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PRODUCTION AND ECONOMIC TRENDS OF SEABREAM AND SEABASS FARMING IN RELATION TO POPULATION GROWTH OF TÜRKİYE AND GREECE

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Abstract

The present study aims to evaluate production trends between Turkish and Greek marine aquaculture activities with focus on human resources by population growth. Both Türkiye and Greece are the main drivers of marine aquaculture industry in the southern European Seas according to FAO statistics, with a remarkable supply of marine fish to meet the growing food demand of the drastically increasing world population. In regards to growth trends and economic performance, human resources play an important role for the continuity of the sustainable development, and safety of the aquaculture industry. Two main fish species in production, namely Gilthead seabream (*Sparus aurata*) and European seabass (*Dicentrarchus labrax*) were used for the comparative evaluation of growth trends and value indices with superimposed figures on population growth over the last two decades from 2003 to 2023. Greek marine fish harvest increased by 1.54-fold between 2003-2023. The figure for the Turkish aquaculture showed 8.35-fold increase for the same time span. Even though Greece recorded 52.79% higher fish production in 2003 compared to the Turkish marine harvest, the latter supplied 34.84% higher fish harvest in 2023, compared to the Greek production. In regards to economic gains, Turkish production of seabream and seabass was 2.86-fold of the Greek production for the same species in 2023. The correlation between fish harvest yields and population growth for the Turkish aquaculture was remarkably strong (R= 0.938). Greece however demonstrated a negative correlation of R= -0.667 for the same variables investigated. The results of this study indicate that not only production volume but also human resources play a significant role in production gains. Besides a variety of factors influencing aquaculture production, human resources may create a rupture in a competitive environment, which is encouraged to be considered in the management and production planning of aquaculture enterprises.

Keywords: Greek aquaculture, Turkish aquaculture, economic trends, production, population

Introduction

Mediterranean aquaculture plays a significant role in meeting the growing demand for food in the world and holds an important position in the European market for aquaculture products (Papageorgiou et al., 2021). According to FAO statistics, Greece and Türkiye stand out as the major producers with the highest aquaculture harvest value among EU countries. Out of a variety of marine fish species, the gilthead seabream and European seabass are the main two species in the Mediterranean aquaculture supplied to the international market. In the Turkish aquaculture sector, total seabream and seabass production (314,813 tons) constitutes approximately 64% of total European production, while the amount for these two species harvested from Greek farms (109,674 tons) comprises around 22% of total European production (490,246 tons) (Food and Agriculture Organization, 2025a). The aquaculture industries of Greece and Türkiye produced more than 86% of the total seabream and seabass production in Europe in 2023. The proportional shares of Turkish and Greek aquaculture sector, in terms of production yields were estimated as 64% and 22%, respectively. Both the increase in the world population and the increasing awareness of the health benefits of fish consumption are leading to an increase in the demand for marine fish (Kidane and Brækkan, 2021; Lund, 2013). Although there are various searches to meet this increasing demand in the world, considering the state of fish stocks in the seas as a result of overfishing (Naylor et al., 2021), the rise of the aquaculture sector indicates that it will play an important role in eliminating this deficit.

In recent years, marine cage farms in the Mediterranean have been moved from sheltered coastal areas to the open seas and are in continuous development with the use resistant cage systems under harsh sea conditions in exposed open sea. Thanks to the developments of marine technologies, new equipment has been introduced in marine cage aquaculture in both Türkiye and Greece. However, it is stated that with the increase in aquaculture, especially the expansion of net cage systems to wider areas, issues such as environmental impacts need to be monitored more carefully and may bring new challenges for the human being (Martinez-Porchas & Martinez-Cordova, 2012). Among several factors affecting farm success, such as consumer preferences, labelling, packing, nutritional value of fish, of which the main factors influencing fish price are product quality and fish size (Maciel et al., 2013; Ike-Obasi, 2021). Further packaging, nutritional quality and the availability of the product on shelfs are important key issues affecting the price and market value of the product (Maciel et al., 2013). Therefore, marketing strategies along with product quality in combination with links to consumer confidences can result in increase of economic gains in the international market. However, human resources are a crucial issue that is often overlooked, and it is anticipated that the shortage of manpower will soon a challenging issue, especially in manpower-based food sectors like aquaculture, as earlier underlined Engle et al. (2019) and van Senten et al. (2020a,b), who addressed that human resources will be one of the biggest problems in the near future for the sustainable growth of the aquaculture sector, which plays an important role in meeting the increasing food demand.

