ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΕΙΡΑΙΩΣ
UNIVERSITY OF PIRAEUS

ECONOMIC IMPACTS OF GREEK FINFISH FARMING

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- Specialist in the Council of Europe and the European Union as Head of Strategic Planning and Branding for Cultural Tourism.
- Head of the Greek Project Team of the European Union & Ministry of Tourism for Tourism Education in Greece (Greek Component Leader).
- Special Adviser: Ministry of Tourism, Ministry of Marine and Island Policy, Ministry of Health, etc.
- Design professional tourism education programs and teaching of over 5500 tourism professionals for professional organisations (INSETE, EEDE)

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Contents

Executive Summary

This report assesses the economic impacts of the aquaculture sector in Greece, focusing on finfish farming—primarily sea bream and sea bass. Overall, the sector demonstrates **limited macroeconomic contribution**, **stagnant employment**, **low innovation**, and **growing environmental conflicts**—raising serious questions about its long-term viability as a strategic sector of the blue economy. In purely economic terms, the sector's impact is marginal. In 2023, aquaculture contributed a mere **0,35% to Greece's Gross Value Added (GVA)**—a minor increase from 0,31% in 2015, yet a sharp drop from 0,46% in 2022. This volatility underscores its **vulnerability to external shocks**, including **global price fluctuations**, **rising input costs**, and **export dependence on a narrow species base**.

Export performance, once a strength, has stagnated: although volumes of sea bream and sea bass have increased, their **share in total Greek exports has declined** both in volume (from 0,32% in 2010 to 0,28% in 2022) and in value (from 1,75% to 1,23%), suggesting **competitive erosion** and **failure to scale or diversify** meaningfully.

The sector's **employment footprint is shrinking**. Between 2002 and 2023, total employment in aquaculture fell by **1,13%**, while **national employment rose by over 13,58%**. Even marine aquaculture, the core of the industry, showed only a below-the-national-average increase in percentage (+7.08%), which not only is small in absolute numbers (241 jobs) but also is dwarfed by strategic sectors such as tourism, which added over **1,3 million new jobs in the same period (over 1,6 million people in 2023 from 250.738 people in 2002)**.

Aquaculture's share in national employment remains negligible, hovering at **0,08%–0,10% during the period 2002-2023**, with **little spillover to local economies**, despite **substantial public subsidies**. Given the employment multiplier (18 jobs per €1 million in final demand), the **lack of employment gains decline in employment (−1,13% during the 2002–2023 period) suggests policy and investment inefficiencies**. In detail, despite the fact that the aquaculture sector has received significant subsidies in recent years, the observed **decline in employment (−1,13% during the 2002–2023 period) reveals a failure to convert funding into real socio-economic benefit**.

Business dynamism is also in decline, driven by consolidation through mergers and acquisitions. While vertical integration may improve cost efficiency, it undermines **local entrepreneurship, weakens rural supply chains**, and centralizes economic benefits—limiting inclusive regional development. Despite EU and national incentives, **species diversification, product innovation**, and **adoption of sustainable practices** remain minimal.

Social indicators further highlight the sector's **limited inclusiveness and knowledge intensity**. Women remain **underrepresented**, and only **18,44%** of aquaculture employees hold higher education degrees—well below the national average of 39,25% (2022). This education gap reinforces the sector's **low innovation and knowledge potential** and deters high-skill workforce entry. Furthermore, aquaculture monthly wages consistently trail the national average, with the gap **widening from**

€472 in 2012 to €587 in 2021, signaling a **deteriorating position for workers** and making the sector unattractive to new talent.

On the **environmental** front, **the costs are profound**. Finfish aquaculture contributes to **marine pollution, eutrophication, antibiotic and chemical use, spread of disease, and genetic risks from fish escapes**. These impacts **violate key EU environmental frameworks** such as the **Marine Strategy Framework Directive**, and they clash with climate resilience goals as warming seas and extreme weather compound operational risks and costs.

Crucially, **aquaculture increasingly competes with high-value tourism for coastal space**, particularly in mature destinations. Aquaculture installations—often located in pristine coastal areas that are core to the tourism product—can **undermine the aesthetic appeal**, **limit beach and marine access**, and **generate visual pollution**, thus reducing the attractiveness of destinations to high-value international visitors. Moreover, aquaculture-induced **environmental degradation**—such as **water turbidity**, **odor issues**, **algal blooms**, and **damage to marine biodiversity**—directly threatens the **natural capital** on which many tourism regions depend, particularly those promoting eco-, marine-, or wellness tourism. In several coastal communities, this **land-use conflict** has already led to tensions between fish farms and local stakeholders who rely on tourism for livelihoods. As the tourism sector is a **key pillar of the Greek economy**, it is essential to critically assess how aquaculture, particularly **finfish farming**, may **negatively affect tourism competitiveness**. In policy terms, promoting finfish aquaculture without a spatially integrated and environmentally sensitive marine planning framework risks **eroding the comparative advantages** of Greek coastal destinations. This trade-off is especially problematic in mature or saturated areas, where tourism yields are significantly higher than aquaculture, both in **direct income** and **multiplier effects**. As such, continued expansion of aquaculture without clear zoning regulations and sustainability safeguards could **undermine Greece's broader strategic objectives**, including the goal of transitioning to **high-value, low-impact tourism** and achieving a **resilient, green, and inclusive coastal economy**.

*In conclusion, while finfish aquaculture has long been presented as a driver of export-led growth, **its real-world contributions are underwhelming**, with **limited economic returns**, **minimal employment**, **low innovation**, and **high environmental and social costs**. Its future expansion should therefore be treated with **caution and scrutiny**. Public policy must shift focus toward a **more balanced, diversified, and resilient blue economy**, emphasizing **low-impact sectors**, **knowledge-driven innovation**, **robust environmental safeguards**, and **inclusive coastal governance**, in line with **EU Green Deal priorities** and the **Just Transition Agenda**.*

Chapter 1: Introduction

Aquaculture is the general term for all types of organized rearing, feeding, propagation or protection of aquatic resources for commercial, recreational or public purpose regardless of the type of water (marine, fresh water, brackish) and inclusive of multiple types of fish (salmon, sea bream, sea bass, trout, etc.) as well as shellfish (salmon, bivalves, etc.) and even plant life (such as algae and sea kelp). Mariculture is the term that is used to refer to the same types of activities but is limited to marine and brackish environments[1].

Providing clear definitions and terminology in the aquaculture sector is important because government, private, public and non-governmental sectors are increasingly using a diversity of aquaculture approaches to achieve diverse outcomes. Misinterpretation, confusion and conflict between terms used in different regulatory contexts can lead to failure of policies and intended outcomes, and in some case, litigation (Czarnezki[i] et al., 2020)[2].

In Greece, aquaculture is composed of three main sub-sectors: (1) marine aquaculture (finfish and mussels), which accounts for approximately **97,8%** of the country's total production in 2023; (2) freshwater aquaculture (mainly trout, carp, and eel), representing **1,7%**; and (3) aquaculture practiced in lagoons (production of eels and mullets), accounting for the remaining **0,5%**.

While this report aims to assess the economic impact of **finfish aquaculture**, it is important to note that **granular statistical data disaggregated specifically for finfish alone** is **not consistently available** in national databases. Therefore, in sections where disaggregated finfish data is lacking, we refer to the **overall aquaculture figures** (marine and freshwater), accompanied by **proportional estimates** (e.g., finfish aquaculture represents **87,2% of total aquaculture volume** and **98,1% of value** in 2023). We explicitly acknowledge these limitations and ensure full transparency by incorporating appropriate caveats in the executive summary, methodology, and relevant data tables to avoid misinterpretation.

1.1 The role of the aquaculture sector at the international and European level

Aquaculture constitutes one of the fastest growing food production sectors in the world. During the last decade (2010–2019) there was a 54 % increase in aquaculture production. In 2022, aquaculture production globally reached a new record of 130,9 million tons, valued at USD 313 billion and comprising 94,4 million tons of aquatic animals and 36,5 million tons of algae. Ten countries around the world (China, Indonesia, India, Vietnam, Bangladesh, Philippines, Republic of Korea, Norway, Egypt and Chile) produced 89,8% of the total aquaculture production.

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[1] FAO (2018). The State of World Fisheries and Aquaculture 2018: Meeting the Sustainable Development Goals. United Nations Food and Agriculture Organization; 2018

[2] Czarnezki JJ, Homant A, Jeans M. Greenwashing and self-declared seafood ecolabels. Tulane Environ Law J. 2014;28(1):37-52, Newton P, Civita N, Frankel-Goldwater L, Bartel K, Johns C. What is regenerative agriculture? A review of scholar and practitioner definitions based on process and outcomes. Front Sustain Food Syst. 2020. Collection;4:577723. doi:10.3389/fsufs.2020.577723

In Europe, aquaculture plays a vital role in its economic growth. In 2020, the EU aquaculture sector reached 1,2 million tons in sales volume and €3,9 billion in turnover value and directly employed around 57.000 people working for approximately 14.000 enterprises.

Moreover, 67% of the aquaculture production[3] in the EU is concentrated in four countries: France, Greece, Spain, and Italy. More than half of the total aquaculture production volume focuses on shellfish, while marine and freshwater fish account for around 21% and 28% of the total volume. The most farmed species are mussels, trout, oysters, sea bream, seabass, carp, and tuna.

From a strategy perspective, aquaculture is one of the key pillars of the "Blue Growth Strategy". Sustainable Blue Growth aims at achieving the objective of the "European Green Deal", the EU's new growth strategy, which is to stimulate the economy and create jobs, while accelerating the green transition in a cost-effective way.

Both the "European Green Deal" and the "Farm to Fork Strategy" highlight the potential of aquaculture as a low-carbon source of protein for food and feed, which can contribute in a significant way to a sustainable food system. Aquaculture also creates jobs and economic development opportunities in coastal and rural communities.

The recently revised EU Strategic Guidelines for a more sustainable and competitive aquaculture in the EU for the period 2021-2030, aim at forming the shared vision of EU Member States and all these sector’s stakeholders for the evolution of the aquaculture industry in the EU furnishing the new EU growth strategy of the European Green Deal. Achieving this vision will require addressing different challenges and opportunities of the EU aquaculture sector to accomplish the following interrelated objectives:

- *Building resilience and competitiveness*
- *Participating in the green transition*
- *Ensuring social acceptance and consumer information*
- *Strengthening knowledge and innovation.*

According to the above-mentioned objectives, sustainable aquaculture in the EU can play a pivotal role in providing public goods, including: i) nutritious and healthy food with a limited environmental footprint, ii) economic development and employment opportunities for coastal and rural communities, iii) pollution reduction, iv) conservation of ecosystems and biodiversity, and v) contribution to combating climate change[4].

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[3] Spain, France, and Italy are among the top aquaculture producers in the EU, and a significant portion of their production is indeed focused on bivalves, especially species that contribute to filtering and cleaning marine water.

[4] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52021DC0236

Furthermore, the latest version of the Common Fisheries Policy (CFP) concludes that aquaculture has a prominent position and the coordinated promotion of the development of European aquaculture is a key priority, ensuring the economic, environmental and social sustainability of the sector.

1.2 The role of the aquaculture sector in Greece

Aquaculture constitutes an evolving sector of Greece's primary sector[5], representing a major share of national seafood production. Factors, like the favorable environmental and climatic conditions, the availability of adequate sea and inland areas, the existing infrastructures and the skilled human resources, highlight aquaculture as one of the key productive sectors in Greece.

According to the "Multi-annual National Strategic Plan for the development of Sustainable Aquaculture for the period 2021 to 2030" Greek aquaculture concerns the breeding of aquatic organisms in marine (saltwater), freshwater, as well as in brackish (fluctuating salinity) waters (lagoons).

Regarding marine **(saltwater) fish farming**, Greece is the largest producer of sea bream and sea bass in the EU and a leading force in the wider Mediterranean region. Apart from the large production volume, marine fish farming has the best organization at all levels, compared to the other sectors of aquaculture. The vertical integration of production of the main marine fish farming enterprises is particularly noted (artificial reproduction, hatching, fry, marketing, etc.).

In Greece, marine fish farming presents a modern organizational structure of enterprises and it is the only sector of the aquaculture that collects systematic production data in a systematic way, as well as other data (economic, employment, imports-exports, etc).

Marine fish farming began to develop in the 1980s. Specifically, 12 fish farming units were operating in 1985 having a total production of 100 tons of fish. Almost 40 years later (2019), 302 marine fish farming units were operating with a total production of 105.800 tons of fish.

Enterprises of marine fish farming faced many problems, due to the economic crisis and the COVID-19 pandemic (selling prices of products, accumulated financial obligations to banking institutions, inability to access loans to cover working capital, etc.), which led to the need for restructuring of a large part of the sector.

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[5] The primary sector in Greece refers to the part of the economy involved in the exploitation of natural resources. It includes 3 main sub-sectors 1) Crop and animal production, hunting and related activities, 2) Forestry and logging and 3)Fishing and aquaculture.

Freshwater aquaculture is not particularly developed in Greece due to the low availability of freshwater in the country. However, it constitutes a particularly important economic sector for certain mountainous areas of the mainland. The main species of this sector are trout, eel, carp, salmon, mullet and spirulina.

Regarding the **brackish aquaculture (in lagoons)**, 70 public fish farms/lagoons are leased, extensive aquaculture dominates, whereas priority is given to fishing partnerships. They are considered among the most productive aquatic ecosystems for high commercial value fish, whereas their exploitation contributes greatly to their protection and conservation.

1.3 Positive and Negative Impacts of the Aquaculture Sector Globally

Like any industry, aquaculture has advantages (economic benefits and employment opportunities, while ensuring food quality) but also negative impacts. The following categories of positive and negative impacts are mentioned below:

- Economic Impacts
- Social Impacts
- Environmental Impacts
- Impacts on Tourism and Local Communities.

1.3.1 Economic Impacts

Employment and Gross Domestic Product Contribution
Millions of people are employed globally in the aquaculture industry, which makes up a substantial portion of the GDP of many nations (Erol, 2022). In 2022, 51% (94 million tons) of aquatic animals produced was from aquaculture and 49% (91 million tons) from capture fisheries. Additionally, compared to 2000, total aquaculture production has increased by 191%. Furthermore, approximately 22.1 million people (up 97% from 1995) were employed globally in the aquaculture industry that year, accounting for roughly 35% of all jobs in fisheries and aquaculture (FAO 2024).

Investment and Economic Diversification
Significant investment is drawn to the aquaculture industry, which promotes economic diversification. Investments in the aquaculture sector can boost other businesses like feed production and aquaculture technologies, which can boost the whole economy. Moreover, increasing the variety of species cultivated, creating new production methods, and incorporating value-added pursuits like processing, packaging, and ecotourism are all components of economic diversification. Traditional aquaculture has often focused on a few high-value species, but diversification into new species, such as seaweed, shellfish, and freshwater fish, can lower risks related to market fluctuations, diseases, and environmental challenges (Chan et al., 2024; Cai, 2023).

Price Fluctuations and Market Volatility
Because of factors like overproduction and shifting customer demand, aquaculture is extremely vulnerable to market swings. Price reductions brought on by an excess of farmed seafood may have an impact on small-scale farmers' profitability. Furthermore, farmers may experience financial instability as a result of price fluctuation in international aquaculture markets (Dahl, 2017; Asche and Dalh, 2015).

Economic Disruptions in Traditional Fisheries
The expansion of large-scale aquaculture can affect traditional fishing by reducing their access to marine resources. Small-scale fishers in developing countries often compete with industrial aquaculture units and this fact leads to job losses (Herrera-Racionero et al., 2020).

Initial Investment Capital and Financial Risks
High initial capital expenditures are needed for aquaculture's feed, infrastructure, technology, and disease management. Small-scale farmers find it challenging to enter the market and maintain operations as a result of this financial load. Farmers may accumulate debt as a result of high startup and operating costs, especially in developing nations with restricted finance availability (Luna et al., 2023; Kleih et al., 2013).

Disease Shocks and Economic Losses
As disease outbreaks in aquaculture systems lower output and raise treatment and biosecurity costs, they can result in enormous financial losses. Disease-related aquaculture losses can have a substantial impact on local economies that rely on aquaculture in a number of ways (Fernández Sánchez et al. 2022; Bouwmeester et al. 2021; Asche et al. 2018;).

1.3.2 Social Impacts

Enhancing Social Resilience
Aquaculture can improve community resilience by fostering the growth of social capital. It has been demonstrated that community-based aquaculture projects (depending on the type) empower local people, improve community relationships, and offer social advantages beyond financial gains (Engle and van Senten, 2022).

Human Rights Abuses and Displacement of Local Communities
Local communities may be displaced as a result of large-scale aquaculture facilities, in contrast to the effects mentioned above. Coastal areas are frequently converted as aquaculture grows, which can cause local inhabitants to lose their land and means of subsistence. This displacement disturbs social structures and cultural customs in addition to having an impact on economic stability (Allsopp et al., 2008). Moreover, an investigation shows how consumers buying fish in the UK are playing a role in food insecurity and unemployment in Senegal (https://www.theguardian.com/ environment/ 2025/ may/22/the-hidden-cost-of-your-super market-sea-bass).

Poor Working Conditions and Gender Inequalities
Aquaculture workers endure low pay, long hours, and hazardous working conditions, especially in developing nations. Workers' social standing and quality of life may suffer as a result of this abuse, which can lead to a vicious cycle of vulnerability. Furthermore, there are notable gender disparities in the aquaculture industry despite the fact that women play a big role in it. In particular, there are still gender disparities in the industry, such as income differences, undervaluation of women's contributions, gender-based violence, etc. (Elias et al. 2024; FAO 2024; Brugère et al. 2023; Salazar et al. 2023).

1.3.3 Environmental Impacts

Habitat Restoration and Conservation
It has been examined that seaweed aquaculture can lead the way towards the restoration and conservation of marine ecosystems as it has the ability of lowering carbon and improve water quality by filtering water, absorbing excess nutrients, providing habitat for marine species and thus mitigating the effects of climate change (Duarte et al., 2017).

Sustainable Resource Utilization
Advancements in integrated multi-trophic aquaculture (IMTA) systems allow more efficient resource use by combining species that utilize different levels of food chains. This reduces waste accumulation and at the same time enhances sustainability (Troell et al., 2009). It has been observed that Greek aquaculture causes local environmental changes, including changes in sediment composition and impacts on benthic communities. These changes can affect the ecological balance of coastal areas. (Klaoudatos et al., 2014).

Water Pollution, Eutrophication and Chemical Use
Extreme aquaculture production may cause water pollution (by uneaten fish species), harm the underwater food chains and release chemicals leading to nutrient enrichment. This phenomenon known as eutrophication, can cause harmful algal blooms, deplete oxygen levels, and result in fish kills. Studies have shown that nutrient inputs from aquaculture can significantly increase phytoplankton biomass, altering aquatic ecosystems (Karakassis et al., 2003; Wu, 1999; Holmer et al., 2008). The Water Framework Directive (2000/60/EC) and Regulation on Maximum Residue Levels of Veterinary Medicines (EC No 470/2009) oblige aquaculture companies to comply with strict standards for maintaining water quality and using antibiotics.

Habitat Destruction and Climate Change Vulnerabilities
Examples from countries like Indonesia and Thailand have occurred, facing significant mangrove and wetland loss, critical habitats, in shrimp farming by the expansion of aquaculture, compromising biodiversity and coastal protection (Primavera, 1997). Additionally, in countries like Greece, where climate change is a reality causing temperature rise or other extreme weather conditions, there is an increase of disease outbreaks affecting the sustainability of aquaculture operations (Lazzari, 2021).

Disease, Parasite Transmission and Genetic Pollution

In countries like Canada and Norway the high-density farming conditions facilitated the spread of diseases and parasites causing declines in wild populations (Krkošek et al., 2007). Furthermore, they are also farmed species that escape from the aquaculture farms posing risks to wild gene pools, leading to the reduction of genetic diversity affecting the resilience of wild populations (Hindar et al., 1991). Moreover, Canada has committed to banning salmon open net-pen aquaculture in British Columbia by 2029 and is transitioning the industry to closed containment technologies for salmon farming (https://www.science.org/ doi/10.1126/sciadv.adt4568).

Chemical Use

In Europe it has been observed that residues of antibiotics accumulate in sediments of aquaculture fish, potentially leading to antibiotic resistance raising many concerns (Cabello, 2006). The Regulation on maximum residue levels of veterinary medicinal products (EC No 470/2009) establishes limits on the use of antibiotics to counter excessive contamination.

1.3.4 Impacts on Tourism and Local Communities

Development of Alternative Forms of Tourism

By making the fish farms accessible to the public, a new opportunity for touristic activities may occur, offering visitors the opportunity to be informed about the procedure, the protocols followed, etc. At the same time, a new experience is to be provided within their touristic experience, and alternative forms of tourism such as agrotourism and ecotourism could flourish (Whitmarsh & Palmieri, 2011 and Martinis et al., 2011).

Job creation and economic development

The development of fish farms in an area can create jobs in several domains, such as processing, catering, and tourist services (Alexander et al., 2017), leading to the economic development of local communities and the improvement of the population's living standards (Cai et al., 2022).

Protection and promotion of the environment

When fish farms (not in open net pen fish farms like in Greece) maintain sustainable productivity standards, the environment is protected, ecology is maintained, and tourists interested in natural beauty and sustainability are attracted (Troell et al., 2009).

Last but not least, the orthological integration of fish farms in the tourism sector may provide several benefits like enhancement of the local economy, promoting sustainability and offering people added value to their experiences (Bostock et al., 2010; Cai et al., 2022).

Negative Impacts of Aquaculture in Tourism Sector

Unpleasant Perceptions of Coastal Visuals

Several tourism authors such as Cappell and Nimmo (2020) or Armbrecht and Skallerud (2019) note that the main conflict between tourism and aquaculture is based on the fact that they compete for the same resource: beaches. Thus, the location of the two activities is their main source of dispute and, generally speaking, these are conflicts of use located near the coasts.

The presence of aquaculture facilities can alter coastal landscapes, leading to negative perceptions among tourists. The installation of marine farms can produce environmental impacts that may deter tourists, including pollution and changes in marine biodiversity, which can adversely affect the perceived quality of water and natural attractions (Perles-Ribes et al., 2023).

Large structures such as mussel rafts and sea-cage fish farms alter the visual appeal of coastal landscapes, sparking concerns about their aesthetic impact. In Southern Chile, approximately 66% of tourists felt that aquaculture spoiled the visual beauty of the coastline, affecting their overall impression of the area. Research indicated that the presence of aquaculture facilities can negatively influence tourists' perceptions of the landscape (Alsaleh and Wang, 2024). About one-third of tourists surveyed stated that they would be less likely to return if marine farms expanded, with an estimated elasticity of demand impacting repeat visits by approximately 10% (Outeiro, et al. 2018).

Willingness to Pay for Environmental Preservation

While aquaculture contributes economically, tourists often prioritize environmental quality. In Southern Chile (Outeiro, et al. 2018), despite recognizing the economic benefits of aquaculture, tourists expressed strong opposition to further expansion due to environmental concerns. The feeding of caged fish introduces substantial nutrient loads into coastal waters, potentially leading to eutrophication and further impacting the quality of marine environments (Alsaleh and Wang, 2024).

Moreover, the aquaculture sector is concerned about the growth of coastal tourism as it can have an impact on water quality (Tan et al., 2023). Many tourists are willing to incur additional costs to preserve environmental quality. Nearly half of ecotourists surveyed were willing to pay extra to avoid areas affected by aquaculture, with younger and wealthier tourists more inclined to support environmental preservation financially (Outeiro, et al. 2018).

Impact on Future Visit Intentions

Environmental quality significantly influences tourists' decisions to revisit destinations. Environmental quality plays a pivotal role in shaping tourists' decisions to revisit destinations. Studies across various regions have consistently demonstrated a strong correlation between high environmental standards and increased revisit intentions.

In Taiwan's Alishan National Forest Recreation Area, research involving 400 visitors revealed that both high environmental quality and perceived quality significantly influence tourists' intentions to return. Visitors who rated the environmental and service quality highly were more likely to express a desire to revisit the area (Sadat and Chang, 2016).

