic growth in Türkiye. Due to the increase in global demand for seafood, Türkiye will gain a crucial role in the industry in the next years. The policy-makers should increase their support for new investments especially to manage of fishery stocks in a sustainable manner for today’s and future generations.

Ethical Statement

This investigation does not involve human and animal data.

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Conflict of Interest

All authors declare that they have no conflict of interest.

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