As production capacities in fish farms continue to increase, the structural characteristics and volumetric dimensions of cage systems also increase. Therefore, visual technologies for monitoring fish within large cage volumes or electronic devices for water quality measurement are being used to monitor fish health and welfare, as well as farm safety. Blaalid (2008) underlined that visual control of fish in marine cages needs underwater vision as surface monitoring can be problematic in larger cage constructions. The author also noted that with eye-vision only 0.2% of the total cage volume might be observed in a cage with 100m diameter and about 160 m circumference. Greece and Türkiye the two key producers of Gilthead seabream and European seabass supply a remarkable amount for the international market and

there is a strong competition among these two main producers, striving for new market opportunities while protecting the present market position. Therefore, human resources may create a rupture in this competitive environment, that needs to be considered in production planning and management of the aquaculture enterprises.

This study focuses on production increase from marine aquaculture harvest of gilthead seabream and European seabass aquaculture in Greece and Türkiye, alongside the effects of human resources by population growth, an important indicator for the sustainable development of the Marine aquaculture industry in the Mediterranean.

Materials and Methods

Production in quantities of gilthead seabream and European seabass in Greece and Türkiye for the last two decades from 2003 to 2023 were obtained from FAO online statistical query panel (Food and Agriculture Organization, 2025a, b). Variables used in the study are given in means ± SD. Percent increase of production quantities has been estimated by the formulae given by Yigit and Kusku (2022), Yigit et al. (2023), and Yigit (2025):

$$PPI = \frac{(FYfh - IYfh)}{IYfh}\ x\ 100 \qquad (1)$$

PPI: percent production increase of fish in tons
FYfh: fish harvest of final year in tons
IYfh: initial year fish harvest in tons

$$PGR = \frac{(Pfin - Pini)}{Pini}\ x\ 100 \qquad (3)$$

PGR: relative population growth
Pfin: initial population
Pini: final population

Statistical analyses

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:

$$Correl\ (X,Y) = \frac{\Sigma(x - \bar{x})(y - \bar{y})}{\sqrt{\Sigma(x - \bar{x})^2\ \Sigma\ (y - \bar{y})^2}} \qquad (4)$$

where, $\bar{x}$ and $\bar{y}$ represents the sample mean values for the two different series, set as annual production increase for Serie 1, and annual population increase in the investigated countries for Serie 2.

Results and Discussion

Gilthead seabream and European seabass are the main two species cultured in marine fish cage systems in the Mediterranean according to FAO statistics. In the Turkish aquaculture, the production quantity of these species together comprises 64.22% of the European production

with accounts for 314,813 tons, whereas Greek harvest of these species' accounts for 22.37% of the total production in Europe, that stands for a yield of 109,674 tons, out of the total European harvest of 490,246 tons in 2023 (Food and Agriculture Organization, 2025a). Greece and Türkiye together produced more than 86% of the total European production of seabream and seabass in 2023. The share between the two main producers was 64.22% and 22.37% for Türkiye and Greece, respectively (Figure 1).

In 2003, seabream and seabass production in Greece aquaculture was 52.79% higher compared to the Turkish production. In 2008 however, the harvest yields almost equalized with 86,993 tons supply from Greece and 80,940 tons from Türkiye, which showed a continues increase over the following years, with nearly 2-fold higher yield (53.26%) compared to the Greek production in 2018, and 34.84% higher harvest than the Greek production in 2023. These declines may have been due to disruptions in the market chain. The closures and lock-downs, particularly during the COVID-19 pandemic, may have disrupted the trade network. Further, conflict between Ukraine and Russia may have also caused market contraction. This however needs further clarifications with detailed assessments. The production increase of seabream and seabass over the last two decades were recorded as 53.52% and 734.67% for the Greek and Turkish harvest, respectively (Figure 1). The total production of seabream and seabass as a total of Greek and Turkish production compiled, has been compared with the total European production of these two species, and the trends are given in Figure 2.