A study in Bali examined how sustainability efforts impact tourists' intentions to revisit, moderated by their environmental awareness (Kusumawati, and Utomo, 2020). The results indicated that tourists with lower environmental awareness were less influenced by sustainability initiatives when considering future visits. This underscores the importance of targeting environmental education to enhance the effectiveness of sustainability efforts in tourism.

Finally, in Southern Chile 88.5% of tourists indicated a preference for returning to areas with positive environmental prospects, compared to only 43% willing to return to areas with negative impacts (Outeiro, et al. 2018).

Conflict for Resources

The growth of aquaculture can lead to conflicts with tourism, as both sectors vie for coastal resources and aesthetic appeal. Aquaculture competes with tourism for coastal resources, particularly in scenic areas valued by visitors. This competition often leads to conflicts regarding land and water use (Perles-Ribes et al., 2023).

Additionally, land-based infrastructure supporting aquaculture, especially near tourist resorts or popular beaches, can affect coastal environments (Alsaleh and Wang, 2024). Furthermore, the expansion of fish farms can lead to the reduction of anchorage zones crucial for recreational boating, as these areas become occupied by aquaculture operations. Navigational hazards may also emerge due to underwater obstacles associated with fish farms, posing risks to vessels traveling between the coast and aquaculture sites. Finally, inadequate separation between visitor pathways and fish farms could result in accidents, adversely affecting both tourists and aquaculture activities (Alsaleh and Wang, 2024).

Impacts of Fish Farming on Tourism in Greece

Fish farming, or aquaculture, plays a significant role in Greece's economy, contributing substantially to the country's seafood production. However, the expansion of fish farms has raised concerns among local communities and tourists alike, primarily due to environmental and aesthetic impacts (Global Seafood Alliance, 2023).

Visual and Environmental Concerns

The proliferation of fish farms along Greece's coastlines has led to debates about their impact on tourism. In Poros, a small island in the Saronic Gulf, plans to expand fish farming operations have met with strong opposition from residents and local authorities. Concerns center around the potential degradation of the island's natural beauty and the possible negative effects on tourism, which is vital to the local economy. The proposed expansion could see fish farms occupying a quarter of the island's coastline, potentially deterring tourists who are drawn to Poros for its pristine landscapes and clear waters (Petridi, et al., 2023).

Community Opposition

Despite some positive initiatives, many coastal communities remain opposed to the expansion of fish farms. In Poros, for example, a survey revealed that 89% of residents are against the planned expansion, citing concerns over environmental degradation and its potential impact on tourism. The island's economy heavily relies on tourism, and residents fear that the introduction of industrial-scale fish farming could alter the island's character and deter visitors (Petridi, Corina et al., 2023).

The relationship between fish farming and tourism in Greece is complex, with both positive and negative aspects. While aquaculture presents opportunities for innovative tourism experiences and economic development, it also poses challenges related to environmental sustainability and the preservation of natural landscape. Balancing these interests requires careful planning, community engagement, and policies that promote sustainable practices in both aquaculture and tourism sectors.

1.3.5 Impacts of the Aquaculture Sector in Greece

Aquaculture in Greece faces the same problems as aquaculture in the rest of the Mediterranean and Europe. However, in Greece, in addition to European legislation and the country's efforts as a member state to address not only the issue of overfishing but also the safe and sustainable operation of aquaculture units, it has also deployed a multitude of other tools in this effort. The Integrated Fisheries Monitoring System as well as the "Multiannual National Strategic Plan for the Development of Aquaculture in Greece, 2021-2030" are additional tools.

In the context of the effort for a sustainable Blue Economy, eco-friendly practices and the support of small-scale fisheries as well as healthy marine ecosystems, the Greek Government, in order to reduce these impacts and with respect for this productive activity of the primary sector and the desire for the development of alternative forms of tourism (fishing and diving tourism), approved a new institutional framework for visitable aquaculture in Greece. In this way, visitors to these will be given the opportunity to familiarize themselves with the relationship of Greeks with the sea and the production process, while they will have the opportunity to admire the rich fauna and flora of the Posidonia through diving (Government Gazette Issue (FEK 7315 B'/2025).

1.4 Aim of the study

The **study aims to provide a comprehensive and updated analysis of the finfish industry's economic impacts, including its contributions to the national and regional level. For this purpose, a range of topics will be investigated and analyzed,** such as employment, market structure (sales, exports, imports), ownership data, regulatory framework, etc.

The structure of the study is the following:

Chapter 1: Introduction
Chapter 2: Employment Impact Assessment
Chapter 3: Economic Contribution and Ownership Analysis
Chapter 4: Conclusions and Recommendations

Chapter 2: Employment Impact Assessment

This chapter provides an analysis of employment characteristics in the aquaculture sector in Greece, focusing on direct and indirect job creation, workforce demographics, employment by different categories, etc. By analyzing employment trends, this chapter aims at providing valuable insights into the role of the sector in employment sustainability and economic growth in Greece.

2.1 Population Data

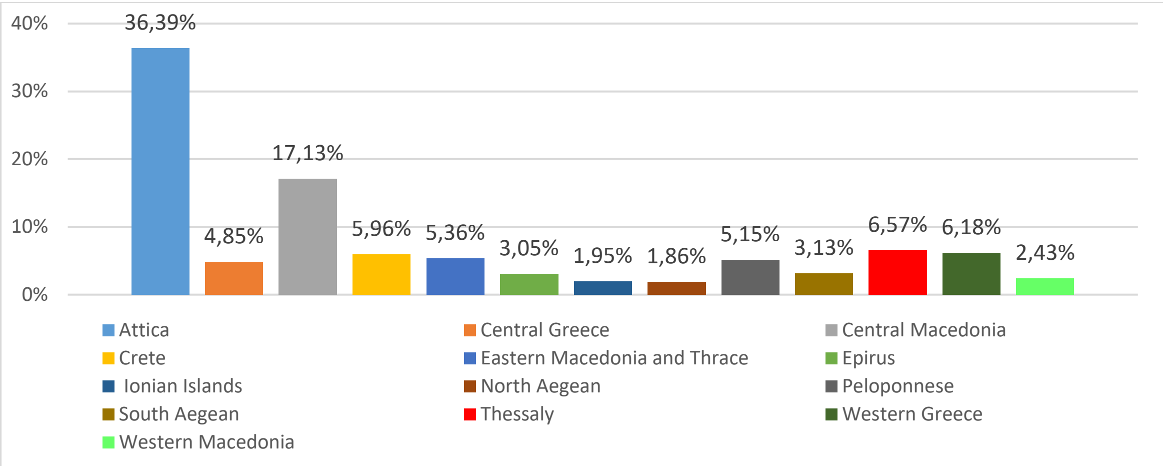
Initially, based on population data analysis, it was found that Greece's population was 10.482.492 inhabitants as of 2021. The largest percentage of population is concentrated in the Regions of Attica (36,39%) and Central Macedonia (17,13%), primarily due to the presence of the two largest urban centers in the country (Athens and Thessaloniki). On the other hand, the smallest percentage of the population is concentrated in the Regions of North Aegean (1,86%) and Ionian Islands (1,95%).

Table 2.1: Population for years 2001,2011, and 2021 at national and regional level

	2001	2011	2021
Greece	10.934.097	10.816.286	10.482.492
Attica	3.894.573	3.828.434	3.814.065
Central Greece	558.144	547.390	508.255
Central Macedonia	1.876.558	1.882.108	1.795.670
Crete	594.368	623.065	624.410
Eastern Macedonia and Thrace	607.162	608.182	562.201
Epirus	336.392	336.856	319.992
Ionian Islands	209.608	207.855	204.533
North Aegean	205.235	199.231	194.943
Peloponnese	597.622	577.903	539.533
South Aegean	298.462	309.015	327.820
Thessaly	740.115	732.762	688.255
Western Greece	721.541	679.796	648.220
Western Macedonia	294.317	283.689	254.595

Source: Hellenic Statistical Authority, Own elaboration

Graph 2.1: Percentage of regional population in relation to the total population of the country (year 2021)



Source: Hellenic Statistical Authority, Own elaboration

Between 2011 and 2021, the country's population decreased by 3,09%. At the regional level, 11 out of 13 regions experienced a decrease during the same period from 2011 to 2021. The two regions that showed a population increase are South Aegean (6,09%) and Crete (0,22%).

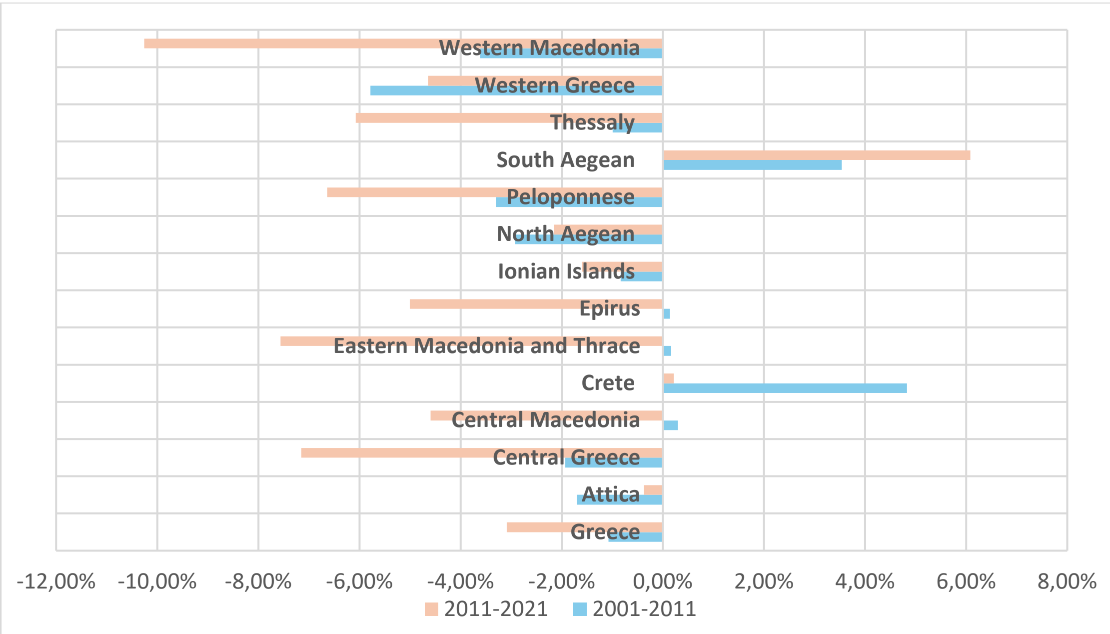
During the period 2001-2011, the country's population decrease was smaller compared to the period 2011-2021 (-1,08% versus -3,09%). During this period, 5 out of 13 regions recorded an increase in their population, with the Region of Crete recording the largest increase (4,83%). On the other hand, the most significant decrease is observed in the Region of Western Greece (-5,79%).

Table 2.2: Population changes at national and regional level during the periods 2001-2011 and 2011-2021

	2001-2011	2011-2021
Greece	-1,08%	-3,09%
Attica	-1,70%	-0,38%
Central Greece	-1,93%	-7,15%
Central Macedonia	0,30%	-4,59%
Crete	4,83%	0,22%
Eastern Macedonia and Thrace	0,17%	-7,56%
Epirus	0,14%	-5,01%
Ionian Islands	-0,84%	-1,60%
North Aegean	-2,93%	-2,15%
Peloponnese	-3,30%	-6,64%
South Aegean	3,54%	6,09%
Thessaly	-0,99%	-6,07%
Western Greece	-5,79%	-4,64%
Western Macedonia	-3,61%	-10,26%

Source: Hellenic Statistical Authority, Own elaboration

Graph 2.2: Population changes at national and regional level during the periods 2001-2011 and 2011-2021



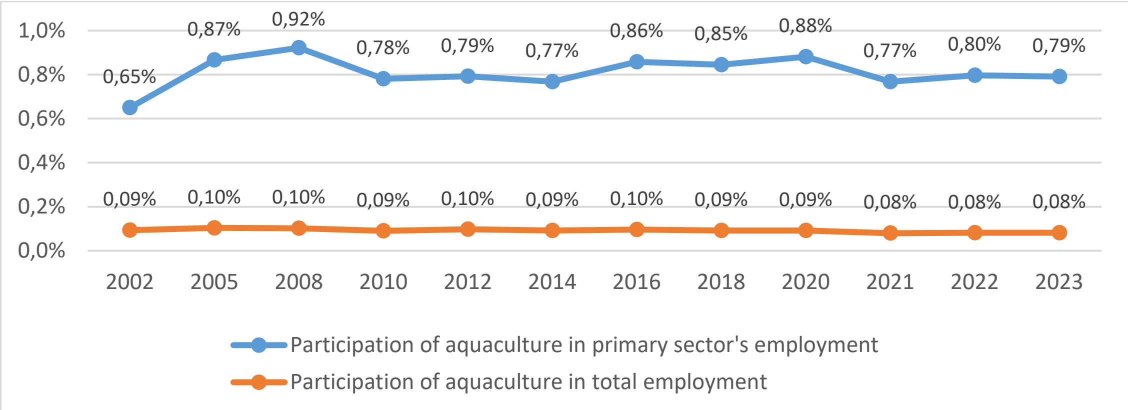
Source: Hellenic Statistical Authority, Own elaboration

2.2 Employment Data

This section will analyze data on employment in the Greek aquaculture sector. For the year 2023, the aquaculture sector employed 4.099 people, accounting for 0,08% of the country's total workforce. Between 2002 and 2023, the percentage of people employed in the aquaculture sector compared to the total number of people in the country does not show significant differences (0,08% and 0,10%).

On the other hand, for the year 2023, the number of people employed in the aquaculture sector constitutes 0,79% of the number of people employed in the primary industry. During the period 2002-2023, the percentage of employment in the aquaculture sector in the primary industry ranges from 0,65% (2002) to 0,92% (2008). Between 2002-2023, this percentage shows an increase of +0,14%.

Graph 2.3: Participation of employment in aquaculture sector during the period 2002 – 2023



Source: Hellenic Statistical Authority, Own elaboration

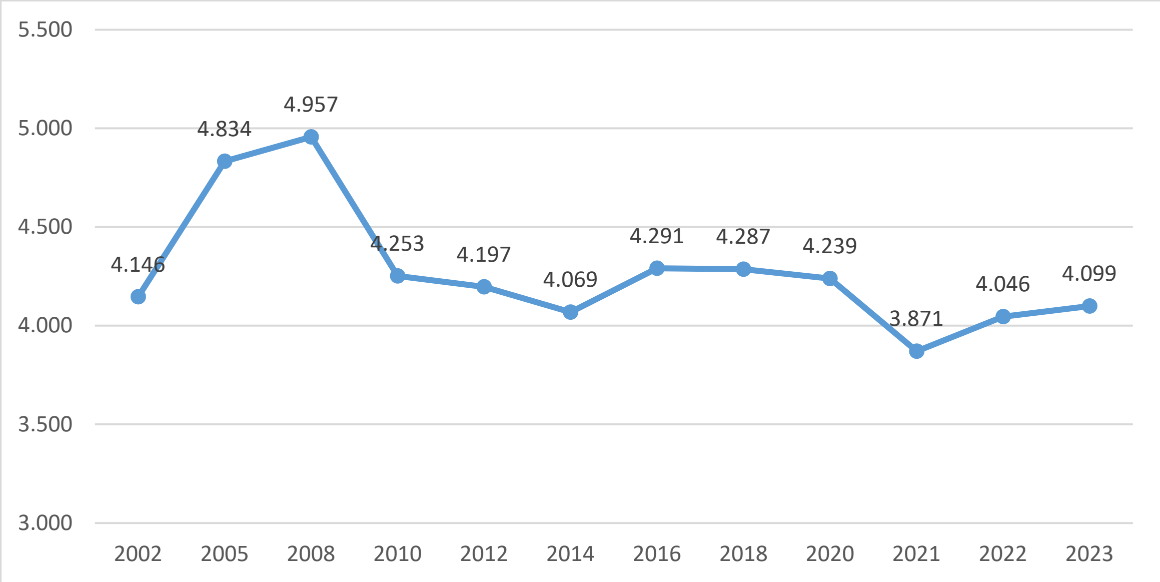
Between 2002 and 2023, the number of people employed in the aquaculture sector shows a slight decrease (-1,13%). During the same time period, agriculture, forestry and fishing appears a significant decrease (-18,76%), whereas the total employment of Greece increases (13,58%). The highest number of people employed in the sector was recorded in 2008, while the economic crisis that Greece experienced after 2008 has significantly affected employment at the three under consideration levels (1. Aquaculture, 2. Primary sector[6], 3. Greece's total employment), as a decrease in the number of people employed was observed between 2008 and 2012, at a rate of -15,33%, -1,46% and -11,12% respectively.

It is also worth noting the decrease observed in the total number of people employed in the aquaculture sector (-8,68%) between 2020 and 2021, which is due to the emergence of the COVID-19 pandemic at a global level. However, during the same

[6] The primary sector in Greece refers to the part of the economy involved in the exploitation of natural resources. It includes 3 main sub-sectors 1) Crop and animal production, hunting and related activities, 2) Forestry and logging and 3)Fishing and aquaculture

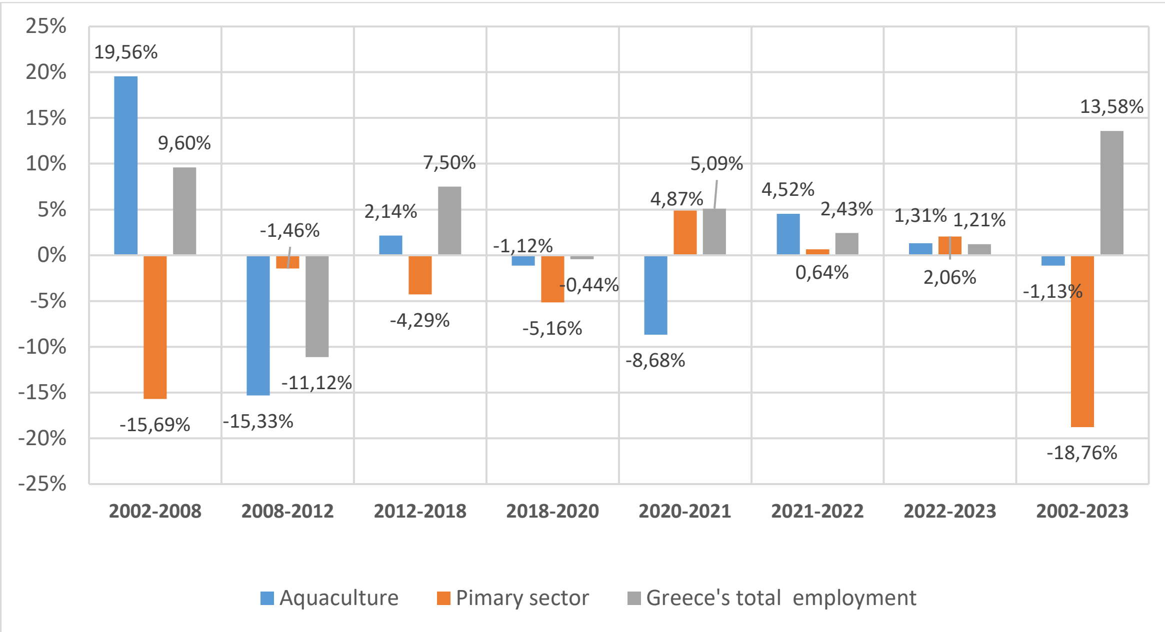
period, employment in primary sector and Greece increases (4,87% and 5,09% respectively).

Graph 2.4: Total number of employees in aquaculture units during the period 2002 – 2023



Source: Hellenic Statistical Authority, Own elaboration

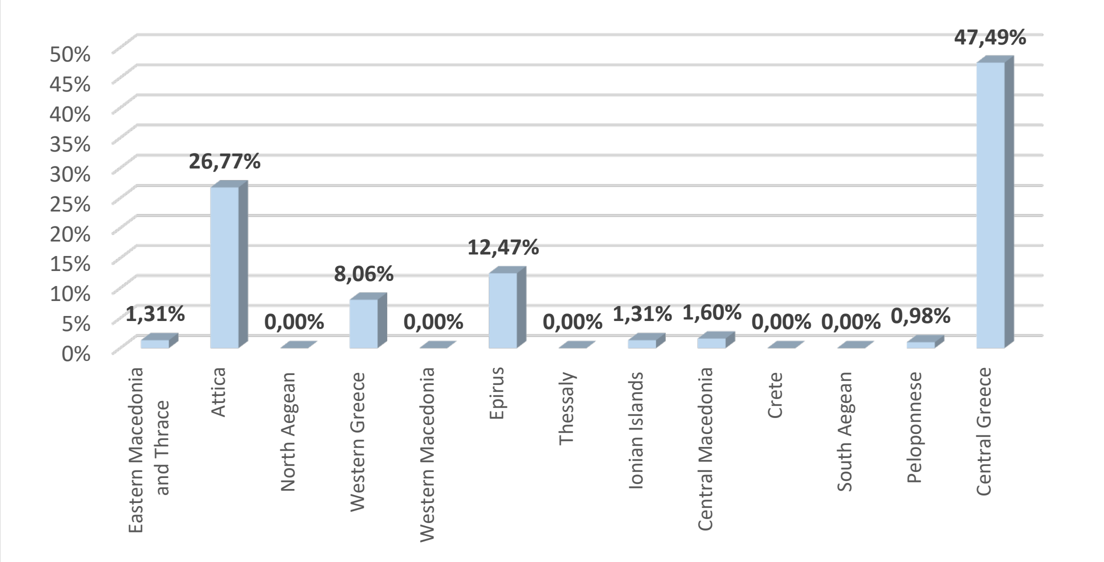
Graph 2.5: Employment changes during the period 2002-2023



Source: Hellenic Statistical Authority, Own elaboration

From the distribution of the number of employees by region for the year 2021, it is found that the most significant percentage of employees is concentrated in the Region of Central Greece (47,49%), followed by the Region of Attica (26,77%) and the Region of Epirus (12,47%). According to the data, there are no employees in the aquaculture sector in 5 Regions (North Aegean, Western Macedonia, Thessaly, Crete, South Aegean).

Graph 2.6: Employment per region (2023)



Source: Ministry of Labour and Social Security, Hellenic Statistical Authority, Own elaboration

Moving on to an analysis of the employed by age group, the data showed that during the period 2012-2023, the largest percentage of employed people is concentrated in the 35-55 year-old age group. The rate of this age group increased by 12,02 percentage points between 2012 and 2023. The other two age groups (20-35 and 55+) exhibit a decrease between these two years by -6,83 and -5,19 percentage points, respectively.

In the year 2023, the age groups that showed the highest percentages of employed people in the aquaculture sector were 50-54 years old (31,31%) and 40-44 years old (25,17%). This fact indicates that these age groups account for more than half of the employed people in the sector.