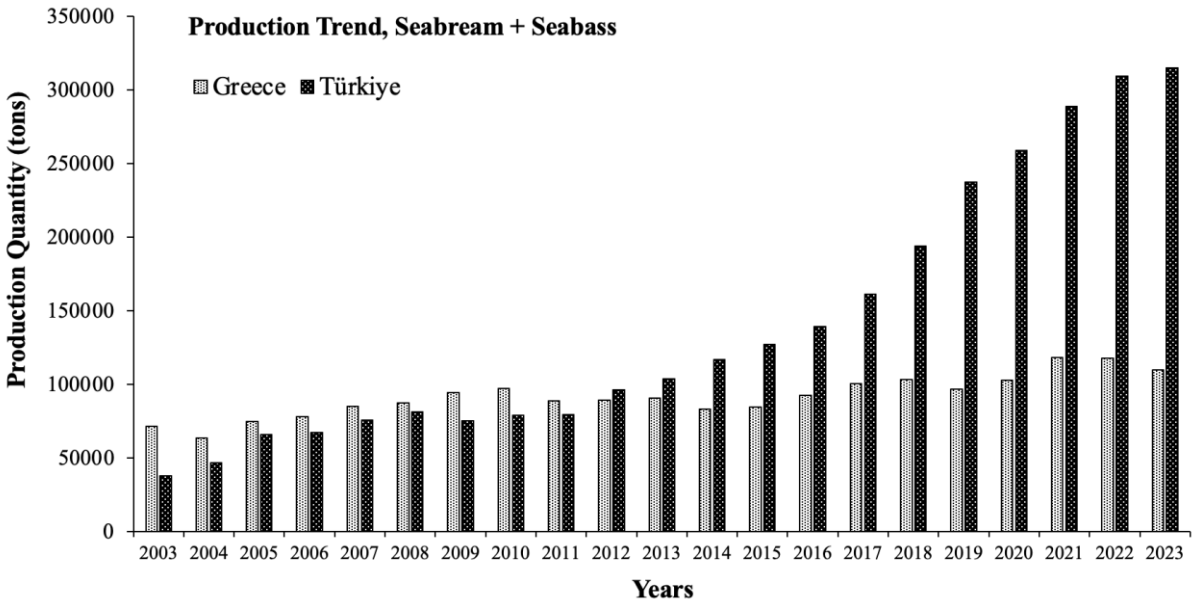

Figure 1. Production trend of gilthead seabream + European seabass, 2003-2023. Figure has been produced from data provided by the Food and Agriculture Organization (2025a)

The economic gain from seabream and seabass production in both Greece and Türkiye over the last two decades, is shown in Figure 3. The production value of seabream and seabass produced in Greece was 55.49% higher than the economic return that Turkish fish farms gained in 2003.