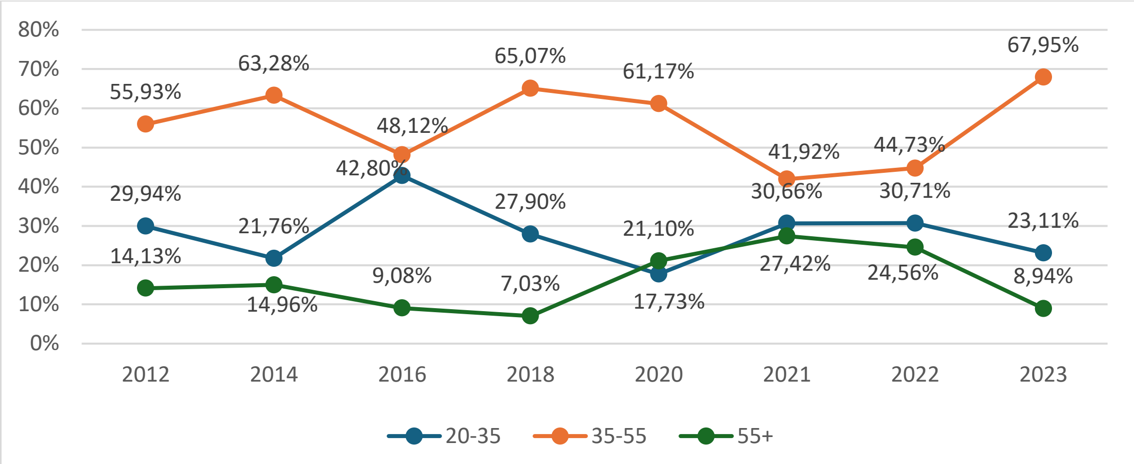
Table 2.3: Percentage of employees per age group in aquaculture units during the period 2012-2023

Age Group	2012	2014	2016	2018	2020	2021	2022	2023
20-24	1,80%	2,09%	3,32%	3,44%	2,72%	0,73%	0,00%	0,00%
25-29	11,21%	13,01%	25,96%	18,65%	9,91%	26,48%	22,99%	10,72%
30-34	16,93%	6,66%	13,51%	5,81%	5,10%	3,45%	7,72%	12,39%
35-39	16,31%	21,94%	18,51%	28,09%	17,02%	13,77%	11,53%	7,47%
40-44	20,96%	15,09%	3,64%	13,25%	20,45%	7,87%	11,27%	25,17%
45-49	10,00%	9,30%	6,79%	12,18%	12,40%	9,86%	9,79%	3,99%
50-54	8,65%	16,96%	19,18%	11,55%	11,31%	10,42%	12,14%	31,31%
55-59	9,11%	5,17%	5,85%	6,28%	7,97%	20,79%	16,68%	4,43%
60-64	5,03%	8,33%	0,00%	0,75%	13,12%	6,63%	4,90%	3,58%
65-69	0,00%	1,46%	0,00%	0,00%	0,00%	0,00%	2,98%	0,93%
70-74	0,00%	0,00%	3,24%	0,00%	0,00%	0,00%	0,00%	0,00%
75+	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%

Source: Ministry of Labour and Social Security, Hellenic Statistical Authority, Own elaboration

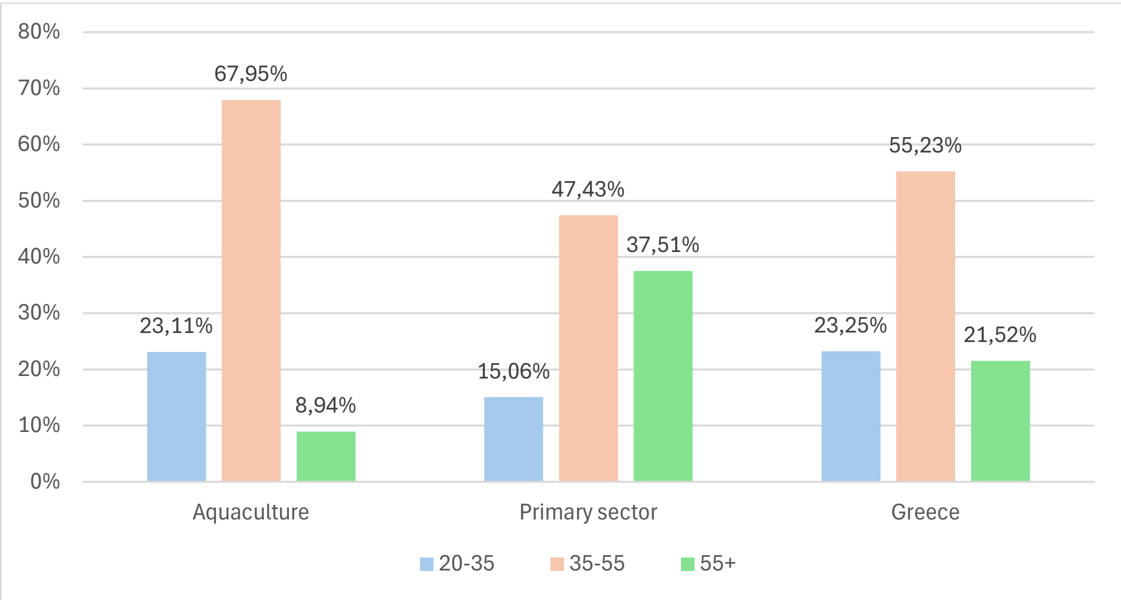
By comparing the three levels under consideration for the same year (2023), it is realized that aquaculture sector concentrates higher percentage of employees in the age group 35-55 (67,95% for aquaculture, 47,43% for primary sector and 55,23% for Greece). This is particularly important, as this age group includes the productive part of a country's population. On the other hand, aquaculture sector concentrates lower percentage in the 55+ age group (8,94% for aquaculture, 37,51% for primary sector and 21,52% for Greece), which includes employees being at the end of their working careers.

Graph 2.7: Percentage of employees per age group in aquaculture units during the period 2012-2023



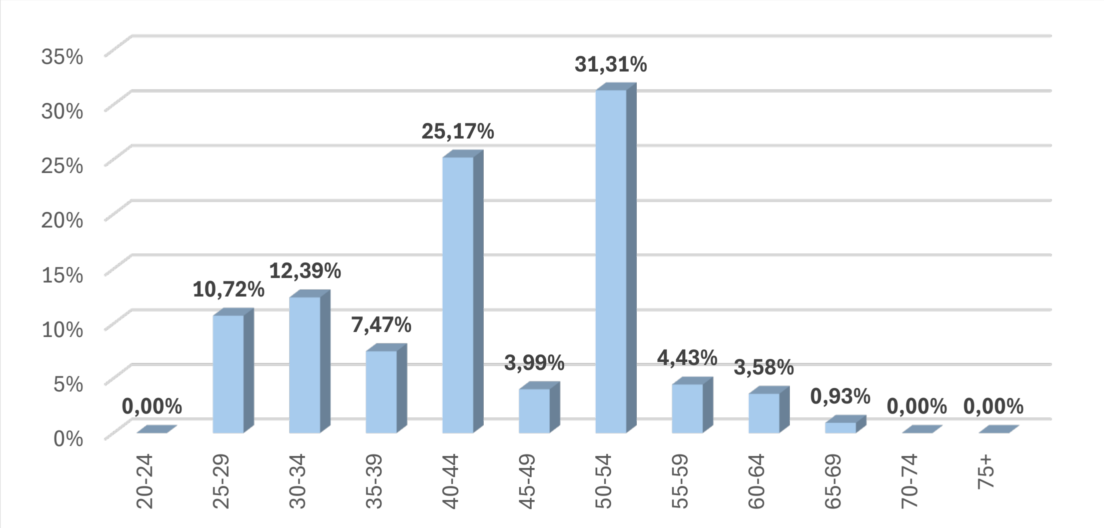
Source: Ministry of Labour and Social Security, Hellenic Statistical Authority, Own elaboration

Graph 2.8: Percentage of employees per age group (2023)



Source: Ministry of Labour and Social Security, Hellenic Statistical Authority, Own elaboration

Graph 2.9: Percentage of employees per age group in aquaculture units in 2023

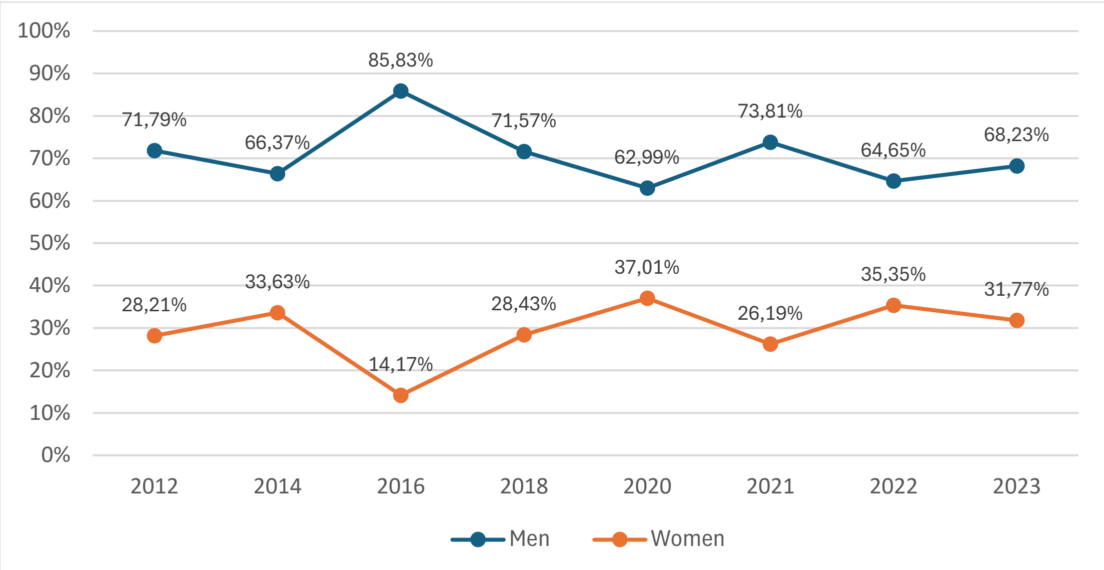


Source: Ministry of Labour and Social Security, Hellenic Statistical Authority, Own elaboration

The analysis by gender employed in aquaculture sector shows that, during the period 2012-2023, men have a higher percentage than women for all the years under consideration. The highest percentage of men (85,83%) is observed in 2016, while the corresponding rate of women (37,01%) is noted in 2020.

Between 2012 and 2023, the percentage of men decreased by 3,56 percentage points, while the percentage of women increased by the same amount. In the last reference year (2023), almost 3 in 10 women were employed in the aquaculture sector, while the rest were men.

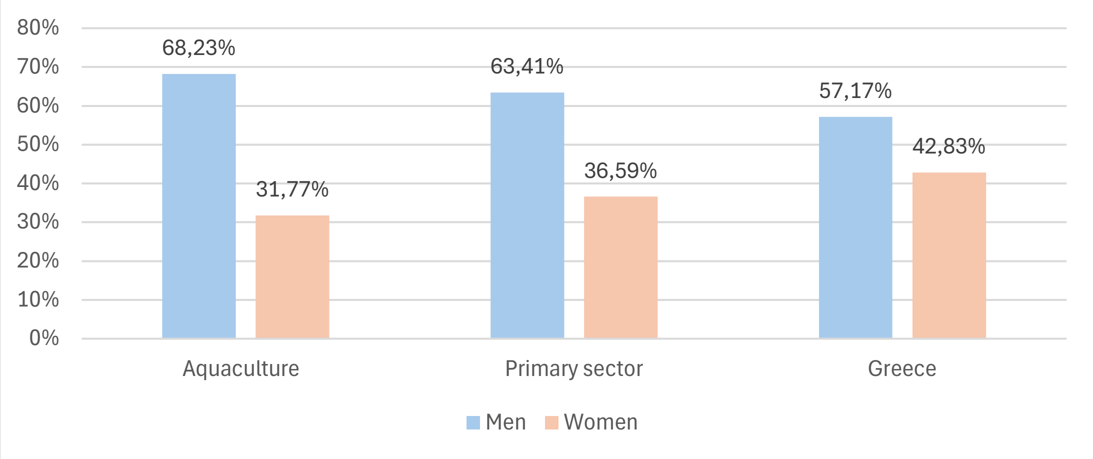
Graph 2.10: Percentage of employees per sex in aquaculture units during the period 2012-2023



Source: Ministry of Labour and Social Security, Hellenic Statistical Authority, Own elaboration

By comparing the three under consideration levels for the year 2023, it is found that aquaculture sector concentrates lower percentage in women employees (31,77% for aquaculture, 36,59% for primary sector and 42,83% for Greece).

Graph 2.11: Percentage of employees per sex (2023)



Source: Ministry of Labour and Social Security, Hellenic Statistical Authority, Own elaboration

Examining the educational level of those employed in the aquaculture sector, it is found that, during the period 2012-2022, the highest percentage has a high school diploma. This percentage increases significantly between 2012 and 2022 (20,99 percentage points). For the year 2022, employees with a high school diploma in aquaculture sector appear a higher percentage compared to the other two levels (60,61% for aquaculture, 37,33% for primary sector and 35,40% for Greece).

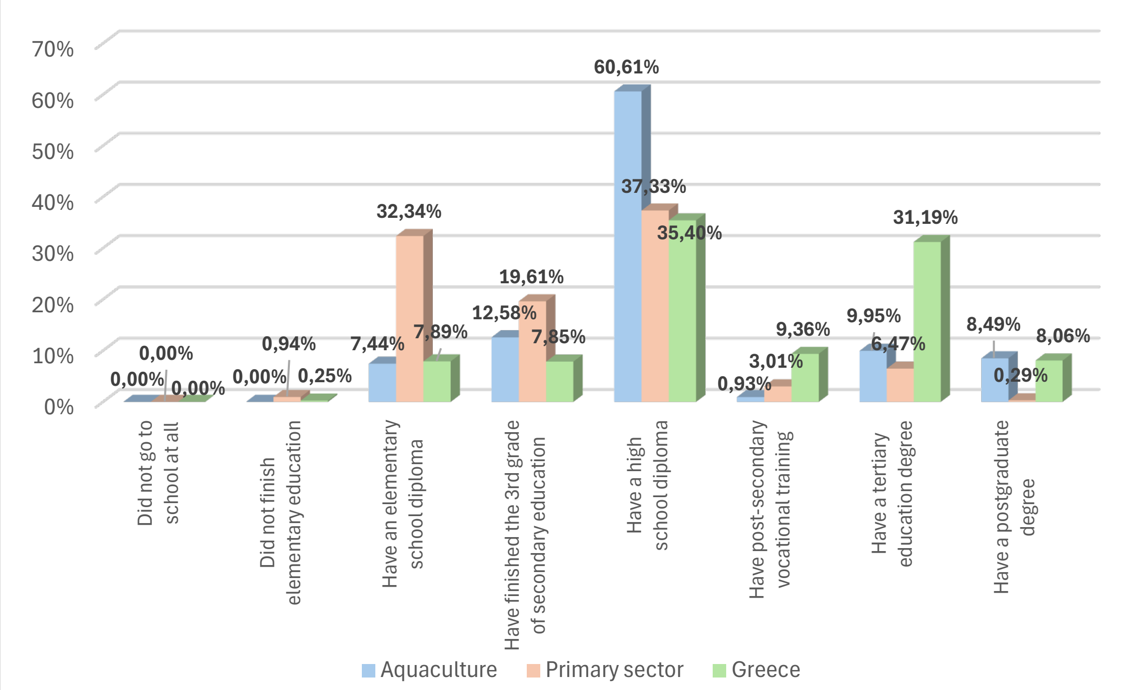
It is also worth noting the increase observed in employees with a tertiary education degree or a postgraduate degree between the two specific years (from 10,06% in 2012 to 18,44% in 2022). This fact shows a significant improvement in the educational level of employees in the aquaculture sector. This percentage (18,44%) is higher than primary sector (6,75%), but significantly lower than the national average (39,25%).

Table 2.4: Percentage of employees per education level in aquaculture units during the period 2012-2022

Educational level	2012	2014	2016	2018	2020	2021	2022
Did not go to school at all	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
Did not finish elementary education	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
Have an elementary school diploma	29,27%	25,26%	10,94%	10,94%	14,08%	8,80%	7,44%
Have finished the 3rd grade of secondary education	20,89%	15,97%	21,79%	4,96%	16,09%	4,01%	12,58%
Have a high school diploma	30,47%	41,95%	52,85%	42,60%	52,41%	81,38%	60,61%
Have post-secondary vocational training	9,31%	8,55%	0,42%	15,79%	2,99%	1,27%	0,93%
Have a tertiary education degree	10,06%	8,27%	14,00%	25,71%	6,57%	2,86%	9,95%
Have a postgraduate degree	0,00%	0,00%	0,00%	0,00%	7,86%	1,68%	8,49%

Source: Ministry of Labour and Social Security, Hellenic Statistical Authority, Own elaboration

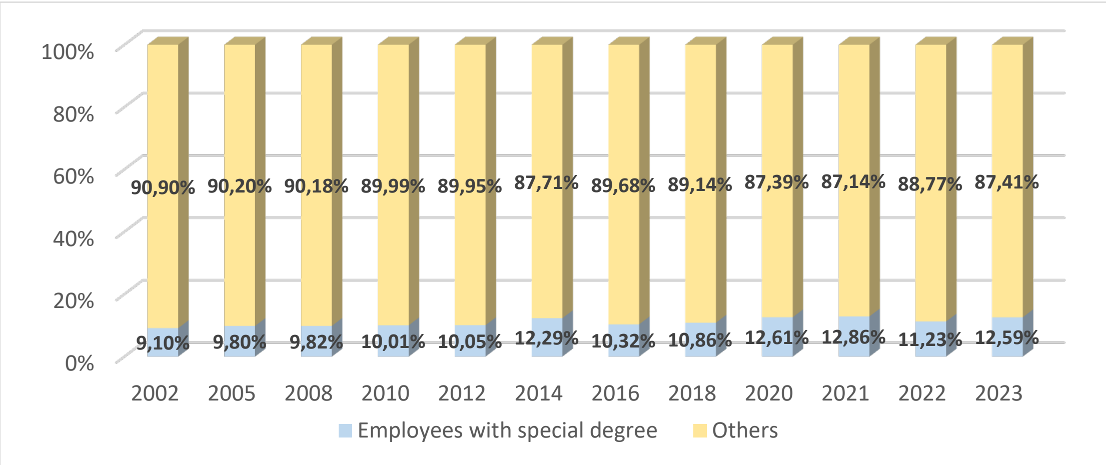
Graph 2.12: Percentage of employees per education level (2022)



Source: Ministry of Labour and Social Security, Hellenic Statistical Authority, Own elaboration

Further analyzing the data of full-time employees, it is found that, between the years 2002 and 2023, the percentage of employees in aquaculture units who hold a special degree shows an increase of 3,49%. Furthermore, the highest percentage of special degree holders is noted in the year 2021 (12,86%), while the lowest percentage is in the year 2002 (9,10%).

Graph 2.13: Percentage of employees with special degree (full time personnel)



Source: Hellenic Statistical Authority, Own elaboration

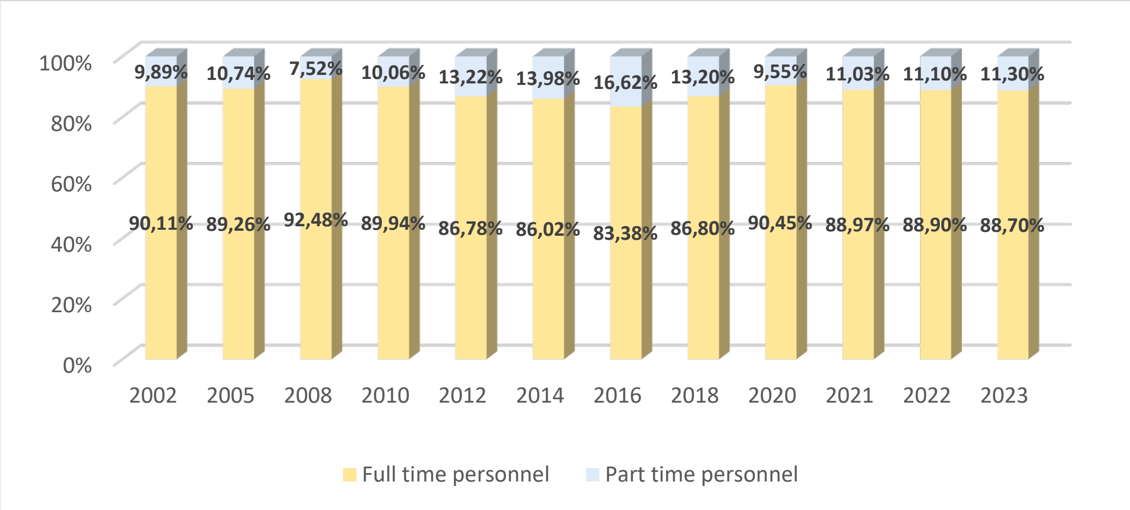
Moving on to an analysis of the employment relationship of workers in the aquaculture sector, it is found that over time the largest percentage is full-time employment. For example, in 2023, the percentage of full-time employees was 88,70%, in contrast to the percentage of part-time employees which is only 11,30%. The highest percentage of full-time employment during the period 2002-2023 was recorded in 2008 (92,48%).

Table 2.5: Number of employees in aquaculture units per work status during the period 2002 – 2023

	2002	2005	2008	2010	2012	2014	2016	2018	2020	2021	2022	2023
Full time personnel	3.736	4.315	4.584	3.825	3.642	3.500	3.578	3.721	3.834	3.444	3.597	3.636
Part time personnel	410	519	373	428	555	569	713	566	405	427	449	463
Total	**4.146**	**4.834**	**4.957**	**4.253**	**4.197**	**4.069**	**4.291**	**4.287**	**4.239**	**3.871**	**4.046**	**4.099**

Source: Hellenic Statistical Authority, Own elaboration

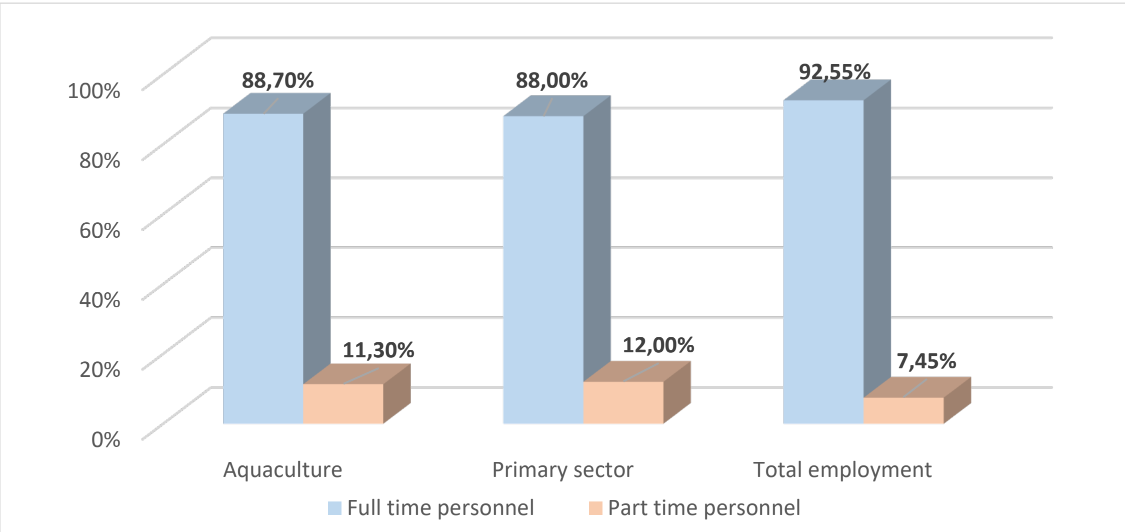
Graph 2.14: Percentage of employees in aquaculture units per work status during the period 2002 – 2023



Source: Hellenic Statistical Authority, Own elaboration

Comparing the three levels under consideration for the year 2023, it is observed that the full-time employment rate in aquaculture (88,70%) is almost the same as the primary sector (88,00%) and slightly lower than the national average (92,55%).