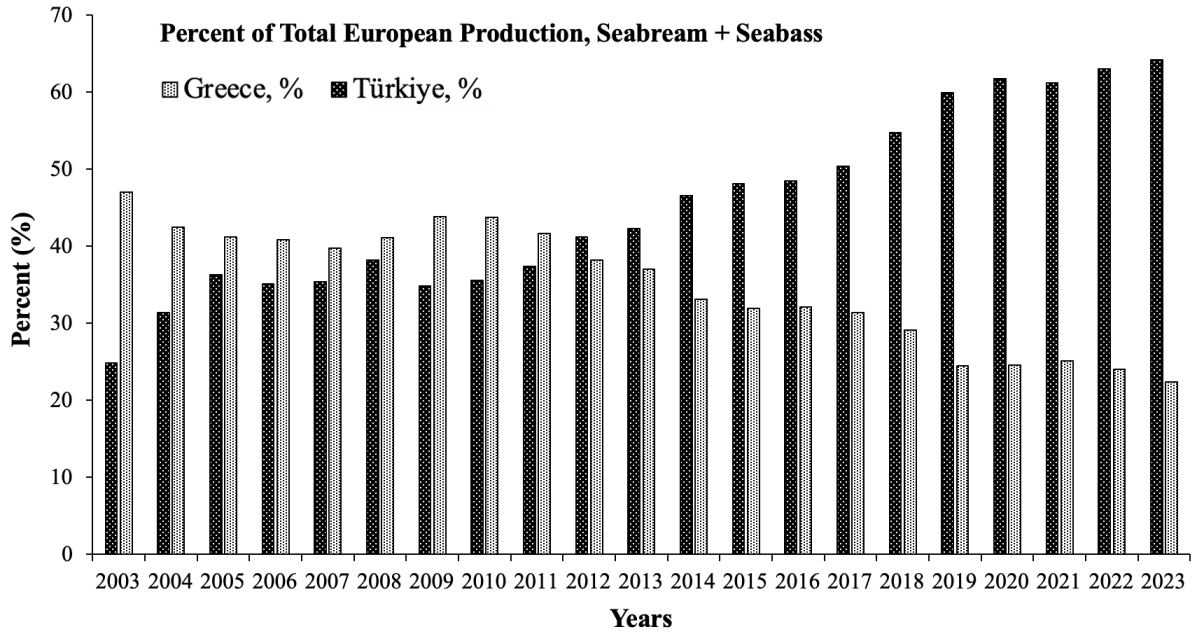

Figure 2. Percent of total European seabream + seabass production, 2003-2023. Figure has been produced from data provided by the Food and Agriculture Organization (2025a)

Considering the drastically growth of the Turkish aquaculture, the catch-up occurred in 2012 and the Turkish aquaculture surpassed Greek aquaculture in terms of economic gains over the following ten years and reached a value of US$ 1,867,703.52, that is 35% higher economic income compared to the Greek economic return of US$ 653,967.62 in 2023 (Figure 3).

In 2003, the economic return on the market from seabream and seabass fish marketed from Greek farms was 39.2% higher than the economic return from the same fish species in Türkiye. In subsequent years, economic return in Türkiye increased, reaching a value 43.7% higher than that of Greece in 2023. Despite some fluctuations over the last 20 years, the overall increase in economic return was 1.53 times for Turkish production and 0.53 times for Greek production. Between 2003 and 2023, economic return increased alongside the increase in production on Greek and Turkish farms. This can be interpreted as an indicator of the continued upward trend in demand in the international market.

It has been reported that low production cost, low distribution and logistics costs, and improved production technologies has boosted the success of aquaculture with the actual prices presently lower than one-third compared to 25 years ago for salmon and shrimp (Asche, 2015). This phenomenon was also reported for the Turkish salmon production, where higher value increase (10-fold) was reported with lower quantity growth (6.6-fold) during the past 27 years (Yigit et al., 2023). However, this phenomenon was not seen in the Greek and Turkish seabream and seabass operations, which have shown consistent increases in both production yields and values during the past 20 years (Figure 1 and 3).