Graph 2.15: Percentage of employees in aquaculture units per work status (2023)

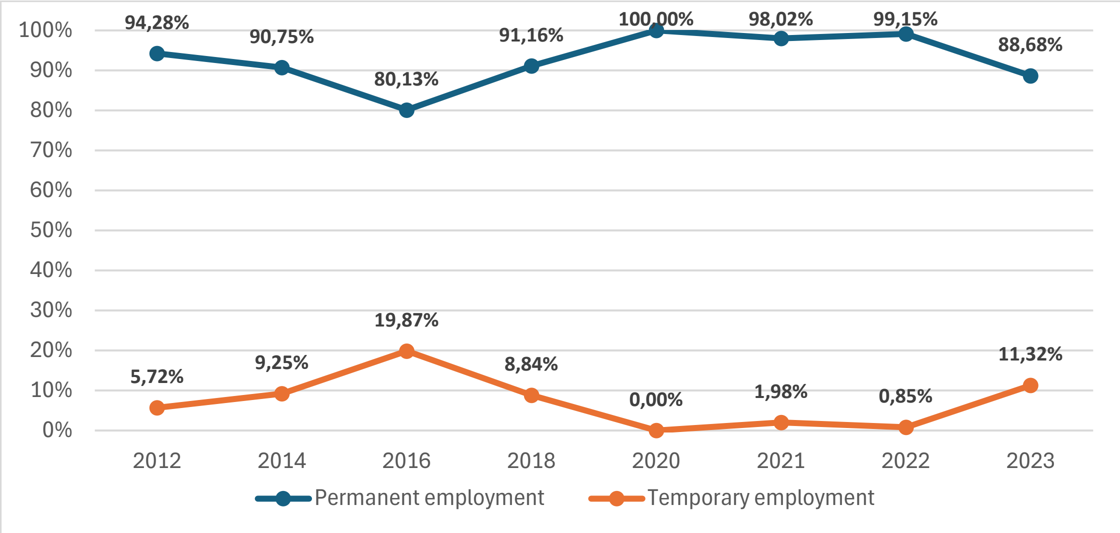


Source: Hellenic Statistical Authority, Own elaboration

Investigating the type of employment contract, the data show that during the period 2012-2023, the largest percentage of employees work in a permanent employment status, with fluctuations observed between the years. It is worth noting that in 2020, all employees in the sector were in a permanent employment status, likely due to measures taken to address the effects of the COVID-19 pandemic. However, in 2023, a significant increase in employees with temporary employment status is observed.

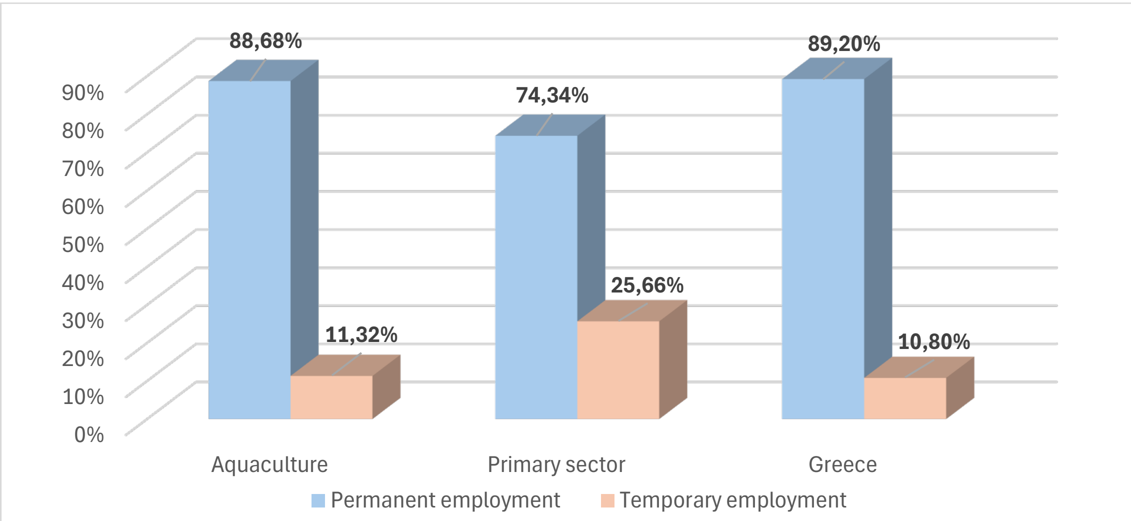
Comparing the three under consideration levels for the year 2023, it is realized that the rates of permanent and temporary work for the aquaculture sector fluctuate at the same levels as the national average. On the contrary, the primary sector shows a higher rate of temporary work, which is due to the nature of the jobs included (seasonal).

Graph 2.16: Percentage of employees in aquaculture units per contract type during the period 2002 – 2023



Source: Ministry of Labour and Social Security, Hellenic Statistical Authority, Own elaboration

Graph 2.17: Percentage of employees per contract type (2023)



Source: Ministry of Labour and Social Security, Hellenic Statistical Authority, Own elaboration

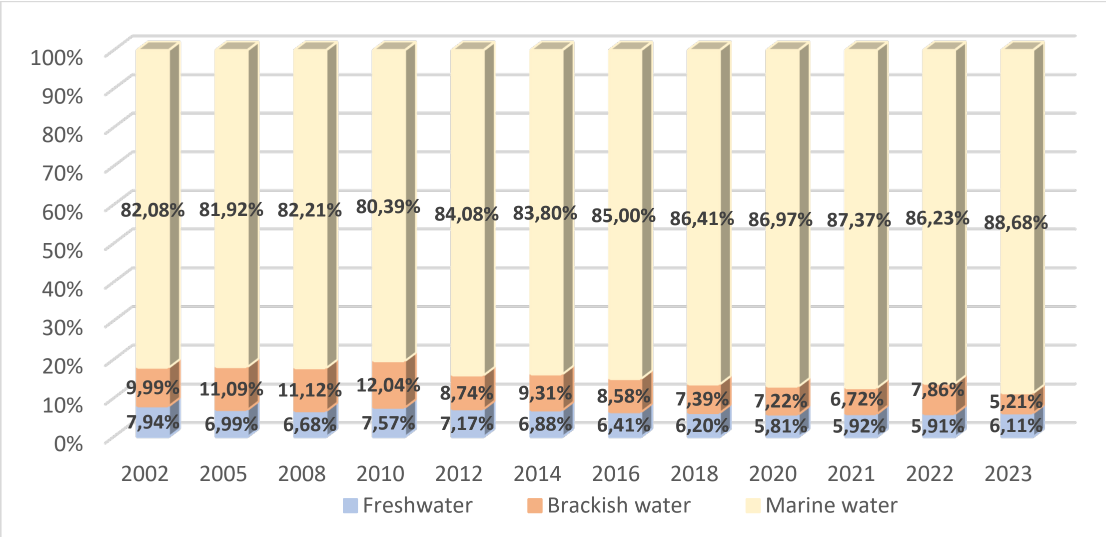
Examining the number of employees by type of water, it is found that over time, the largest percentage of employees has been employed in marine water aquaculture. Between 2002 and 2023, the proportion of employees in marine water aquaculture increased by 6,60% (from 82,08% to 88,68%). Furthermore, for the year 2023, the percentages of employees employed in freshwater, brackish, and marine aquaculture are 6,11%, 5,21%, and 88,68%, respectively.

Table 2.6: Number of employees in aquaculture units by type of water during the period 2002 – 2023[7]

	2002	2005	2008	2010	2012	2014	2016	2018	2020	2021	2022	2023
Freshwater	329	338	331	322	301	280	275	264	246	229	239	251
Brackish water	414	536	551	512	367	379	368	315	306	260	318	214
Marine water	3.403	3.960	4.075	3.419	3.529	3.410	3.644	3.681	3.684	3.382	3.489	3.644
Total	**4.146**	**4.834**	**4.957**	**4.253**	**4.197**	**4.069**	**4.287**	**4.260**	**4.236**	**3.871**	**4.046**	**4.109**

Source: Hellenic Statistical Authority, Own elaboration

Graph 2.18: Percentage ratio of employees in aquaculture units by type of water during the period 2002 – 2023



Source: Hellenic Statistical Authority, Own elaboration

2.3 Direct and indirect employment multipliers

In this section, the Input-Output Analysis methodology is used to calculate direct and indirect jobs. Generally, Input-output analysis interprets the functioning of an economic system by using the interdependence of its financial sectors. It has been established as a particularly useful tool in economics and is used to analyze the impacts on economic sectors at national, regional, and local levels. The basis of Input-Output Analysis is the input-output table, which depicts the flows of goods and services between all sectors of an economy at a specific point in time. Primary and secondary data are used to construct the input-output table, which records all goods and services

[7] The deviations in the values of total employed persons for the years 2016, 2018, 2020, 2023 in Tables 2.5 and 2.6 are due to the data of Hellenic Statistical Authority

produced in an economy. These data are then used to depict inter-sectoral transactions.

Specifically, the input-output table is a double-entry table with each industry appearing twice. Specifically, the rows of the table describe each industry as a seller who distributes its product to the other industries (intermediate demand), while the columns depict each industry as a buyer who purchases the inputs required to produce the final product from the other industries (intermediate supply). At the same time, the input-output table provides information on the supply of products to final demand (private and public consumption, investment, government spending, exports), as well as on the primary inputs that constitute value added and include elements such as wages, salaries, interest, taxes, imports, etc. (Livas 1994; Pnevmatikos 2017; Miller and Blair 2022).

The input-output table consists of four quadrants: a) the quadrant of inter-industry transactions, b) the quadrant of final demand, c) the quadrant of value added or primary inputs, and d) the quadrant of primary inputs to final demand.

The first quadrant depicts the intermediate transactions between the productive sectors of the system. That is, it includes the flows of goods and services produced and consumed within the production process. This quadrant constitutes a square matrix, as the number of rows equals the number of columns.

The second quadrant records the share of the total product of each sector that is intended for the elements of final demand, such as private consumption, public consumption, government spending, exports, etc.

The third quadrant depicts the primary inputs to the productive sectors. These inputs constitute the value added of the productive sectors and are called primary because they are not the result of any production process. This quadrant includes x columns corresponding to the number of sectors and y rows corresponding to the primary inputs (wages, contributions, depreciation, interest, imports, etc.).

Finally, the fourth quadrant describes the value of the factors of production (e.g. capital, labor) used directly by final consumers (Pnevmatikos 2017; Miller and Blair 2022).

In an input-output model involving n industries, inter-industry transactions can be specified through a system of linear equations, as shown below (Leontief 1986; Pnevmatikos 2017; Miller and Blair 2022):

$$X_1 = z_{11} + z_{12} + \ \ldots\ldots . + z_{1_n} + f_1$$
$$X_2 = z_{21} + z_{22} + \ \ldots\ldots . + z_{2_n} + f_2$$
$$X_3 = z_{31} + z_{32} + \ \ldots\ldots . + z_{3_n} + f_3$$
$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$
$$X_n = z_{n_1} + z_{n_2} + \ \ldots\ldots . + z_{nn} + f_n$$

where, z_{ij} denotes the inter-industry transactions between industries i and j, X_i indicates the value of the total output of industry i, f_i depicts the final demand for the products of industry i, while i, j = 1, 2,….., n are the industries of the model.

The input-output model is based on the assumption that the demand for products of each industry by the others depends on the size of the production of these industries. This assumption has as a consequence, the inputs from industry i to industry j (z_{ij}) can be expressed as a function of the total output of industry j (X_j). Specifically, the ratio of input to output (zij/Xj), which is denoted by the constant factor, α_{ij}, is called the technological coefficient and is given by the following relation (Leontief 1986; Pnevmatikos 2017; Miller and Blair 2022):

$$\alpha_{ij} = \frac{z_{ij}}{X_j}$$

Technological coefficients indicate the amounts of inputs required by industry i to produce a unit of output of industry j. Otherwise, technological coefficients indicate the monetary value of inputs originating from industry i per unit of output produced by industry j.

At this point, it should be noted that the change in final demand for the product of a productive industry causes direct and indirect effects on the production of the industries of an economy. Technological coefficients estimate only the direct effects, which are part of the total effects, since there are also indirect effects.

The determination of the total (direct and indirect) effects can be achieved by inverting the matrix resulting from subtracting the matrix of technological coefficients from the unit matrix.

The above can be expressed in matrix form as follows (Leontief 1986; Miller and Blair 2022):

$$(I - A)\ X = f \rightarrow X = (I - A)^{-1} f \rightarrow X = Lf$$

where, A is the matrix of technological factors (the matrix of direct requirements), L is the inverse Leontief matrix (or total requirements matrix), I is the unit matrix, X is the vector of final product and f is the vector of final demand.

The above equation concerns the basic question of Input-Output Analysis. That is, to what extent should the output of each sector of the economy change in total, in order to satisfy an increase in total demand, due to a change in an exogenous factor (e.g. consumption or exports).

The importance of the inverse Leontief matrix, within the context of the input-output model, is related to the estimation of changes in the production levels of each sector, due to changes in final demand, as well as to the effective depiction of the structural characteristics of an economy.

A key feature of Input-Output Analysis is the estimation of the multipliers. The multipliers of Input-Output Analysis are particularly important indicators used to estimate the impact of changes in final demand on an economy's output, income, employment, and other related factors. Specifically, the employment multiplier of sector *j* represents the overall change in employment that is induced in the economy by a change in the final demand of that sector. In particular, for the estimation of employment multiplier, the direct employment multipliers vector (or labour intensity vector) is first estimated as follows (Miller and Blair, 2022):

$$DE_j = E_j / X_j$$

where E_j is the number of employees in each sector and X_j is the total output of each sector. Then, total employment multipliers are estimated from the following formula:

$$EM_j = DE_j (I - A)^{-1}$$

Moreover, indirect employment multipliers are estimated as follows:

$$IE_j = EM_j - DE_j$$

An Input-Output table (37x37 sectors) was used for the estimation of the employment multipliers of the Greek economy for the year 2020. The results show that the average employment multiplier suggests that an increase of €1 million in final demand causes an increase of 22 people in employment (new employment positions).

In the case of fisheries and aquaculture sector[8], an increase of €1 million in final demand the total employment multiplier causes an increase of 18 people in employment (13 direct and 5 indirect). At this point it is worth mentioning that despite the hundreds of millions of euros allocated through subsidies and the increased revenues, no jobs have been added. So, in fact, the multiplier did not work at all in favor of the aquaculture sector, as during the period 2002-2023, the number of employees in the aquaculture sector has decreased by 1,13%.

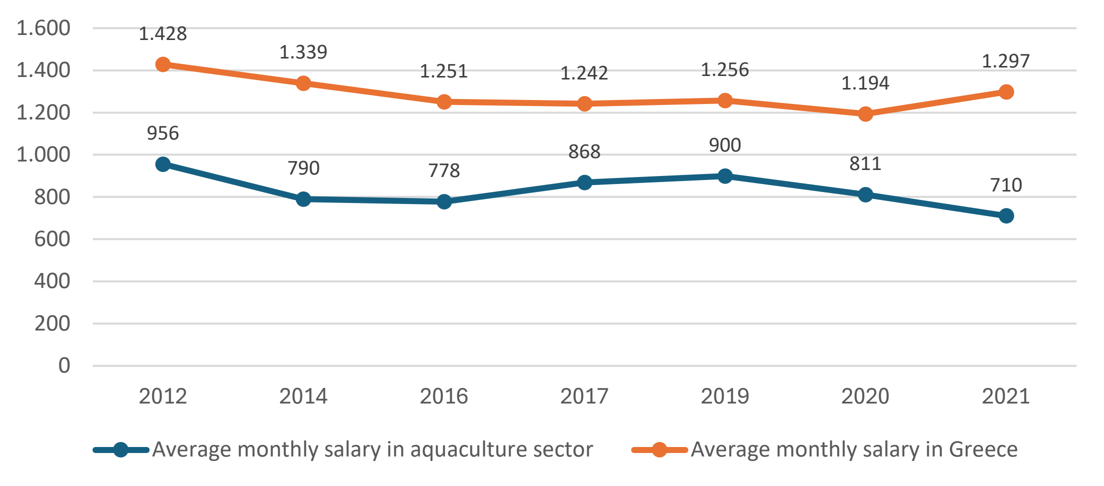
Sectors with the highest total employment multipliers are retail trade (56) Crop and animal production, hunting and related activities (45), whereas sectors with the lowest total employment multipliers are Real estate management (2) and Scientific research and development (8). The fisheries and aquaculture sector ranks in the 16th position among the 37 sectors of the Greek economy (see Appendix, Table A1).

[8] In the Input-Output Tables, the fisheries and aquaculture sectors are shown as a single sector and not separately.

2.4 Wage Data

From the analysis of the data in the Chart below, it is found that, during the period 2012-2021, the average monthly wage in the aquaculture sector is significantly lower compared to the average monthly wage in Greece. Furthermore, between 2012 and 2021, the average monthly wage deviation shows an increase, rising from 472 euros in 2012 to 587 euros in 2021. It should also be noted that during the same period (2012-2021), the average monthly wage of employees in the sector shows a more significant decrease compared to the country (-25,68 % compared to -9,16 %).

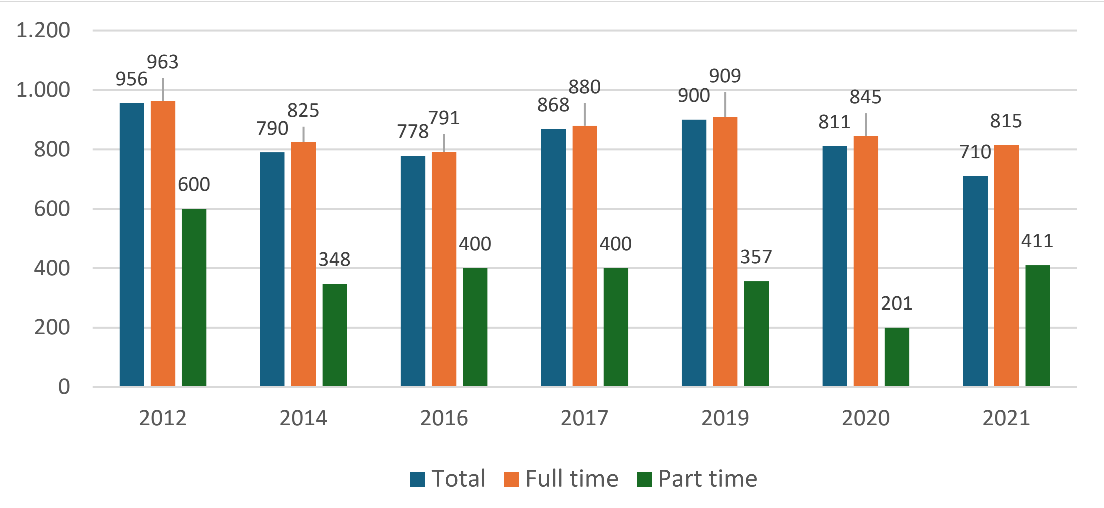
Graph 2.19: Average monthly salary in aquaculture sector and in Greece



Source: Ministry of Labour and Social Security, Hellenic Statistical Authority, EUROSTAT, Own elaboration

Investigating the data on the average monthly salary in the aquaculture sector by type of employment, it is observed that during the period 2012-2021, there was a significant decrease in the monthly salaries of full-time (-15,42%) and part-time (-31,57%) employees.

Graph 2.20: Average monthly salary of employees in aquaculture units (2012 – 2021)



Source: Ministry of Labour and Social Security, Hellenic Statistical Authority, Own elaboration

Furthermore, the analysis of data on part-time workers reveals a significant increase in daily wages per employee, from 27,80 in 2002 to 107,81 in 2023. This fact shows that part-time workers are now employed for longer periods of time in aquaculture units.

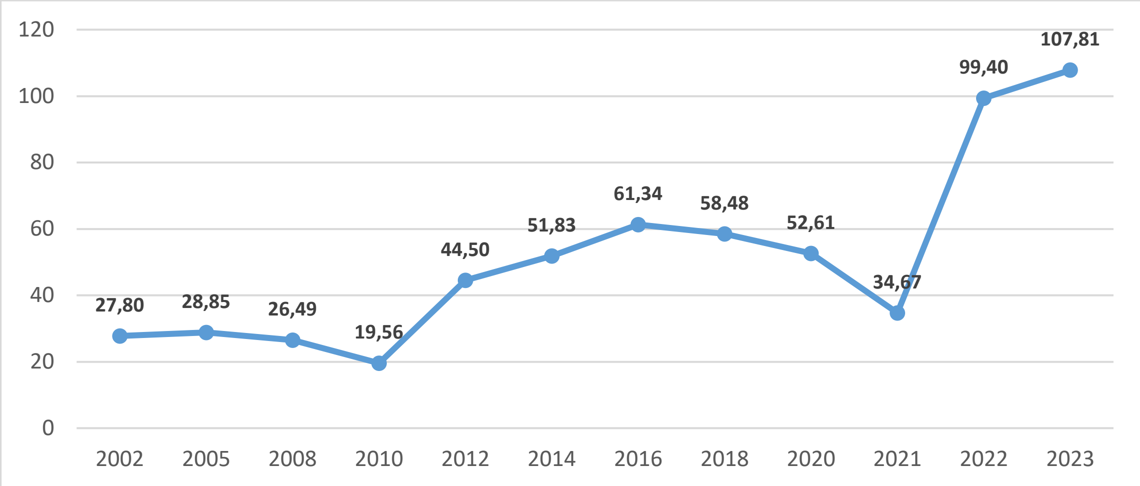
Table 2.7: Number of daily wages per employee (part-time personnel)

	2002	2005	2008	2010	2012	2014	2016	2018	2020	2021	2022	2023
Fresh water	47,80	39,66	46,21	45,70	87,12	68,76	82,27	77,92	83,21	64,59	69,13	82,11
Brackish water	47,89	39,00	50,75	50,50	22,86	46,00	95,38	36,00	121,25	32,86	29,09	38,30
Marine water	19,98	26,69	24,84	17,91	42,06	50,70	59,37	57,58	47,19	33,45	102,94	116,53
Total	**27,80**	**28,85**	**26,49**	**19,56**	**44,50**	**51,83**	**61,34**	**58,48**	**52,61**	**34,67**	**99,40**	**107,81**

Source: Hellenic Statistical Authority, Own elaboration

In particular, after 2021, there has been a rapid increase in the daily wages per part-time worker in the aquaculture sector. It is also worth noting that both the economic crisis and the emergence of the COVID-19 pandemic appear to have negatively affected the rate of change of this factor.

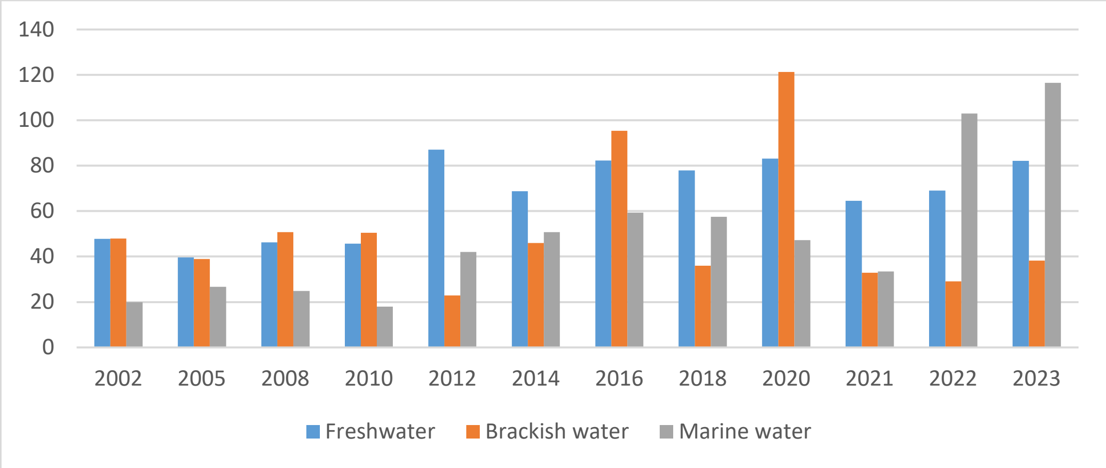
Graph 2.21: Number of daily wages per employee in total (part-time personnel)



Source: Hellenic Statistical Authority, Own elaboration

Based on the investigation of this specific factor by water type, it can be observed that, for 2023, the highest daily wage per employee is recorded in marine water aquaculture (116,53), followed by freshwater aquaculture (82,11) and brackish water aquaculture (38.30). The following Chart shows the significant decrease in the number of daily wages per employee in brackish water aquaculture after 2020. On the other hand, there has been a significant increase in daily wages in marine water aquaculture in the years 2022 and 2023.

Graph 2.22: Number of daily wages per employee by type of water (part-time personnel)



Source: Hellenic Statistical Authority, Own elaboration

Chapter 3: Economic Contribution and Ownership Analysis

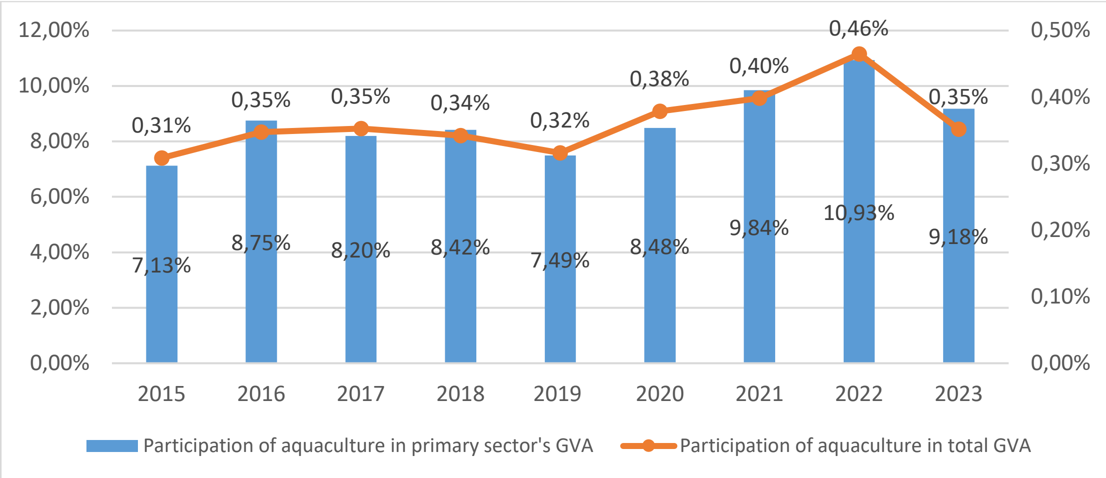
This chapter examines the economic impact of Greek aquaculture, focusing on the quantity and value of production, as well as trends in turnover. It also examines the imports and exports of the main species in the aquaculture sector. Finally, the chapter discusses the ownership situation of aquaculture enterprises in Greece, focusing on the number of active enterprises per region, their legal form, current enterprise status, and age.

3.1 Participation of aquaculture sector in Gross Value Added

Gross Value Added (GVA) is a variable used to assess a region's economic prosperity. When broken down by sector, GVA reveals the contribution of each sector to the economy, providing insight into the economy's structure, such as whether it is service—or industry-oriented.

According to the graph below, the contribution of the aquaculture sector to Greece's Gross Value Added (GVA) shows a slight increase between 2015 and 2023, (from 0,31% to 0,35%), despite the significant decrease observed between 2022 and 2023 (from 0,46% to 0,35%). During the same period, there was also an increase in the participation of the aquaculture sector in the GVA of the primary industry (from 7,13% in 2015 to 9,18% in 2023).

Graph 3.1: Participation of aquaculture sector in Gross Value Added



Source: Hellenic Statistical Authority, Own elaboration

3.2 Aquaculture production

The total production of aquaculture increased between 2015 and 2023, both in terms of quantity (+31,36%) and value (+44,74%). Analyzing the output by aquaculture category, the tables below show that marine aquaculture shows the highest percentage of production over time, both in terms of quantity (97,8% in 2023) and in terms of value (98,1% in 2023), with output in the other two categories (freshwater aquaculture and coastal aquaculture) being particularly low throughout the period 2015-2023 (only 2,2% in 2023 in terms of quantity and 1,9% in terms of value).

Table 3.1: Quantity of aquaculture products by water category, 2015-2023 (in tonnes)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	Change (2015-2023)
Freshwater	2.102	2.071	2.440	2.646	2.425	2.308	2.268	2.653	2.488	18,38%
Brackish water	773	971	642	863	656	902	862	756	589	-23,78%
Marine water	105.158	120.588	125.716	128.877	125.704	129.891	140.683	138.493	138.833	32,02%
Total	**108.032**	**123.630**	**128.797**	**132.385**	**128.785**	**133.101**	**143.812**	**141.902**	**141.909**	**31,36%**

Source: Hellenic Statistical Authority, Own elaboration

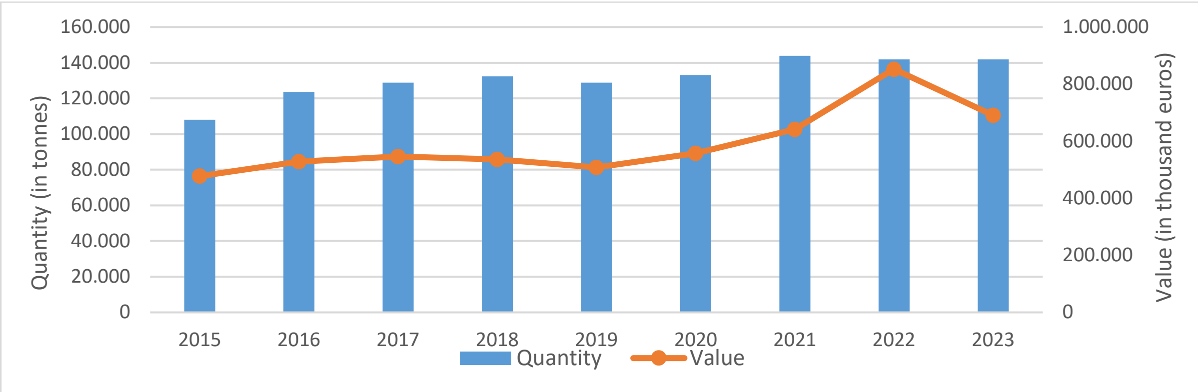
Table 3.2: Value of aquaculture products by water category, 2015-2023 (in thousands of euros)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	Change (2015-2023)
Freshwater	8.987	9.853	11.117	10.742	10.275	8.764	9.612	12.307	11.233	24,99%
Brackish water	2.784	3.348	2.464	2.350	1.965	2.613	2.346	2.348	2.123	-23,73%
Marine water	465.733	514.762	532.397	523.091	495.904	546.243	629.775	837.993	677.804	45,53%
Total	**477.504**	**527.963**	**545.977**	**536.183**	**508.144**	**557.619**	**641.734**	**852.648**	**691.160**	**44,74%**

Source: Hellenic Statistical Authority, Own elaboration

The evolution of production over time for the examined period shows a gradual increase in both quantity and value, except for the period from 2018 to 2019, during which there was a 2,7% decrease in quantity. Similarly, during the period 2017-2019, there was a 6,9% decrease in the value of production. In the following years, particularly from 2021 onwards, the production quantity remains relatively stable, whereas the production value exhibits notable fluctuations. It is particularly noteworthy that the production value increased by 32,9% during 2021-2022, a period in which production quantity decreased by 1,3%. In the following year, the figures returned to normal.

Graph 3.2: Quantity and value of aquaculture products (2015-2023)



Source: Hellenic Statistical Authority, Own elaboration

The analysis of production data for the period 2015-2023 shows that the total production quantity has increased significantly (+31,4 %). This increase is mainly due to the positive change in the production quantity of the finfish category (+38,6%). In particular, among the four (4) main categories of farmed species (finfish, shellfish and crustaceans, aquatic plants-seaweeds, fish eggs), the fish category appears to have the highest production volume (over 80%) for all the years of the examined period, followed by the shellfish and crustaceans category. In contrast, the categories of aquatic plants (seaweeds) and fish eggs have a very small share in the production of the aquaculture sector in terms of volume.

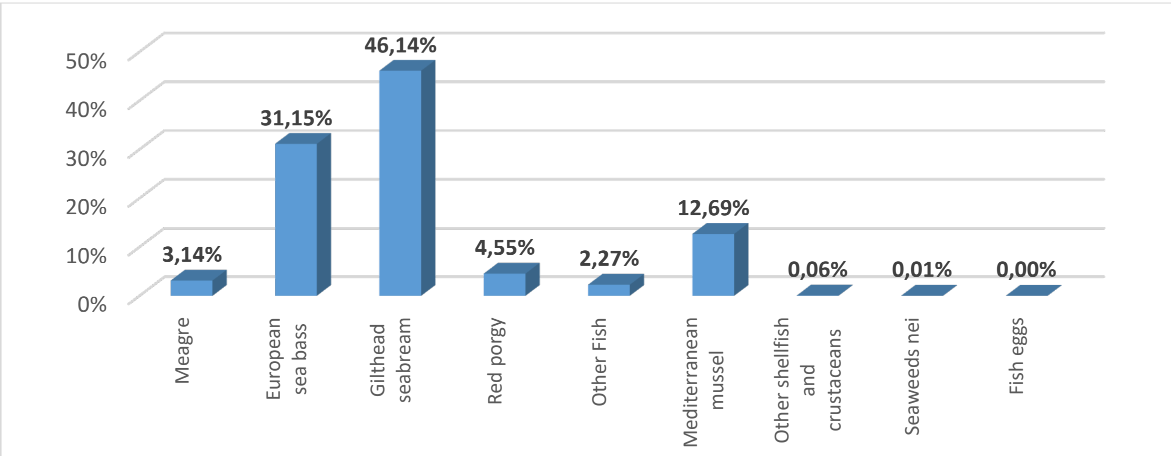
Moving to a species-by-species analysis, and in particular regarding the category of fish, gilthead seabream and European sea bass show the highest production for 2023 (46,14% and 31,15%, respectively), followed by the Mediterranean mussel (12,69%). The production rate of the first two species ranges from 74,50% (2016) to 82,78% in 2022. In addition, the significant increase in red porgy production from 2015 to 2023 is noteworthy, as is the gradual rise in meagre production quantity from 2019 onwards.

Table 3.3: Quantity (in tonnes) of reared and cultivated species (2015-2023)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	Change (2015 - 2023)
Total	**108.032**	**123.630**	**128.797**	**132.386**	**128.784**	**133.234**	**143.812**	**141.902**	**141.909**	**31,4%**
Fish	**89.335**	**100.295**	**106.230**	**110.166**	**104.944**	**112.980**	**130.062**	**130.972**	**123.801**	**38,6%**
Meagre	-	-	-	-	2.392	3.427	4.201	5.697	4.449	-
European sea bass	36.600	42.479	44.408	46.911	41.252	41.173	51.232	47.145	44.201	20,8%
Gilthead seabream	47.713	49.621	55.885	56.203	55.531	62.271	67.059	70.315	65.474	37,2%
Red porgy	782	3.031	1.280	2.202	2.939	3.033	4.590	4.793	6.455	725,8%
Other Fish	4.240	5.165	4.658	4.849	2.830	3.076	2.982	3.022	3222,2	-24,0%
Shellfish and Crustaceans	**18.680**	**23.321**	**22.462**	**22.088**	**23.696**	**20.120**	**13.684**	**10.869**	**18.087**	**-3,2%**
Mediterranean mussel	18.628	23.289	22.156	21.916	23.498	19.965	13.508	10.734	18.008	-3,3%
Other Shellfish and Crustaceans	52	32	307	172	198	156	176	135	79	52,5%
Aquatic plants-Seaweeds	**15**	**10**	**103**	**130**	**142**	**133**	**62**	**58**	**18**	**18,9%**
Seaweeds nei	15	10	103	130	142	133	62	58	18	18,9%
Fish eggs	**2**	**4**	**2**	**2**	**2**	**1**	**3**	**3**	**3**	**39,1%**

Source: Hellenic Statistical Authority, Own elaboration

Graph 3.3: Percentage proportion of quantity of reared and cultivated species (2023)



Source: Hellenic Statistical Authority, Own elaboration

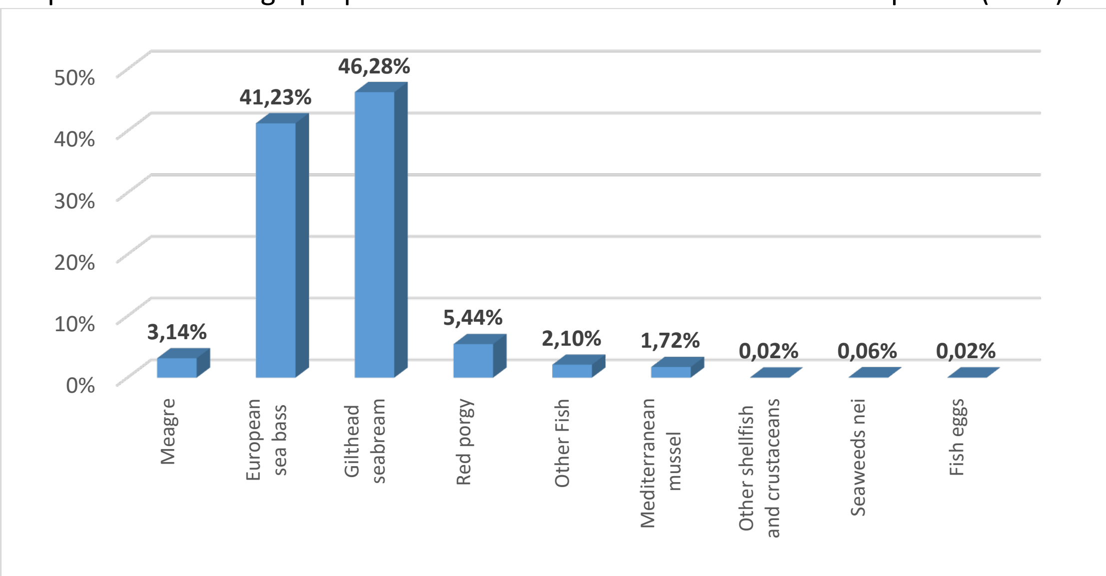
Analyzing the aquaculture sector's production in terms of value reveals a similar picture to the one presented above in terms of quantity. In particular, the total value of production shows a significant increase of 44,7% during the period 2015-2023. It is worth noting that while the value of total production increases by 67,80% during the period 2019-2022, the following year shows a decrease of 18,94%. Moreover, the fish category shows the largest share of the sector's production in terms of value, increasing from 97,83% in 2019 to 99,17% in 2022. This is due to the production value of gilthead seabream and European sea bass, which account for more than 85% of the total production value for the examined period of 2015-2023.

Table 3.4: Value (in thousands of euros) of reared and cultivated species (2015-2023)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	Change (2015 - 2023)
Total	**477.504**	**527.963**	**545.977**	**536.183**	**508.141**	**558.930**	**641.734**	**852.648**	**691.160**	**44,7%**
Fish	**469.968**	**518.957**	**536.130**	**526.576**	**497.114**	**550.756**	**635.784**	**845.613**	**678.590**	**44,4%**
Meagre	-	-	-	-	13.147	17.597	22.137	42.140	21.678	-
European sea bass	199.871	235.580	248.358	238.896	200.466	209.252	275.286	342.743	284.971	42,6%
Gilthead seabream	246.551	242.223	257.140	251.119	253.108	289.810	294.634	403.777	319.844	29,7%
Red porgy	4.918	16.444	8.334	14.926	19.547	22.940	31.500	44.180	37.599	664,5%
Other Fish	18.627	24.711	22.297	21.636	10.846	11.158	12.227	12.773	14499	-22,2%
Shellfish and Crustaceans	**6.889**	**8.481**	**8.713**	**8.219**	**9.598**	**6.818**	**5.271**	**6.236**	**12.013**	**74,4%**
Mediterranean mussel	6.849	8.450	8.282	7.743	9.132	6.461	4.992	5.997	11.897	73,7%
Other Shellfish and Crustaceans	40	31	431	476	466	357	279	239	115,3	186,8%
Aquatic plants-Seaweeds	**560**	**383**	**1.071**	**1.309**	**1.367**	**1.311**	**552**	**653**	**408**	**-27,1%**
Seaweeds nei	560	383	1.071	1.309	1.367	1.311	552	653	408	-27,1%
Fish eggs	**87**	**143**	**64**	**79**	**63**	**45**	**127**	**147**	**149**	**71,6%**

Source: Hellenic Statistical Authority, Own elaboration

Graph 3.4: Percentage proportion of value of reared and cultivated species (2023)



Source: Hellenic Statistical Authority, Own elaboration

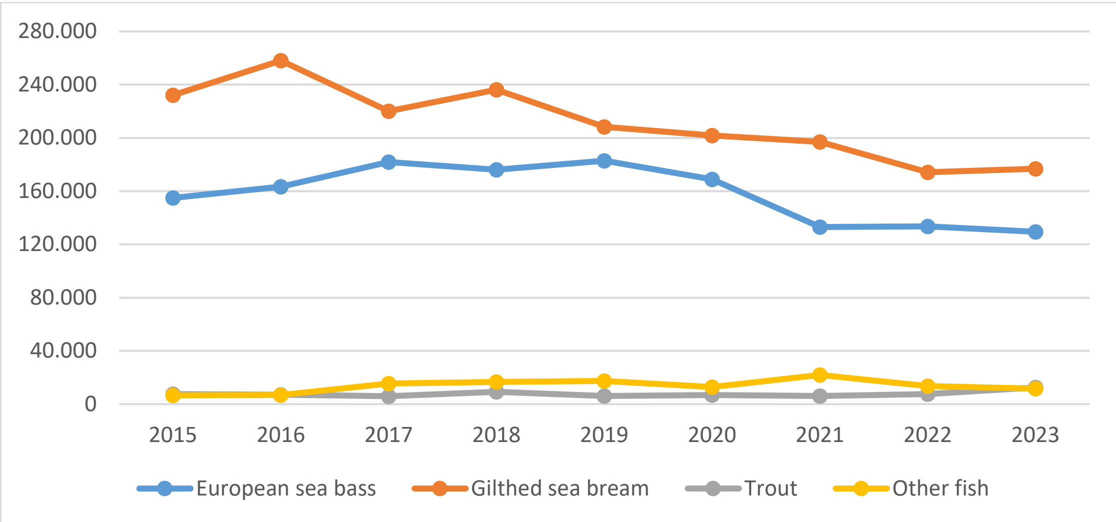
Analyzing the production of fry from hatcheries and breeding units, the data in the following table show that, during the period 2015-2023, the total output decreased by 17,58%. The decrease in total production is primarily observed after 2018 and is attributed to a decline in fry production of the European sea bass and the gilthead sea bream. These two species account for more than 90% of the total output across all years of the examined period. In particular, for 2023, the percentage of fry production of European sea bass and gilthead sea bream was 39,17% and 53,48%, respectively. On the other hand, although the production of fry from trout and other fish shows a significant increase during the period 2015-2023 (+66,85% and +77,97%, respectively), the percentage of the total production was at a significantly low level (3,79% and 3,55%, respectively, for 2023).

Table 3.5: Production of larva from hatcheries and breeding units by species during the period 2015-2023 (in thousand small fishes)

	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**Change (2015 - 2023)**
European sea bass	154.915	163.316	181.815	176.264	182.909	168.994	133.007	133.482	129.542	-16,38%
Gilthed sea bream	232.221	258.137	220.057	236.315	208.470	201.793	197.044	174.256	176.871	-23,84%
Trout	7.518	7.002	5.983	9.334	6.094	6.789	6.209	7.665	12.544	66,85%
Other fish	6.599	6.824	15.408	16.679	17.328	12.976	21.926	13.647	11.744	77,97%
Total	**401.253**	**435.279**	**423.263**	**438.592**	**414.801**	**390.552**	**358.186**	**329.050**	**330.701**	**-17,58%**

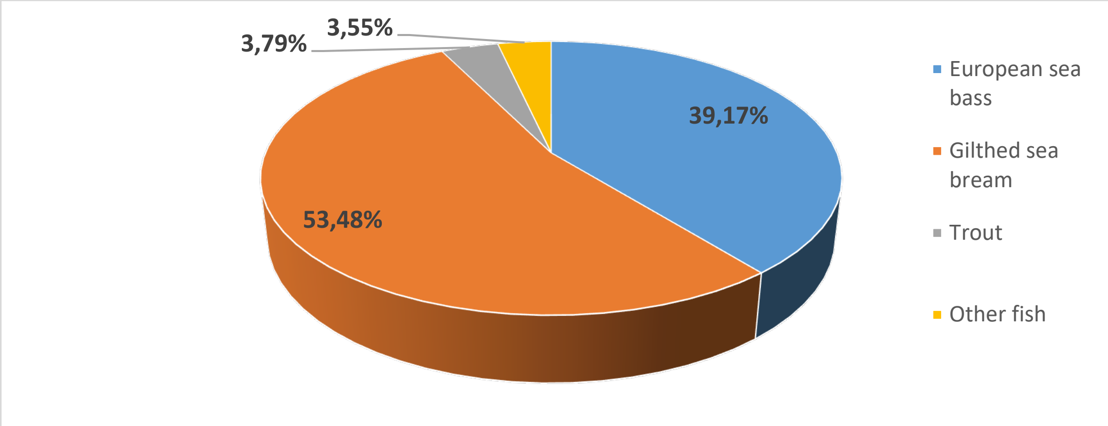
Source: Hellenic Statistical Authority, Own elaboration

Graph 3.5: Production of larva from hatcheries and breeding units, by species during the period 2015-2023 (in thousand small fishes)



Source: Hellenic Statistical Authority, Own elaboration

Graph 3.6: Percentage proportion of larva production by species (2023)



Source: Hellenic Statistical Authority, Own elaboration

3.3 Input sources used for production

This section will provide an analysis of the input sources used in the aquaculture industry. Using an Input-Output table (37x37 sectors), the technology coefficients and value-added coefficients were estimated for the year 2020.

Specifically, technological coefficients in Input-Output Analysis represent the quantity of inputs (e.g., raw materials, intermediate products) required to produce a unit of final product within a sector of the economy. Moreover, the value-added coefficients show the portion of final product value that is not attributed to intermediate inputs but instead to labor, capital, etc. According to the structure of the input-output table described in chapter 2, for the production of 1 product unit, the sum of the technological coefficients (a_{ij}) and the value- added coefficients (v_j) equals to 1. Specifically (Miller and Blair, 2022):

$$\sum_{i=1}^{n} a_{ij} + v_j = 1$$

The table below shows that for the production of a unit of final product in the fisheries and aquaculture sector[9], inputs from eighteen (18) sectors are used, contributing to a total of 29,86% of the production. The largest contribution is observed in Fishing and aquaculture products (7,902%), Coke and refined petroleum products (5,260%), Financial services, Insurance, reinsurance and pension funding services (3,561%), Transport services (3,069%), Wholesale trade services (2,790%), Textiles, wearing apparel and leather products (2,588%), Machinery and equipment (1,321%), and Retail trade services (1,213%). The remaining 70,14% of the inputs are value added and include wages and salaries, fixed capital, etc.

The total value of technological coefficients in the fisheries and aquaculture sector (0,2986 or 29,86%) is relatively low compared to the other sectors of the Greek economy. Specifically, the fisheries and aquaculture sector has the 6th lowest value of

[9] In the Input-Output Tables, the fisheries and aquaculture sectors are shown as a single sector and not separately.

technological coefficients among the 37 sectors of the economy. The low value of technological coefficients suggests that the sector requires fewer inputs to produce an output having reduced inter-sectoral dependency, whereas the production method is quite self-sufficient.

On the other hand, the relatively high value of the value-added coefficients (70,14%) in the fisheries and aquaculture sector shows that most of the production value remains within the industry itself and is not directed to suppliers. That is, a large part of the value goes into wages, income, etc. and not into purchasing products from other industries. So, the industry produces pure economic value and contributes to GDP in a significant way.

For the year 2020, the lowest (highest) values of technological coefficients (value added coefficients) are observed in the sectors of education (9,38% for technological coefficients and 90,62% for value added coefficients) and real estate services (10,49% for technological coefficients and 89,51% for value added coefficients), while the highest (lowest) values of technological coefficients (value added coefficients) are observed in the sectors of coke production and petroleum refining products (91,59% for technological coefficients 8,41% for value added coefficients) and metal product manufacturing (70,85% for technological coefficients and 29,15% for value added coefficients) (see Appendix, Tables A4 and A5).