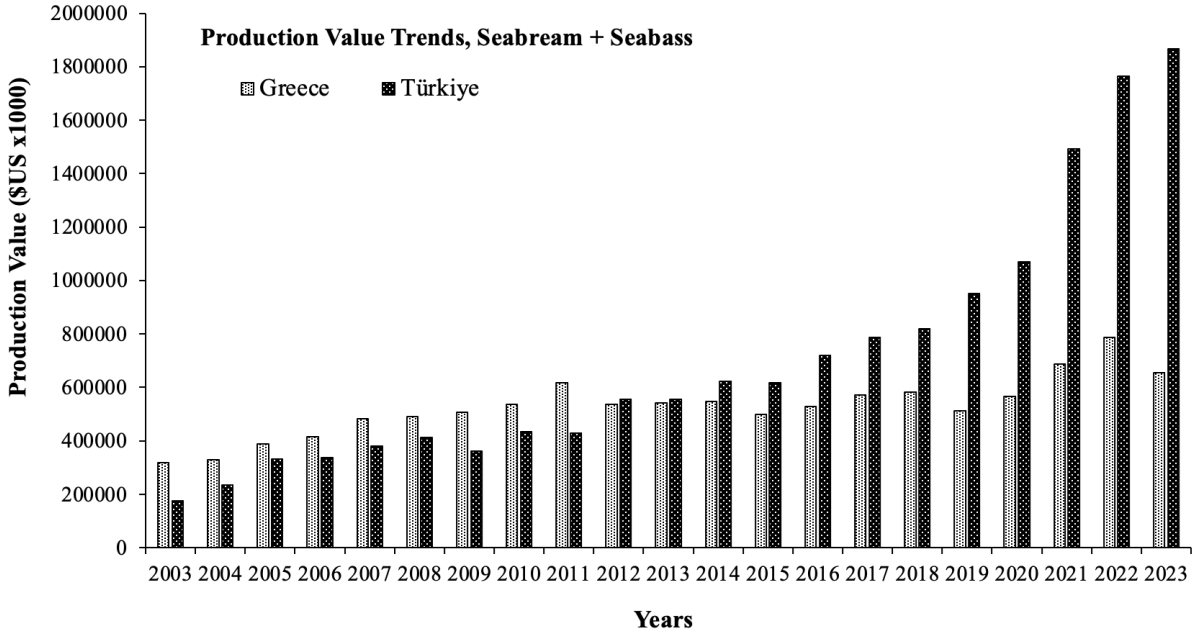

Figure 3. Production value of gilthead seabream + European seabass (2003-2023). Figure has been produced according to data provided by FAO (2025b).

In 2003, the proportional distribution of the total production value from the harvest of both seabream and seabass in European countries ($US 760,893,870) between Greece and Türkiye was 41.8% and 23.19%, respectively. Along with the remarkable production increase in Turkish aquaculture, this situation reversed in 2023, and 21.69% of the total production value in Europe ($US 3,015,489,830) was obtained from farms in Greece, while 61.94% of the total production value in Europe was brought to the Turkish economy (Figure 4).