Table 3.6: Participation of inputs and value added in aquaculture production

Sectors	Participation Percentage
Fishing and aquaculture products	7,902%
Coke and refined petroleum products	5,260%
Financial services, Insurance, reinsurance and pension funding services	3,561%
Transport services	3,069%
Wholesale trade services	2,790%
Textiles, wearing apparel and leather products	2,588%
Machinery and equipment	1,321%
Retail trade services	1,213%
Food products, beverages and tobacco products	0,666%
Wood and products of wood and cork, except furniture; articles of straw and plaiting materials	0,459%
Legal and accounting services; Architectural and engineering services; Advertising and market research services; Other professional, scientific and technical services	0,292%
Paper and paper products	0,290%
Products of agriculture, hunting and related services	0,174%
Postal and telecommunications services	0,170%
Real estate services	0,046%
Chemical products and pharmaceutical products	0,044%
Electricity, gas, steam and air-conditioning	0,018%
Rubber and plastics products	0,001%
Total intermediate consumption	**29,86%**
Value added (Wages and salaries, fixed capital, etc.)	70,14%
Total	**100,00%**

Source: Hellenic Statistical Authority, Own elaboration

3.4 Entrepreneurship and ownership in the aquaculture sector

This section presents the key figures of entrepreneurship in the aquaculture sector in Greece. According to the most recent available statistical data from the General Register of Enterprises for 2025, a total of 339 enterprises are actively operating in the sector in Greece (0,035% of the country's total enterprises and 3,99% of the enterprises in the primary sector).

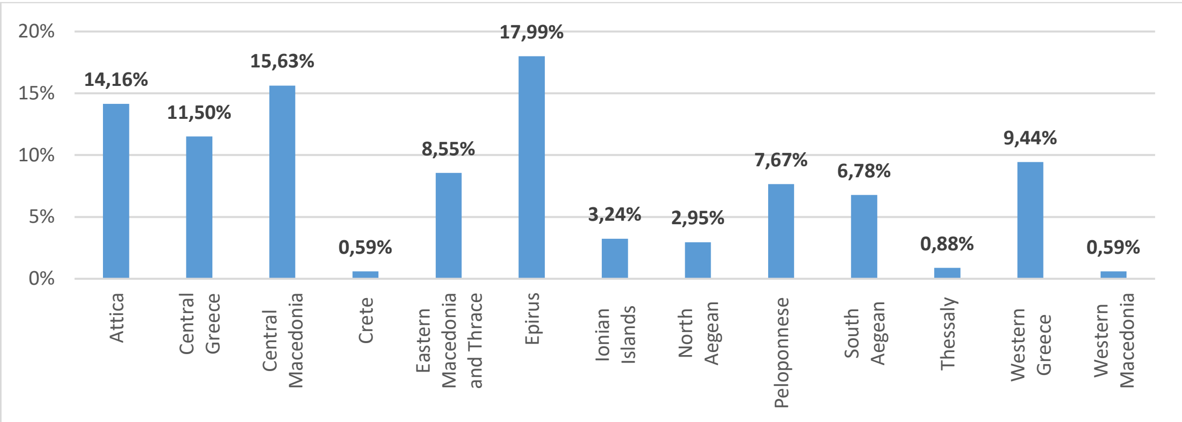
The largest percentage of these enterprises is located in the regions of Epirus (17,99% of the total), Central Macedonia (15,63%), Attica (14,16%), and Central Greece (11,50%). In fact, these four regions together account for slightly less than 60% of the total enterprises operating in the sector in Greece. On the contrary, the percentage of enterprises in the sector found in the regions of Crete, Thessaly, and Western Macedonia is particularly low, accounting for just over 2% of the total enterprises in the sector in Greece.

Table 3.7: Active enterprises in aquaculture sector at national and regional level (2025)

	Number of active enterprises	Percentage
Attica	48	14,16%
Central Greece	39	11,50%
Central Macedonia	53	15,63%
Crete	2	0,59%
Eastern Macedonia and Thrace	29	8,55%
Epirus	61	17,99%
Ionian Islands	11	3,24%
North Aegean	10	2,95%
Peloponnese	26	7,67%
South Aegean	23	6,78%
Thessaly	3	0,88%
Western Greece	32	9,44%
Western Macedonia	2	0,59%
Greece	**339**	**100,00%**

Source: General Commercial Register (G.E.MI.), own elaboration

Graph 3.7: Percentage of active enterprises in aquaculture sector per region (2025)



Source: General Commercial Register (G.E.MI.), own elaboration

Focusing on marine aquaculture subsector, the following Table shows that it concentrates the largest percentage of aquaculture sector enterprises in total (87,61%). Within the marine subsector, it should be noted that aquaculture enterprises of farmed marine finfish hold the 45,46% (135 in number) of the subsector enterprises.

Table 3.8: Active enterprises in marine aquaculture subsector at national level (2025)

	Number of active enterprises	Percentage
Aquaculture of farmed marine finfish available live	16	5,39%
Aquaculture of farmed marine finfish available fresh or chilled	119	40,07%
Marine aquaculture of cultured crustaceans available unfrozen	3	1,01%
Marine aquaculture of oysters, available live, fresh or chilled	3	1,01%
Marine aquaculture of other molluscs and aquatic invertebrates supplied live, fresh or chilled	61	20,54%
Marine aquaculture of other aquatic plants, animals and their products	2	0,67%
Marine aquaculture of seaweed and other algae	2	0,67%
Support services for aquaculture	91	30,64%
Total	**297**	**100,00%**

Source: General Commercial Register (G.E.MI.), own elaboration

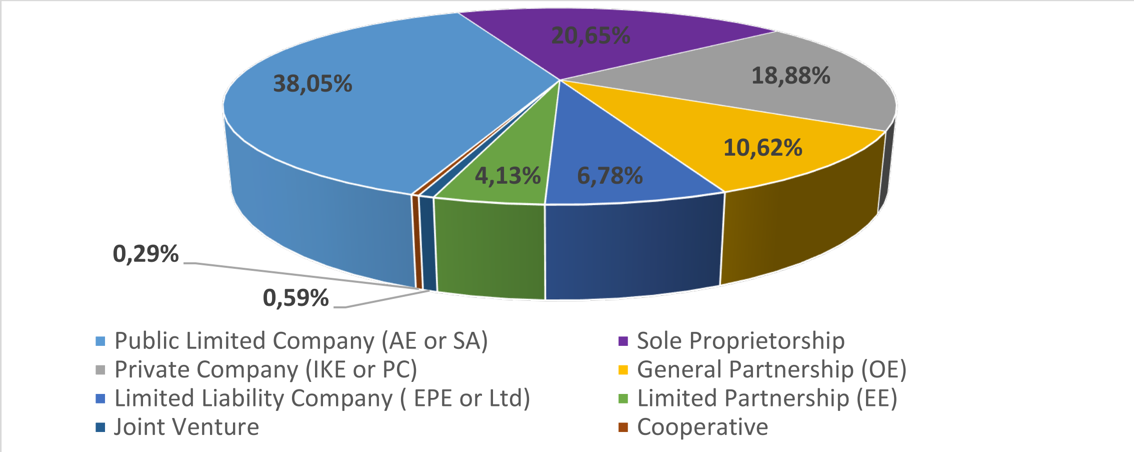
The largest share of active aquaculture enterprises in the aquaculture sector is limited liability companies (38,5%), followed by sole proprietorships (20,65%), private companies (18,88%), and general partnerships (10,62%). The traditional legal forms of entrepreneurship continue to represent a significant portion of the country's business activity in the sector, although the share of relatively newer forms, such as private limited companies, is noteworthy. On the other hand, the degeneration of other forms, which can be observed in all economic sectors of the country, such as joint ventures and cooperatives, is also evident in the aquaculture sector.

Table 3.9: Active aquaculture enterprises per legal form (2025)

	Number of active enterprises	Percentage
Public Limited Company (AE or SA)	129	38,05%
Sole Proprietorship	70	20,65%
Private Company (IKE or PC)	64	18,88%
General Partnership (OE)	36	10,62%
Limited Liability Company (EPE or Ltd)	23	6,78%
Limited Partnership (EE)	14	4,13%
Joint Venture	2	0,59%
Cooperative	1	0,29%
Total	**339**	**100,00%**

Source: General Commercial Register (G.E.MI.), own elaboration

Graph 3.8: Percentage of active aquaculture enterprises per legal form (2025)



Source: General Commercial Register (G.E.MI.), own elaboration

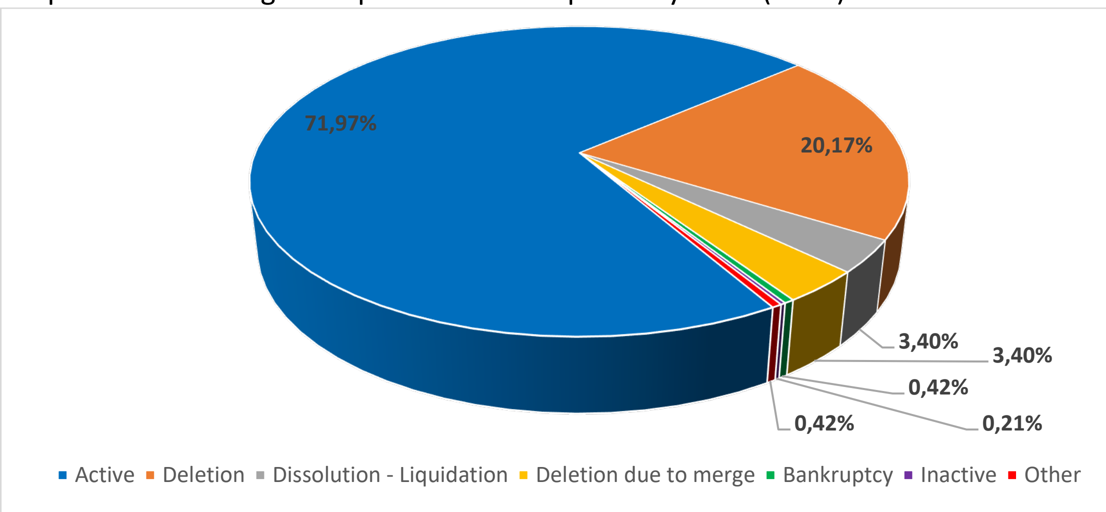
At this point, it is essential to note that, as of 2025, 132 enterprises have been recorded as having ceased their activities for various reasons. 71,9% of these enterprises were deleted from the registers of the General Register of Enterprises, a further 12,1% were liquidated, while another 12,1% were merged with other enterprises.

Table 3.10: Number of aquaculture enterprises by state (2025)

	Number of enterprises	Percentage
Active	339	71,97%
Deletion	95	20,17%
Dissolution – Liquidation	16	3,40%
Deletion due to merge	16	3,40%
Bankruptcy	2	0,42%
Inactive	1	0,21%
Other	2	0,42%
Total	**471**	**100,00%**

Source: General Commercial Register (G.E.MI.), own elaboration

Graph 3.9: Percentage of aquaculture enterprises by state (2025)



Source: General Commercial Register (G.E.MI.), own elaboration

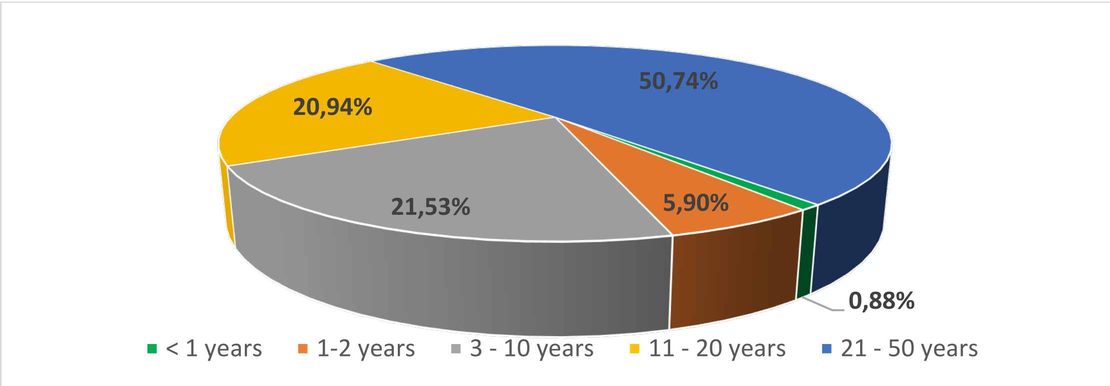
The data regarding the years of operation of the active enterprises of the sector for 2025 reveal that the majority of them (50,74%) are established enterprises with more than 21 years of operation. The relatively new enterprises (with up to 10 years of operation) comprise 28,31% of the total active enterprises, while enterprises that have just started their activity (up to 2 years of operation) comprise 6,78% of the total enterprises of the sector.

Table 3.11: Age of active aquaculture enterprises (2025)

Age (in years)	Number of active enterprises	Percentage
< 1 years	3	0,88%
1-2 years	20	5,90%
3 - 10 years	73	21,53%
11 - 20 years	71	20,94%
21 - 50 years	172	50,74%
Total	**339**	**100,00%**

Source: General Commercial Register (G.E.MI.), own elaboration

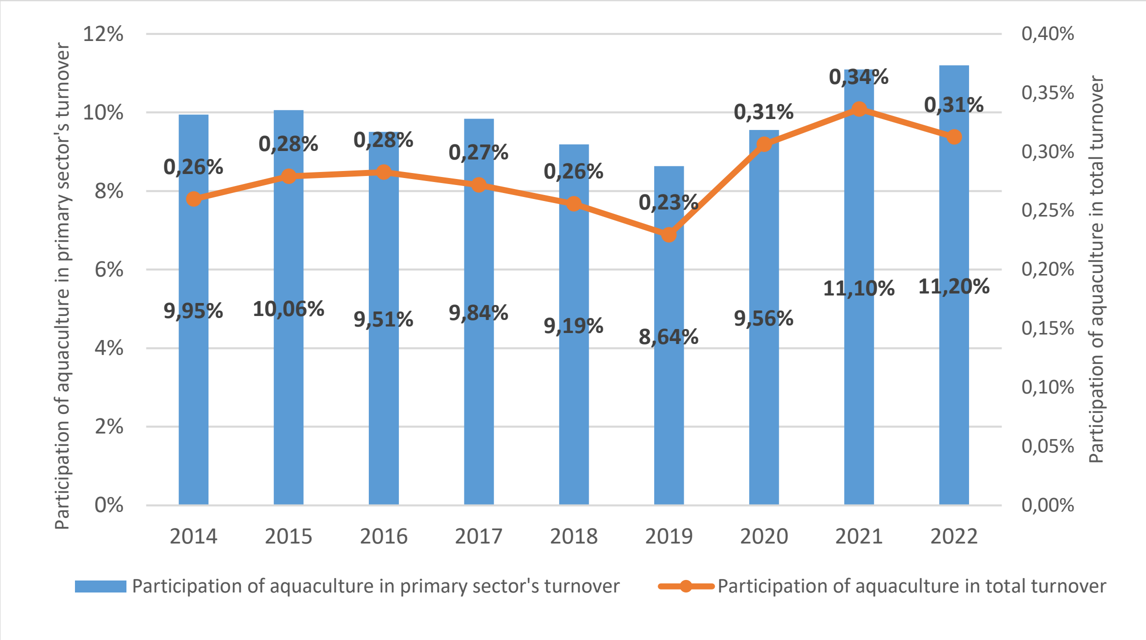
Graph 3.10: Percentage of active aquaculture enterprises per age (2025)



Source: General Commercial Register (G.E.MI.), own elaboration

The available data from the Hellenic Statistical Authority (ELSTAT) show that during the period 2014-2022, the percentage of aquaculture enterprises' turnover in relation to the overall country's turnover shows a slight increase (from 0,26% in 2014 to 0,31% in 2022). In addition, the share of aquaculture turnover in the primary sector also shows an increase (from 9,95% in 2014 to 11,20% in 2022). The share reached its highest value in 2021 (0,34% for the total economic activity of the country and 11,10% in the primary sector).

Graph 3.11: Participation of aquaculture enterprises in turnover



Source: Hellenic Statistical Authority, Own elaboration

Marine water enterprises concentrate the biggest percentage of turnover in aquaculture sector generally (about 99% during the period 2011-2022). During the period 2011-2019, a small decrease (-4,62%) is noted regarding the level of total turnover of aquaculture enterprises, with small fluctuations per year. In this period, turnover in marine aquaculture enterprises also decreases (-4,80%).

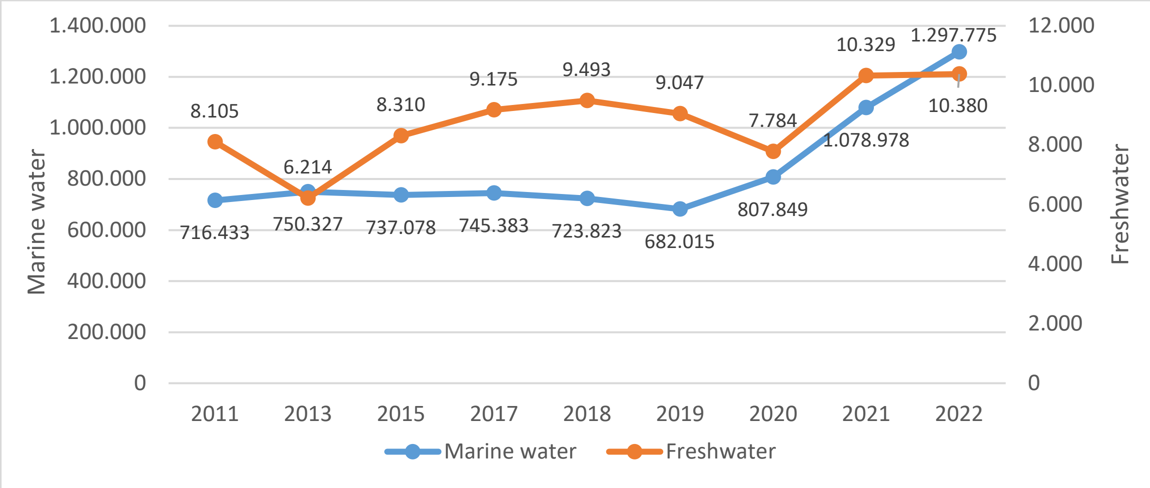
However, during the period 2019-2022, there was a significant increase of 89,3% for the turnover, that is clearly due to the evolution of the corresponding turnover in marine aquaculture (+90,29%). This increase is likely due to the increase in production (+67,79% in value and +10,18% in quantity) during the period 2019-2022.

Table 3.12: Turnover (in thousands of euros) of aquaculture enterprises by water category (2011-2022)

	2011	2013	2015	2017	2018	2019	2020	2021	2022
Marine water	716.433	750.327	737.078	745.383	723.823	682.015	807.849	1.078.978	1.297.775
Fresh water	8.105	6.214	8.310	9.175	9.493	9.047	7.784	10.329	10.380
Total	**724.538**	**756.541**	**745.388**	**754.558**	**733.316**	**691.062**	**815.633**	**1.089.307**	**1.308.155**

Source: Hellenic Statistical Authority, Own elaboration

Graph 3.12: Turnover (in thousands of euros) of aquaculture enterprises by water category (2011-2022)



Source: Hellenic Statistical Authority, Own elaboration

3.5 Trade Flows in aquaculture sector

3.5.1 Imports

The two main products (fish meal and fish oil)[10] used to meet the needs of aquaculture units are analyzed below. Over the period 2010-2022, the imports of these two products as a share of the country's total imports ranged from 0,18% (2017) to 0,26% (2020) in terms of quantity and from 0,20% (2011) to 0,34% (2020) in terms of value. For the year 2022, imports of the two products constitute 0,24% of the country's total imports (in volume and value terms).

Table 3.13: Imports (in volume and value) of basic products (fish meal and fish oil) as a percentage of Greek total imports:

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Volume	0,21%	0,19%	0,23%	0,20%	0,21%	0,19%	0,19%	0,18%	0,20%	0,22%	0,26%	0,23%	0,24%
Value	0,21%	0,20%	0,24%	0,25%	0,23%	0,27%	0,29%	0,23%	0,24%	0,26%	0,34%	0,25%	0,24%

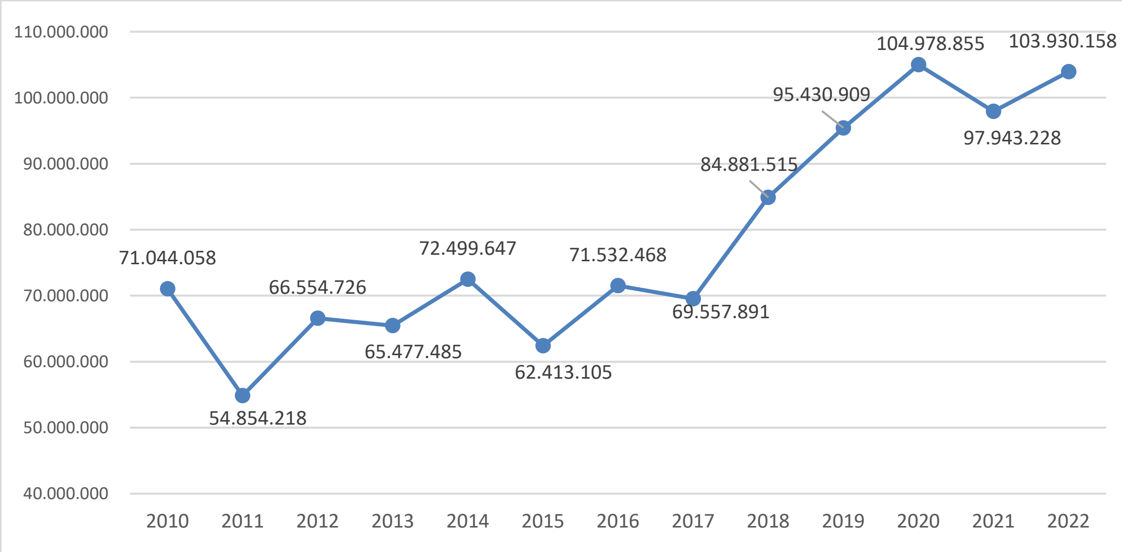
Source: European Market Observatory for Fisheries and Aquaculture Products (EUMOFA), Hellenic Statistical Authority, Own elaboration

Between 2010 and 2017, there were fluctuations in fishmeal imports, both in terms of quantity and value. However, in the following years, fishmeal imports show a significant increase, with the exception of the year 2021. Specifically, during the period 2017-2022, fishmeal imports in Greece increased by 49,42% in terms of quantity and by 97,85% in terms of value. For the year 2022, the countries from which Greece had the largest shares of fishmeal imports were Morocco (23,67% and 24,93%), Denmark

[10] It should be noted that it takes 4,5 kilos of wild fish to make 1 kilo of fish meal and 20 kilos of wild fish to make 1 kilo of fish oil. So for producing 100,000 tons of fish meal that Greece imports, it uses 450,000 tons of wild fish.

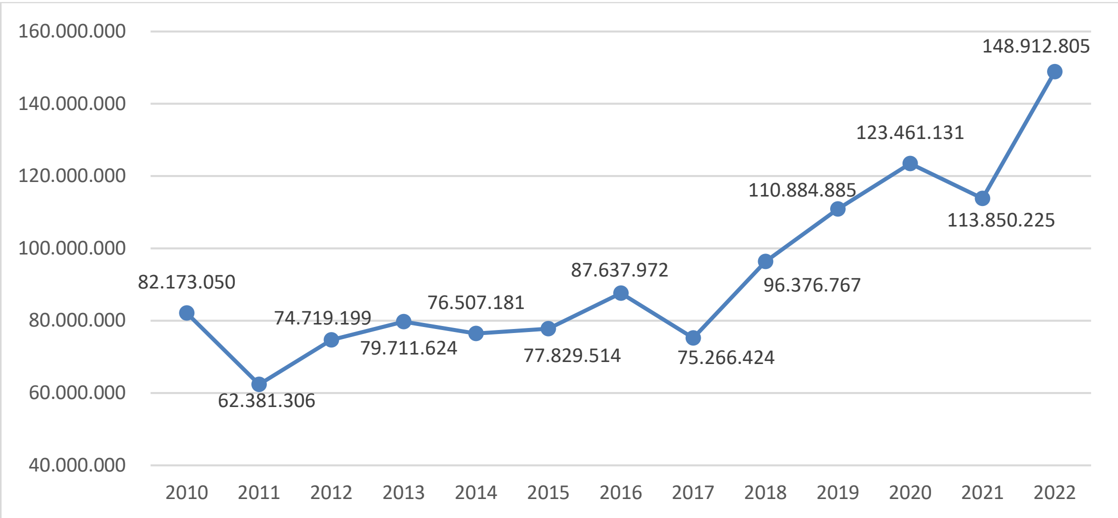
(19,13% and 20,36%), Germany (14,20% and 15,17%), Spain (12,16% and 12,83%) and Mexico (6,41% and 6,74%).