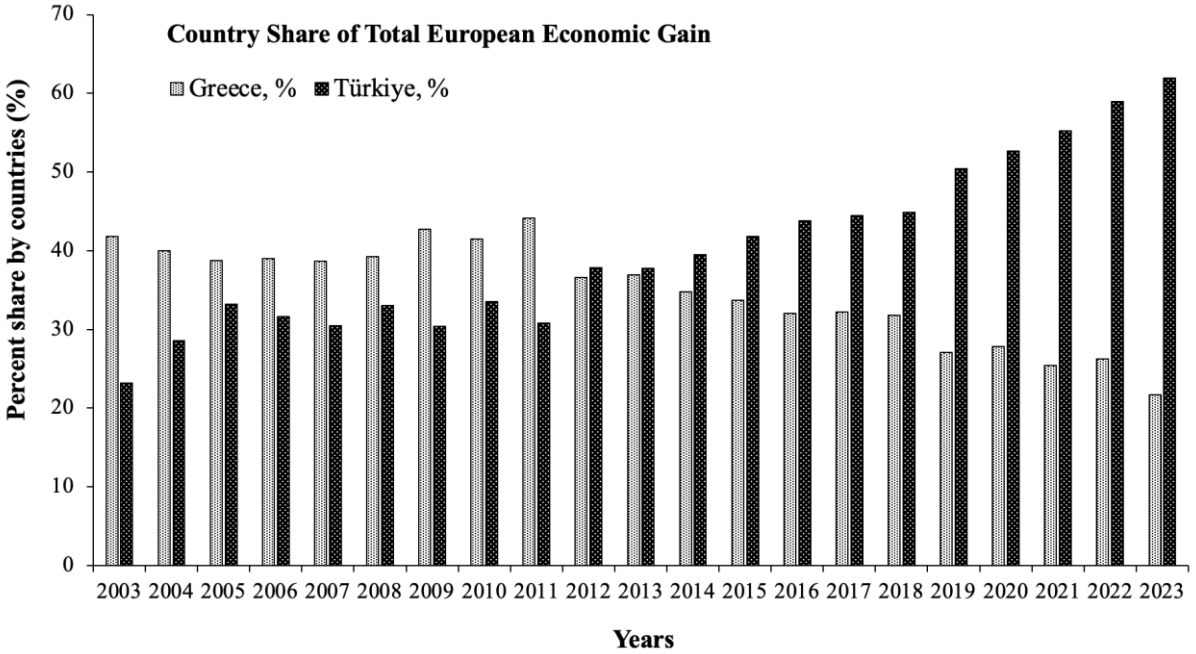

Figure 4. Percent share of total European production by Türkiye and Greece for Gilthead seabream + European seabass (2003-2023). Figure has been produced according to data provided by FAO (2025b).

The continuous increase in the production value of seabream and seabass produced in Türkiye and Greece indicates high consumer demand and market confidence in Turkish and Greek fish. This is consistent with the relationship between increased trust and demand and price increases noted by Mutambuki (2014). Mutambuki (2024) states that a high market share of a well-known and trusted brand triggers the perception of superior quality among consumers, which plays a significant role in consumer preferences. In this context, exporting countries with already high market shares can be considered to be in a stronger position to set prices for their products, relying on brand equity. This is consistent with Feucht and Zander (2017), who noted that consumer preferences in European countries tend to pay a higher price for high-quality fish, and this is directly related to sustainable production practices.

Evaluating the population growth rates in both countries over the past two decades, Greek population was reported as 10,918,471 in 2003, that over the years declined by 6.19% to 10,242,908 in 2023. On the contrary, Turkish population increased from 78,750,201 to 87,270,501 between 2003-2023, showing a 28.66% increase.

While the average age of Turkey's population is 33.5, in Greece it is 46.8. This suggests that the Turkish population is younger than the Greek population and may be more likely to be employed in the aquaculture sector, particularly in the coming years (Worldometer, 2025a, b) (Figure 5).

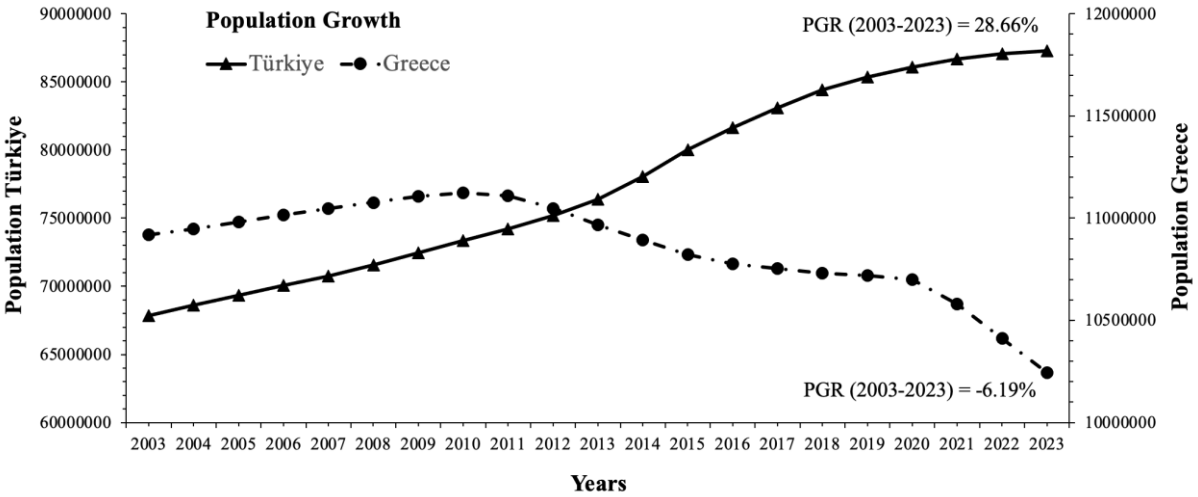

Figure 5. Population increases in Greece and Türkiye (2003-2023). Figure produced using data provided by Worldometer, 2025a, b). PGR: population growth rate.

The fact that Turkey's population is expected to be approximately 8.5 times larger than Greece's in 2023, and that the proportion of young people is particularly high, is considered a significant advantage for the sustainability of the aquaculture industry. Manpower is one of the most important factors affecting the success of the aquaculture business, and the lack of human resources recently has been underlined as a challenging matter for fish farms globally (Engle et al., 2019; van Senten et al., 2020a, b). Yigit (2025) also underlined that a rupture in the production trends, because of either limited human resources or disruptions in trade chain can severely influence economic indicators of the aquaculture business. Therefore, a broader selection of well-educated and experienced personnel, and the attraction of young people,

particularly, to the aquaculture sector, are also seen as promising for the future of the Turkish aquaculture industry.

In regards to the correlation between the production quantity trends and human population growth over the last two decades from 2003 to 2023, a strong correlation has been noted for Türkiye (R= 0.93841616), whereas a negative correlation was found for Greece (R= -0.66671143) (Figure 5), an indication that the increase of fish production in the Turkish aquaculture is strongly related to the population growth of the country, that is in agreement with earlier reports of Yigit and Kusku (2022) and Yigit (2025). Interestingly however, a negative correlation was found for Greece, an indicating that the relationship between the two variables investigated here moved in opposite directions, with one showing an increase while the other variable presenting an increasing trend.

In earlier investigations, it was underlined that populations with high mean age rates may lose enthusiasm and excitement for nature-related work environment, particularly in industrialized and developed countries (Erwin & Richard, 2002). Findings in the present study is in line with earlier reports of Yigit and Kusku (2022) and Yigit (2025), who noted that countries with increasing populations may have higher opportunities for the selection of young employees in nature-linked work environments such as fish farms, as it was addressed for the Turkish aquaculture development. Considering the high average age in Greece, however, it can be predicted that the increase in Greek aquaculture production may face long-term challenges with manpower concerns. Further investigation on these conditions is encouraged with focus on food safety indices and indicators, that is believed to influence the Mediterranean aquaculture developments in the future.

Conclusions

In conclusion, the production increase is dependent on a variety of factors, such as marketing and branding strategies, technological developments, feed quality and costs, political support, education level, etc., among which however human resources are most overlooked and need to be considered for the continuous development of the aquaculture industry, particularly in sectors relying on manpower. Considering the lack of manpower, a challenging issue for the future of the aquaculture sector, human resources by population growth is suggested to be considered in the management and planning strategies to ensure sustainable growth of the aquaculture industry in the future.

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.

Funding organizations

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Contribution of authors

Ümüt Yigit: Conceptualization, methodology, resources, data curation, analysis, writing original draft, finalizing paper.

References

Asche, F. (2015). Green Growth in Fisheries and Aquaculture Production and Trade. OECD Report, Green Growth Studies. Accessed on 2 May, 2015. https://www.oecd.org/greengrowth/sustainable-agriculture/48258799.pdf

Blaalid, G. E. (2008). Når notveggen er like stor som en fotballbane (When the net wall has got the size of a football ground). *Norsk Fiskeoppdrett, 33*(11), 28-30 (in Norwegian).

Engle, C. R., van Senten, J., & Fornshell, G. (2019). Regulatory costs on U.S. salmonid farms. *Journal of the World Aquaculture Society, 50*(3), 522-549. https://doi.org/10.1111/jwas.12604

Erwin, H. B., & Richard, D. H. (2002). Does Human Population Growth Increase Wildlife Harvesting? An Economic Assessment. *The Journal of Wildlife Management, 66*(3), 574-580. https://doi.org/10.2307/3803125

Feucht, Y., & Zander, K. (2017). Results on consumer preferences for sustainable seafood products from Europe. H2020 SUCCESS project, Deliverable 2.2. www.thuenen.de/media/institute/ma/Downloads/SUCCESS_D2.2.pdf

Food and Agriculture Organization (2025a). Food and Agriculture Organization (FAO-UN). Fisheries and Agriculture Statistical Query Panel. Global aquaculture production (Quantity). Accessed on 28 October 2025. https://www.fao.org/fishery/statistics-query/en/aquaculture/aquaculture_quantity