Graph 3.13: Volume of imported fish meal (in kg)



Source: European Market Observatory for Fisheries and Aquaculture Products (EUMOFA), Own elaboration

Graph 3.14: Value of imported fish meal (in euro)

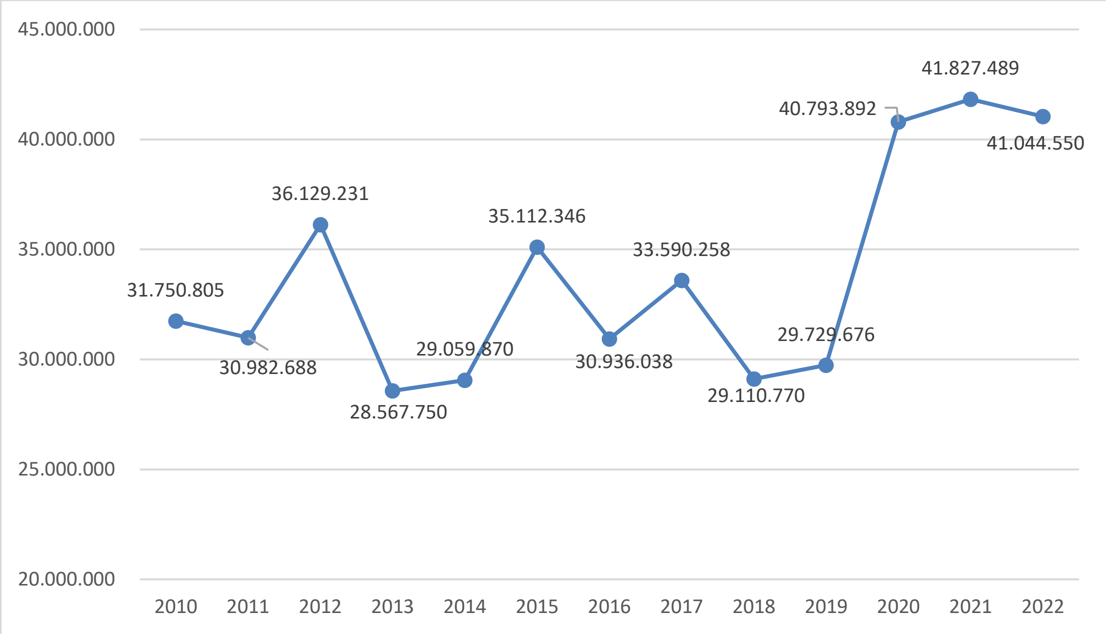


Source: European Market Observatory for Fisheries and Aquaculture Products (EUMOFA), Own elaboration

By analyzing the trends in fish oil imports, fluctuations become evident throughout the period from 2010 to 2019. However, during the period 2019-2022, fish oil imports show a particularly significant increase (+38,06 % in terms of quantity and +137,11 % in terms of value).

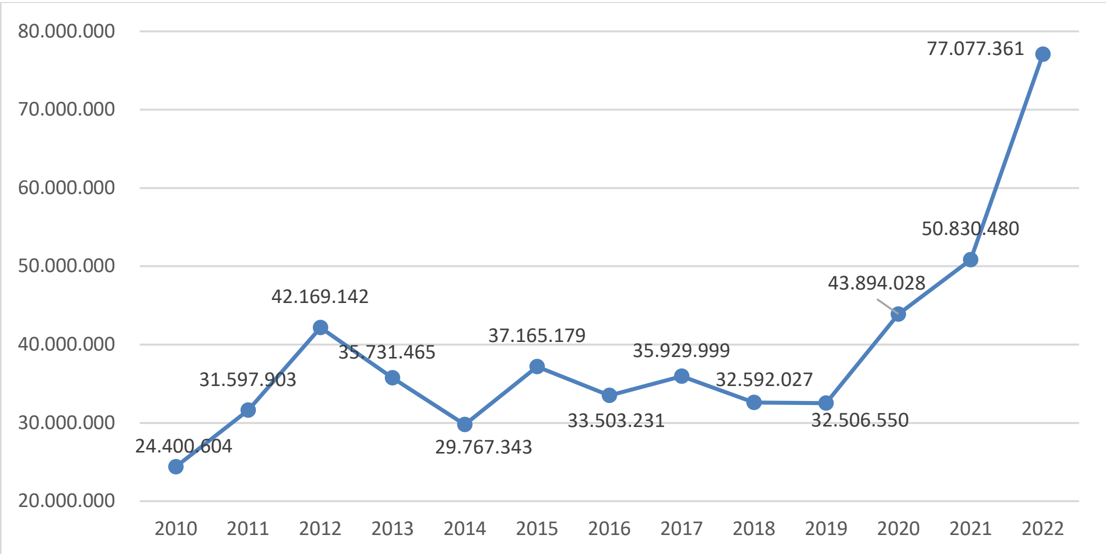
For the year 2022, the countries from which Greece had the largest shares of fish oil imports in terms of quantity and value were Norway (40,73% and 29,49%), Germany (19,84% and 23,68%), Poland (7,84% and 7,10%), Chile (7,77% and 8,23%) and Spain (7,25% and 7,08%).

Graph 3.15: Volume of imported fish oil (in kg)



Source: European Market Observatory for Fisheries and Aquaculture Products (EUMOFA), Own elaboration

Graph 3.16: Value of imported fish oil (in euro)



Source: European Market Observatory for Fisheries and Aquaculture Products (EUMOFA), Own elaboration

In general, the significant increase (in volume and value) observed in the basic imported aquaculture products (fish meal and fish oil) is reflected in Table 3.13 because the country's total imports increased at a lower percentage. Specifically, during the period 2010-2022, imports of basic aquaculture products increased by 41,03% (in volume) and 112,05% (in value), while the country's total imports increased by 25,11% (in volume) and 90,44% (in value). This fact implies that imports of basic aquaculture species as a percentage of the country's total exports increased between 2010 and 2022 (from 0,21% to 0,24% in volume and value as referred above).

3.5.2 Exports

This section refers to the main fish species (gilthead sea bream, European sea bass, mussel, trout, and eel) exported from aquaculture units in Greece. During the period 2010-2022 the share of exports of the above main fish species in relevance with the total exports of the country ranges from 0,20% (2015) to 0,32% (2010) in terms of volume and from 1,23% (2022) to 1,75% (2010) in terms of value. Between 2010 and 2022, there was a decrease in the above percentage, both in terms of volume and value.

Table 3.14: Exports (in volume and value) of basic products (gilthead sea bream, European sea bass, mussel, trout, and eel) as a percentage of Greek total exports

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Volume	0,32%	0,30%	0,26%	0,25%	0,22%	0,20%	0,22%	0,24%	0,23%	0,26%	0,27%	0,27%	0,28%
Value	1,75%	1,68%	1,40%	1,31%	1,35%	1,46%	1,65%	1,65%	1,38%	1,41%	1,71%	1,39%	1,23%

Source: European Market Observatory for Fisheries and Aquaculture Products (EUMOFA), Hellenic Statistical Authority, Own elaboration

Focusing on the 2 dominant finfish species (Gilthead sea bream and European sea bass), the table below shows that they account for the largest percentage of the sector's exports (in volume and value). Specifically, during the period 2010-2022 the share of exports of the 2 main finfish species in relevance with the total exports of the country ranges from 0,17% (2015) to 0,29% (2010) in terms of volume and from 1,19% (2022) to 1,69% (2010) in terms of value. Between 2010 and 2022, there was a decrease in the above percentage, both in terms of volume and value.

Table 3.15: Exports (in volume and value) of Gilthead sea bream and European sea bass as a percentage of Greek total exports

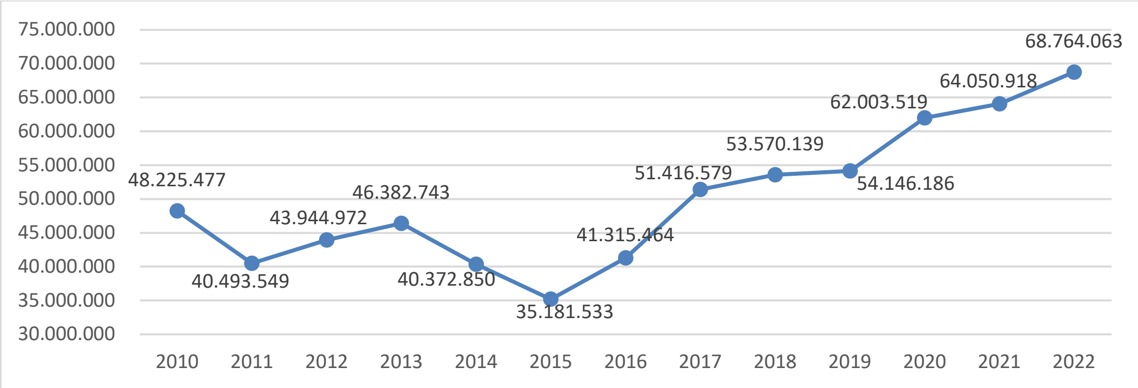
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Volume	0,29%	0,27%	0,22%	0,21%	0,18%	0,17%	0,18%	0,21%	0,21%	0,22%	0,25%	0,25%	0,27%
Value	1,69%	1,62%	1,34%	1,26%	1,30%	1,39%	1,57%	1,59%	1,33%	1,35%	1,66%	1,34%	1,19%

Source: European Market Observatory for Fisheries and Aquaculture Products (EUMOFA), Hellenic Statistical Authority, Own elaboration

By analyzing the following graphs showing the export activity for the main fish species, it is realized that the export activity of the sector's enterprises has been gradually increasing in recent years, with some periods of decline in between, particularly in the export trade of fish, including sea bream, sea bass, and trout. On the other hand, exports of mussels and eels show a relatively declining trend over time, without any years of occasional increase in activity. For 2022, the exports of sea bream by tonnage were mainly to Spain (33,86%) and Italy (30,93%), which were followed by France (13,63%), Germany (4,61%), the Netherlands (3,78%), Romania (2,35%), and Bulgaria (2,10%). In terms of total export value, the top three positions remain unchanged for 2022 (Spain, 31,86%; Italy, 31,08%; and France, 13,64%), with the Netherlands (4,97%), Germany (4,82%), Portugal (3,02%), and Romania (2,27%) following by a significant margin.

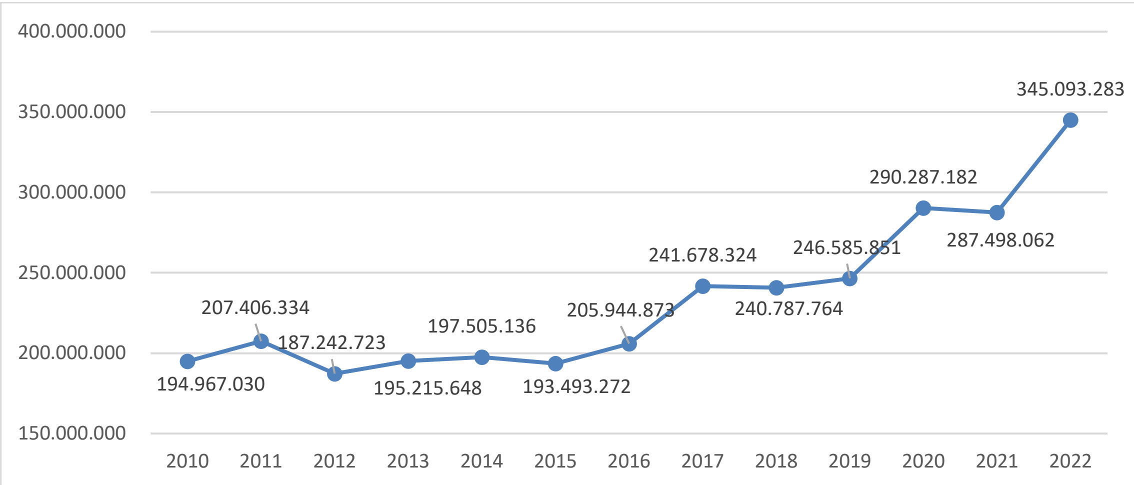
More specifically, during the period 2015-2022, there was a significant increase of 92,6% (almost doubling) in sea bream exports in terms of quantity and 78,3% in terms of value. During the preceding period 2010-2015, there was a 27,0% decrease in the tonnage of sea bream exports, although the corresponding total value of exports remained relatively unchanged (-0.8%).

Graph 3.17: Volume of exported gilthead seabream (in kg)



Source: European Market Observatory for Fisheries and Aquaculture Products (EUMOFA), Own elaboration

Graph 3.18: Value of exported gilthead seabream (in euro)

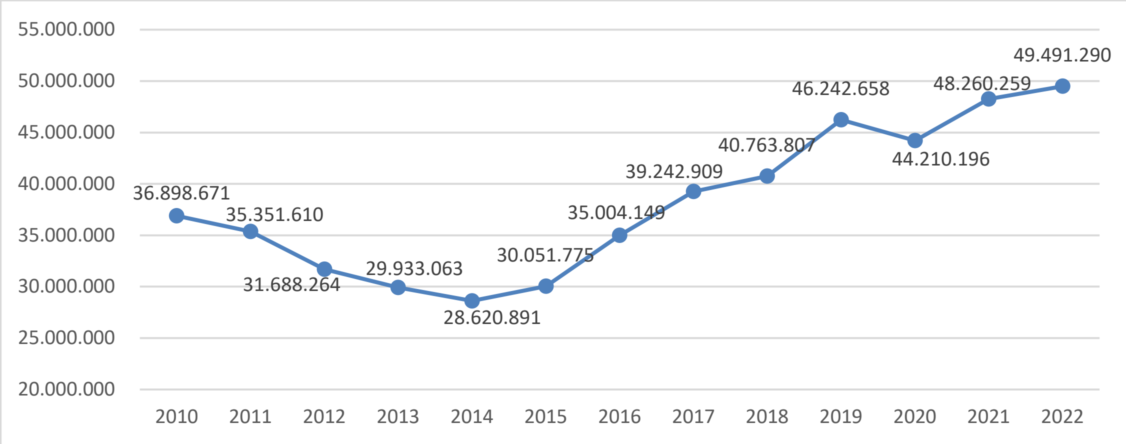


Source: European Market Observatory for Fisheries and Aquaculture Products (EUMOFA), Own elaboration

For 2022 the largest exports of sea bass by tonnage were made mainly to Italy (34,31%), Spain (26,84%) and USA (10,12%), followed by France (8,06%), the Netherlands (4,98%), Bulgaria (2,03%) and the UK (1,95%). In terms of export value the top three countries are also unchanged for 2022 (Italy 35,16%, Spain 22,69% and USA 11,14%) with France (8,16%), Netherlands (6,68%), Germany (2,25%), Bulgaria (2,06%), the UK (2,03%) and Canada (2,00%) following by a significant margin.

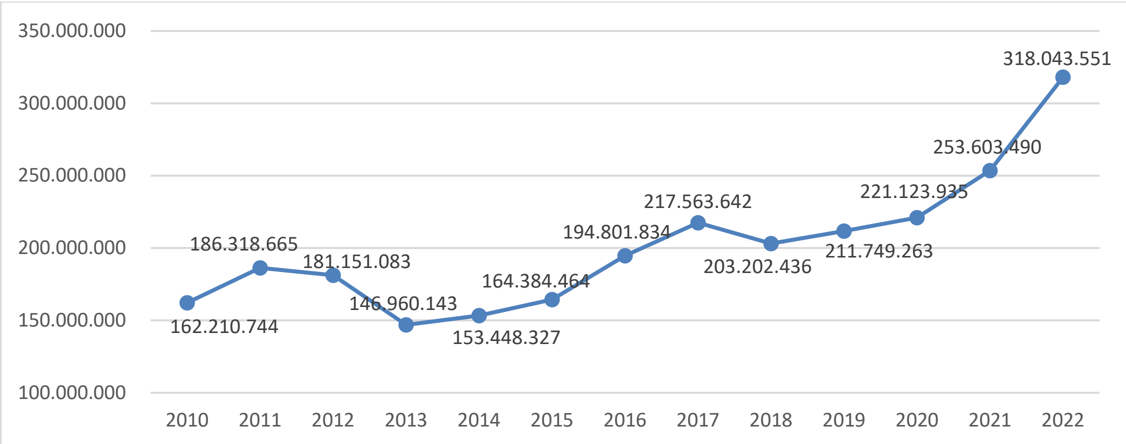
Over the period 2014-2022, an increase of 72,9% occurs in terms of quantity (with a slight decrease in 2020), while a similar increase in terms of value (+116,4 %) occurred during the period 2013-2022. During the preceding period, 2010-2014, there was a 22,4% decrease in the export quantities of sea bass. On the contrary, during the intermediate years 2011 and 2012, the total value of exports touched higher levels than 2010 and 2013.

Graph 3.19: Volume of exported European sea bass (in kg)



Source: European Market Observatory for Fisheries and Aquaculture Products (EUMOFA), Own elaboration

Graph 3.20: Value of exported European sea bass (in euro)

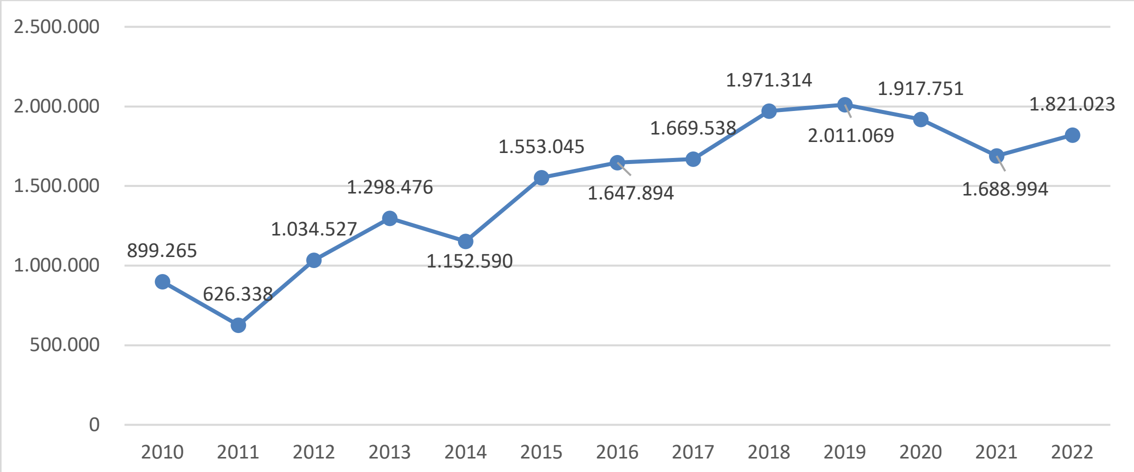


Source: European Market Observatory for Fisheries and Aquaculture Products (EUMOFA), Own elaboration

Almost half of the total quantity of trout exports of the year 2022 headed to Romania (47,37%), followed by exports to the Netherlands (11,26%), Denmark (10,51%), Italy (9,97%), and Bulgaria (8,70%). Regarding the total value of trout exports for 2022, the top importer countries were Romania (31,53%), Denmark (17,31%), Italy (15,25%), and the Netherlands (14,17%), followed with a significant margin by Poland (7,15%) and Germany (4,65%).

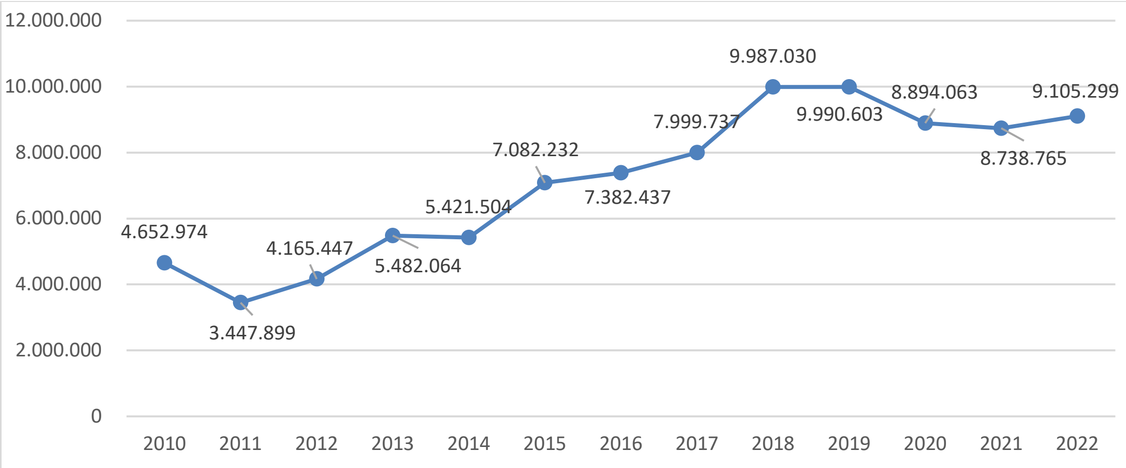
The evolution of trout exports over time has increased in terms of quantity during the period 2011-2019 by 221,1%. A temporary decrease is mentioned only in certain years (2011 and 2014) and during the period 2019-2021 (-16,0%). A similar picture is observed when analyzing the relevant data on the evolution of trout exports over time. More specifically, during the period 2011-2019, an increase of 189,8% is also mentioned, while during the period 2019-2021, a decrease of 12,5% occurs.

Graph 3.21: Volume of exported trout (in kg)



Source: European Market Observatory for Fisheries and Aquaculture Products (EUMOFA), Own elaboration

Graph 3.22: Value of exported trout (in euro)

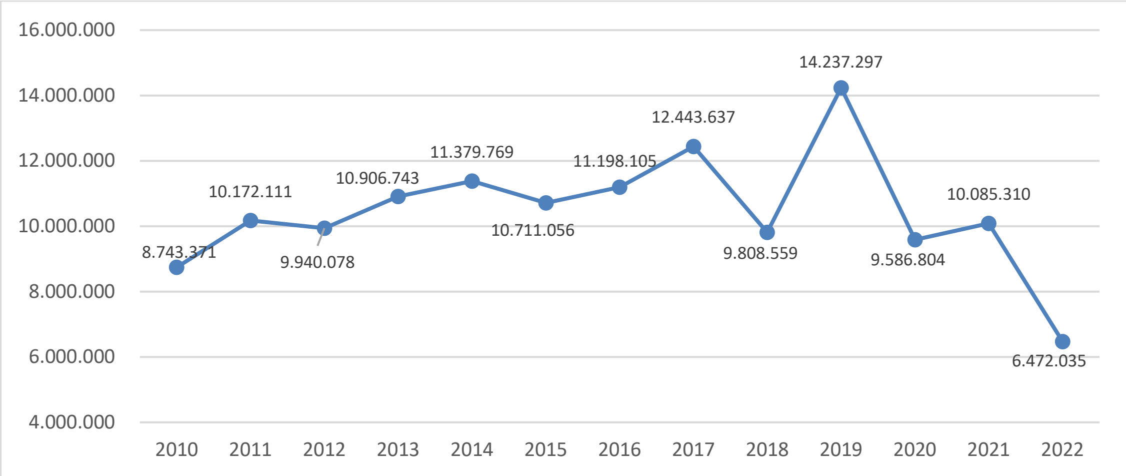


Source: European Market Observatory for Fisheries and Aquaculture Products (EUMOFA), Own elaboration

The largest share of the exported quantities for 2022 (more than ¾ of the total exported quantity) headed to Italy (76,92%). Bulgaria was a distant second (8,49%), followed by Spain (5,72%) and Germany (3,39%). In terms of the total value of mussel exports, the first place for 2022 was Italy's as expected (55,18%), followed by Germany (12,19%), Qatar (6,60%), the United Arab Emirates (5,99%), Bulgaria (4,01%) and Cyprus (3,85%).