Food and Agriculture Organization (2025b). Food and Agriculture Organization (FAO-UN). Fisheries and Agriculture Statistical Query Panel. Global Aquatic trade – all partners aggregated (Value). Accessed on 29 October 2025. https://www.fao.org/fishery/statistics-query/en/trade/trade_value

Ike-Obasi, J. C. (2021). Factors Influencing Market Price of Fish in Obio-Akpor Local Government of Rivers State, Nigeria. *International Journal of Innovative Studies in Aquatic Biology and Fisheries, 7*(1), 26-30. http://dx.doi.org/10.20431/2454-7670.0701004

Kidane, D. G., & Brækkan, E. H. (2021). Global seafood demand growth differences across regions, income levels, and time. *Marine Resources and Economics, 36*, 289–305.

Lund, E. K. (2013). Health benefits of seafood; is it just the fatty acids? *Food Chemistry, 140*, 413–420.

Maciel, E. S., Savay-Da-Silva, L. K., Vasconcelos, J. S., Sonati, J. G., Galvão, J. A., Lima, L. K. F., & Oetterer, M. (2013). Relationship between the price of fish and its quality attributes: a study within a community at the University of São Paulo, Brazil. *Food Science and Technology, Campinas, 33*(3), 451-456. http://dx.doi.org/10.1590/S0101-20612013005000059

Martinez-Porchas, M., & Martinez-Cordova, L. R. (2012). World aquaculture: environmental impacts and troubleshooting alternatives. *Scientific World Journal*, 389623.

Mutambuki, M. K. (2014). Marketing strategies of. Commercial fish farming under economic stimulus programme (ESP) in Kenya: a case of Kitui County. Master of Business administration of Kenyatta University, Nairobi (D53/CE/26507/2011). Accessed on 03 May 2023. https://ir-library.ku.ac.ke/bitstream/handle/123456789/10220/Marketing%20strategies%20of....pdf?sequence=1&isAllowed=y

Naylor, R. L., Hardy, R. W., Buschmann, A. H., Bush, S. R., Cao, L., Klinger, D. H., Little, D. C., Lubchenco, J., Shumway, S. E., & Troell, M. (2021). A 20-year retrospective review of global aquaculture. *Nature, 591*, 551–563.

Papageorgiou, N., Dimitriou, P. D., Moraitis, M. L., Massa, F., Fezzardi, D., Karakassis, I. (2021). Changes of the Mediterranean fish farm sector towards a more Sustainable approach: a closer look at temporal, spatial and technical shifts. *Ocean & Coastal Management*, 214. https://doi.org/10.1016/j.ocecoaman.2021.105903.

van Senten, J., Engle, C. R., & Smith, M. (2020b). Impacts of COVID-19 on U.S. aquaculture, aquaponics, and allied businesses. *Journal of the World Aquaculture Society, 51*(3), 571-573.

van Senten, J., Engle, C. R., Hudson, B., & Conte, F. S. (2020a). Regulatory costs on Pacific coast shellfish farms. *Aquaculture Economics & Management, 24*(4), 447-479. https://doi.org/10.1080/13657305.2020.1781293

Worldometer (2025a). Population growth, Greece. World population info. Accessed on 29 October 2025. https://www.worldometers.info/world-population/greece-population/

Worldometer (2025b). Population growth, Türkiye. World population info. Accessed on 30 October 2025. https://www.worldometers.info/world-population/turkey-population/

Yigit, Ü. (2025). Competitive trends of Atlantic bluefin tuna farming among major Mediterranean producers, with special emphasis on human capacity by population growth. *Marine Reports*, https://doi.org/10.5281/10.5281/zenodo.17477669

Yigit, Ü., & Kusku, H. (2022). Comparison of production trends in Japan with long history in aquaculture and challenging success of Türkiye as a fairly new country in fish farming. *Marine Reports*, *1*(2), 99-109. https://doi.org/10.5281/zenodo.7393998

Yigit, Ü., Yigit, M., Ergün, S., Sanver, F., & Taylor, N. (2023). Competitive economic trends of Steelhead farming in Türkiye and Norway: Economic competition of Steelhead farming. *Marine Reports, 2*(1), 16–25. https://doi.org/10.5281/zenodo.8050627