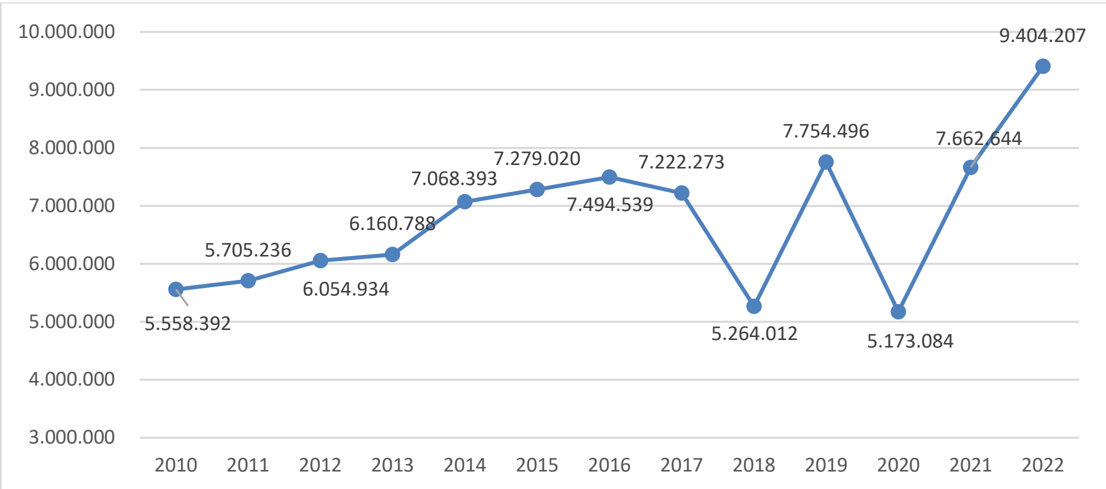
The exports of mussels show a mixed picture over time during the period 2010-2022, particularly in the last years of the examined period. More specifically, during the period 2010-2017, there was a gradual increase in exports in terms of quantity and value (+42,3% and +29,9% respectively). However, for the year 2017 in particular, while there is an increase in terms of quantity (+4,5 %), a decrease occurs in terms of value (by 3,6%). This likely occurred due to a decrease in the price of these products during that year. During the more recent years, however, the picture changes significantly, as there have been years of significant decreases in both quantity and value. More specifically, in 2018, there was a decrease of 21,2% in terms of quantity and a corresponding decrease of 21,1% in terms of value, while in the following year, there was again a significant increase of 45,2% in terms of quantity and 47,3% in terms of value. During the period 2019-2022, there was a significant decrease in the quantity of exported mussels (-54,5%), while in parallel (with the exception of 2019), the value of exports increased significantly (during the period 2020-2022, there was a significant increase of 81,8%). This reverse trend shows a significant increase in the price of exported mussels during those years.

Graph 3.23: Volume of exported mussel (in kg)



Source: European Market Observatory for Fisheries and Aquaculture Products (EUMOFA), Own elaboration

Graph 3.24: Value of exported mussel (in euro)

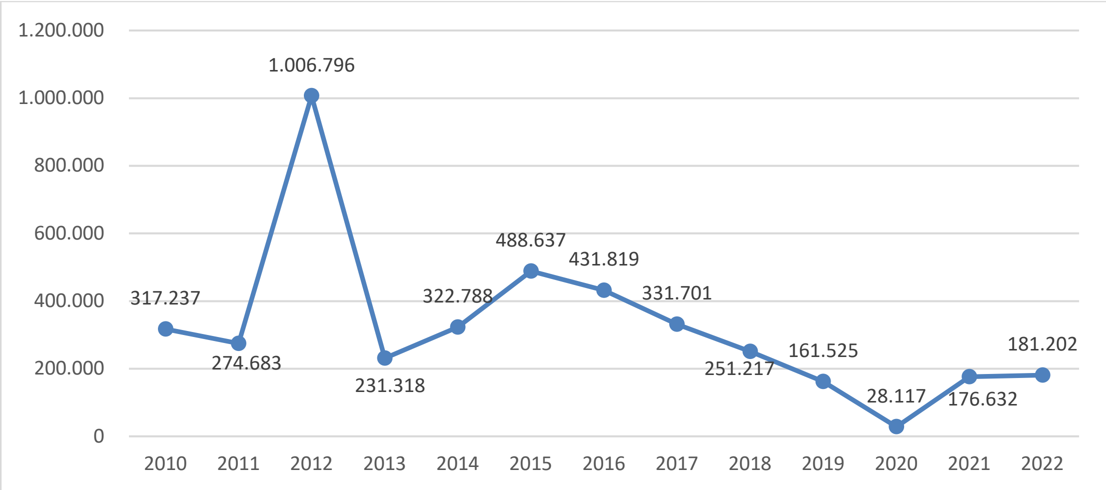


Source: European Market Observatory for Fisheries and Aquaculture Products (EUMOFA), Own elaboration

Almost all of the exported quantities of eels in the year 2020 were exported to Italy (92,86%). The Netherlands acquired a distant second place (2,20%), followed by Spain (1,32%) and Belgium (1,25%). In terms of the total value of eel exports, the first place for 2022 is again Italy's as expected (76,47%), followed by Spain (4,44%) and Belgium (4,11%).

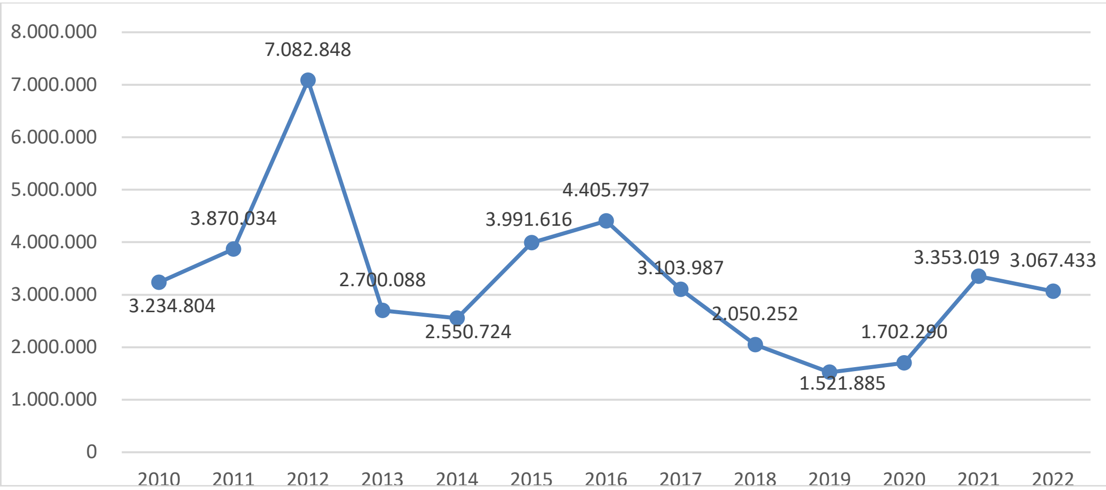
Finally, regarding the evolution of eel exports, they appear to have been decreasing over time for most of the examined period, with the exception of some specific years during which there was a temporary recovery. In particular, in 2012, there was a significant increase in exports (+266,5% in terms of quantity and +83,0% in terms of value). In 2013, this temporary increase is reversed (decrease to the 2011 levels), while during the following two years, 2014 and 2015, there is also a temporary but clearly smaller increase in exported quantities of eels (+111,2%). As regards the total value of exports, a slight decrease was recorded during 2013 and 2014 (-5,5%), followed by an increase during 2014 and 2016 (+72,7%). A period of gradual decrease in exported quantities followed - a significant decrease of 94,2% during 2015-2020 - while the value of exports during 2016-2020 also decreased significantly by 61,4%. During the last years of the examined period (2020-2022), there was a slight recovery of the sector.

Graph 3.25: Volume of exported eel (in kg)



Source: European Market Observatory for Fisheries and Aquaculture Products (EUMOFA), Own elaboration

Graph 3.26: Value of exported eel (in euro)



Source: European Market Observatory for Fisheries and Aquaculture Products (EUMOFA), Own elaboration

In general, the significant increase (in volume and value) observed in the more exported aquaculture species is not reflected in the Table 3.14 because the country's total exports increased at a higher percentage. Specifically, during the period 2010-2022, exports of basic aquaculture species increased by 33,28% (in volume) and 84,75% (in value), while the country's total exports increased by 52.44% (in volume) and 163.51% (in value). This fact implies that exports of basic aquaculture species as a percentage of the country's total exports decreased between 2010 and 2022 (from 0,32% to 0,28% in volume and from 1,75% to 1,23% in value as referred above).

3.6 Subsidies

This section analyzes the amounts of subsidies received by aquaculture companies. Specifically, from 2014 to date, enterprises in the sector have received subsidies amounting to over €120 million. This amount does not include subsidies for the programming period 2021-2027, as it is in progress. At the end of the current programming period, the exact amount of absorption by the aquaculture sector will be estimated.

Table 3.16: Subsidies in the aquaculture sector since 2014

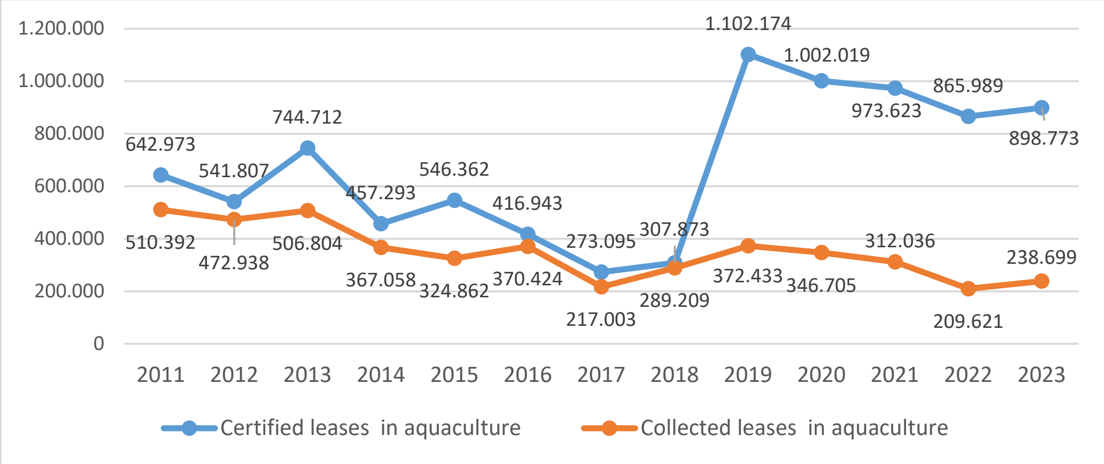
Time period	Programme / Source	Amount (mil. €)	Description
2014–2020	OP Fisheries and Maritime 2014–2020 (Actions 3.2.2 & 4.2.4)	43,1	Productive investments, innovation, sustainability (Initial total budget 93.1: million euros - Loss of funds: Approximately 50 million euros)
2021–2023	Aids (Ministry of Rural Development and Food)	25	Strengthening aquaculture to address the impacts of COVID-10 pandemic
2022–2023	Special compensations (war in Ukraine)	19,4	Compensation due to energy/geopolitical crisis
2022–2025	Recovery & Resilience Fund	34,44	Modernization of facilities, addressing climate change, reducing production costs, product diversification, promotion, research and innovation
2021–2027	Fisheries, Aquaculture and Sea Program (PALYTH)	130,4	Sustainable development of aquaculture, strengthening of processing and marketing of products (At the end of the current programming period, the exact amount of absorption by the aquaculture sector will be estimated)
Total sum of subsidies from 2014		**252,34**	**The 130,4 million euros of the programming period 2021-2027 are budgeted and not absorbed. At the end of the current programming period, the exact amount of absorption will be clarified.**

Source: Ministry of Rural Development and Food, Ministry of Health, Ministry of Development

3.7 Leasing Arrangements

Regarding the leasing arrangements, the certified leases in aquaculture range from 273.095,16 euros (2017) to 1.102.174,09 euros (2019) constituting 1,17% and 2,70% of the total state revenue respectively. Moreover, the collected leases in aquaculture range from 209.621,04 euros (2022) to 510.392,28 euros (2011) constituting 0,51% and 3,63% of the total state revenue respectively. Leasing arrangement data in the aquaculture sector show that there is a large deviation between certified and collected leases[11] after 2019. In particular, the ratio of receivable balance to certified leases in aquaculture increases rapidly after 2019 and fluctuates at high levels (from 66.21% to 75.79%) until 2023.

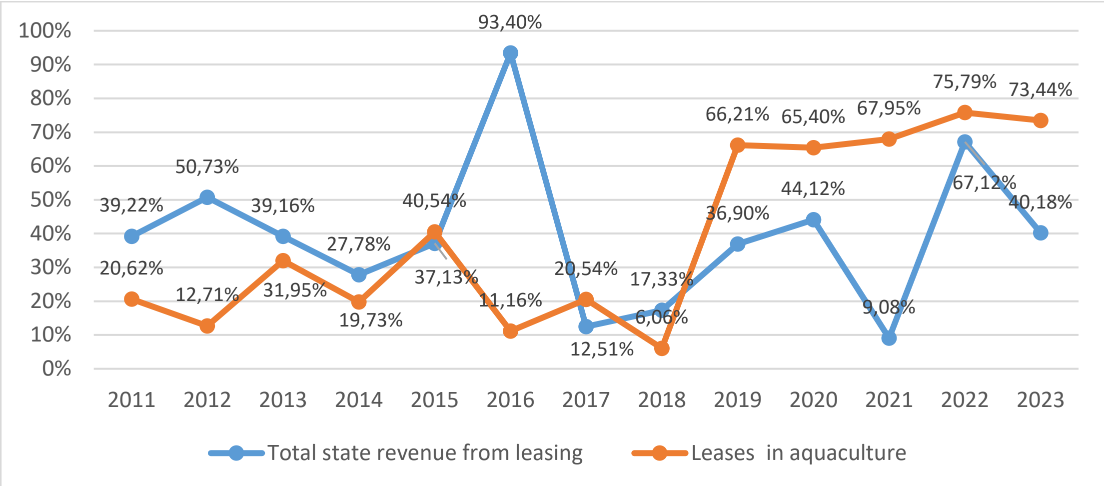
Graph 3.27: Certified and collected leases in aquaculture



Source: State budget data, Ministry of Economics

Furthermore, it should be noted that the ratio of receivable balance[12] of certified leases in aquaculture is much higher compared to the total state revenue from leasing after 2019.

Graph 3.28: Ratio of receivable balance το certified leases



Source: State budget data, Ministry of Economics

[11] Certified leases are the revenues that have been officially recorded as owed to a public authority. Collected leases are the actual cash amounts received by the authority — the payments actually made by the debtors.
[12] Receivable balance is the portion of certified revenue that has not yet been collected — in other words, the remaining amount expected to be received.

Chapter 4: Discussion and Conclusions

This report set out to assess the economic significance of the aquaculture sector in Greece, with a specific focus on **finfish aquaculture**, which represents the **core of Greek marine aquaculture** in both volume and value. While aquaculture more broadly comprises marine, freshwater, and extensive lagoon-based activities, the dominance of **finfish farming in marine environments—accounting for over 87% of production volume and over 98% of sectoral value in 2023—renders it the defining subsector** and thus the main subject of scrutiny in evaluating the sector's performance and sustainability.

Despite this dominance, **finfish aquaculture's contribution to the Greek economy remains disproportionately low**, particularly when benchmarked against its scale and policy support. Specifically, **aquaculture's Gross Value Added (GVA)** contribution of just **0,35%** in 2023 reveals structural limitations, and recent declines from 0,46% in 2022 point to **volatility driven by narrow species reliance, input cost shocks, and unstable export markets**. These weaknesses are especially concerning for a sector that has been the **recipient of significant national and EU subsidies**, and which has been promoted as a driver of rural coastal development and export-led growth.

One of the most pressing concerns surrounding Greek finfish aquaculture is its **inability to translate output volumes into robust employment or value-chain spillovers**. The subsector's employment growth between 2002 and 2023 was **marginal in absolute numbers**, and its national employment share remains negligible (below 0,1% for aquaculture sector), even as tourism—a spatially and economically adjacent sector—has witnessed explosive growth. This suggests that **finfish farming's economic footprint remains narrow and capital-intensive**, delivering minimal multipliers for local communities or the broader Greek economy.

Through the evaluation of data related to production, employment, exports, imports, etc., an attempt was made to assess the sector's role and its contribution to the country's economy. This chapter evaluates the study's findings and presents the key conclusions drawn from the analysis.

An investigation into the specific characteristics of the employed workforce reveals that, during 2012–2023, most workers belonged to the 35–55 age group across all examined years. The percentage of this age group increased by 12,02 percentage points between 2012 and 2023. Specifically, in 2023, the aquaculture sector had a higher proportion of workers in the 35–55 age group (67,95%) compared to the primary sector (47,43%) and the total national average (55,23%).

Gender-based analysis of employment reveals limited gender equality and the consistent underrepresentation of women in finfish aquaculture operations—particularly in technical, managerial, and hatchery roles—diminishing the sector's overall social inclusiveness and innovation potential. Specifically, the gender-based analysis of employment reveals that, during 2012–2023, men consistently held a higher share of employment than women across all examined years. Specifically, in

2023, the aquaculture sector had a lower percentage of female employees (31,77%) compared to the primary sector (36,59%) and the national average (42,83%). These figures point to limited gender equality and the consistent underrepresentation of women in the sector, which diminishes aquaculture's (and finfinh’s) overall social contribution to the economy.

Regarding gender distribution in the tourism sector, men were the majority throughout the reference period. For instance, in Q3 of 2008, men represented 53,1% and women 46,9% of the workforce. In 2017, these figures were 53,6% and 46,4%, respectively. Furthermore, after 2014, when employment in tourism began to recover, male employment increased faster than female employment.

The educational level of employees reveals a need for upskilling. Examining the educational level of employees in the aquaculture sector during 2012–2022, there was a significant rise in the proportion of workers with a high school diploma (+20,99 percentage points). This suggests the sector is increasingly attracting staff with basic secondary education, thereby improving the overall educational foundation and quality of human capital. At the same time, the increase in higher education/postgraduate degree holders (from 10,06% in 2012 to 18,44% in 2022) has strengthened the sector's knowledge base and technical capacity. The proportion of university graduates is higher than the average in the primary sector (6,75%), indicating that aquaculture is more technologically advanced and demanding than other primary activities such as agriculture or livestock farming. However, despite these improvements, the share of employees in aquaculture with higher education remains significantly **below the national average** (18,44% vs. 39,25% in 2022), suggesting **the sector still lags behind the broader economy regarding innovation and knowledge potential**.

From the analysis of wage data for 2012–2021, a significant weakness emerges in the sector's contribution to the labor market, specifically in wage levels and salary competitiveness. The average monthly wage in aquaculture is consistently lower than the national average, ranging from €710 (in 2021) to €956 (in 2012), compared to the national average, which ranges from €1.194 (in 2020) to €1.428 (in 2012). This makes aquaculture **less attractive to highly skilled human capital**. Moreover, the widening gap between average monthly wages in aquaculture and the national average (from €472 in 2012 to €587 in 2021) indicates a worsening relative position for sector employees, despite the country's post-crisis economic recovery.

Additionally, during the same period (2012–2021), the aquaculture sector experienced a much **sharper decline in average monthly wages (−25,68%) compared to the national economy** as a whole (−9,16%). This suggests that workers in the sector were disproportionately affected by crises (economic crisis, pandemic), potentially discouraging the recruitment and retention of labor. Lastly, the dramatic 31,57% decrease in wages for part-time employees highlights economic insecurity for this group, often including youth, women, and seasonal workers.

The increase in workdays per part-time employee suggests improved employment duration, especially in finfish hatcheries and nurseries. However, **this does not correspond to higher earnings or improved conditions**. In detail, the data analysis regarding part-time employees reveals a significant increase in workdays per employee, from 27,80 days in 2002 to 107,81 days in 2023 (almost a fourfold rise). This indicates improved stability and duration of employment for workers in this category. The sharp increase after 2021 may be linked to heightened production needs, company operational adjustments, or efforts to reinforce the labor force following the pandemic. However, it should be noted that an increase in workdays does not necessarily mean higher earnings per employee, but rather an increase in the number of working days. Therefore, while job duration has improved, this does not automatically imply increased daily wages.

Analyzing production data from 2015 to 2023, there was a significant increase in both production volume (+31,36%) and production value (+44,74%), indicating steady growth and improved efficiency in the sector. When examining the breakdown by water type, marine aquaculture overwhelmingly dominates, serving as the industry's central pillar (97,8% of volume and 98,1% of value in 2023). On the other hand, the almost negligible contribution of freshwater and brackish water aquaculture indicates **a lack of diversification and a potential risk of overdependence on marine production,** which exposes the entire sector to biological, market, and environmental risks related to just two species.

A review of data by species category shows that finfish production forms the sector's backbone (over 80% of production volume and more than 97% of production value), demonstrating a high degree of specialization, competitiveness, and economies of scale. However, this also implies a vulnerability due to dependence on specific species.

The two dominant fish species in Greek aquaculture are gilthead sea bream and European sea bass. During 2015–2023, these two species accounted for between 74,50% and 82,78% of production volume and between 87,51% and 93,49% of production value respectively. This intense concentration offers stability due to market familiarity and well-established farming techniques, but also exposes the sector to risks in case of price drops or disease outbreaks. Beyond these two species, a small but growing diversification is observed, with meagre and red porgy showing notable increases in production.

A decline in hatchery production between 2015 and 2023—especially for sea bream and sea bass—**raises concern for long-term sustainability**. Given that hatchery production represents the first critical stage in the aquaculture value chain, the 17,58% decrease during the 2015–2023 period directly impacts future output of final products. It serves as a negative indicator for the long-term sustainability of the sector. Specifically, gilthead sea bream and European sea bass account for over 90% of hatchery production each year. Both species experienced significant declines in hatchery output after 2018 (−25.15% and −26.51% respectively during 2018–2023), concerning the sector’s resilience and competitiveness.

Analyzing the production structure through input-output analysis reveals that the total technological coefficients for the fishing and aquaculture sector are relatively low (6th lowest among 37 sectors of the economy). This means that the sector does not heavily rely on inputs from other sectors (e.g., machinery, fuels, services, materials) to produce its goods. In other words, aquaculture is a relatively autonomous sector with more self-sufficient production than other parts of the economy. Overall, **Input-output analysis reveals weak backward linkages** in finfish aquaculture, limiting inter-sectoral dynamism, despite high value-added coefficients.

On the other hand, the relatively high added-value coefficients in the fishing and aquaculture sector show that most of the value generated remains within the sector itself— i.e., a significant portion goes toward wages, income, etc., rather than purchasing products from other sectors. As such, aquaculture generates pure economic value and can contribute meaningfully to GDP.

Entrepreneurship data reflects a mature but stagnant sector, with high failure rates and regional concentration, particularly among high-capital finfish units: Regarding the sector's entrepreneurial structure, the 339 aquaculture enterprises (as of 2025) represent only 0.035% of all Greek businesses and 3.99% of those in the primary sector. Around 60% of these enterprises are located in just four regions (Epirus, Central Macedonia, Attica, Central Greece), indicating regional specialization. In contrast, other regions (Crete, Thessaly, Western Macedonia) show almost zero participation, reflecting geographic imbalances.

Furthermore, over 50% of aquaculture businesses are over 21 years old, which points to a mature and stable sector with firms that have withstood the test of time. However, the significant number of enterprises that have ceased operations (e.g., due to deregistration or liquidation) suggests a high level of business risk, possibly due to economic pressures, financing difficulties, strict regulatory frameworks, or price volatility. Finally, only 6,78% of businesses are very young (≤2 years old), indicating low startup activity—possibly due to high initial costs, administrative hurdles, or weak investment interest.

Turnover data show modest improvement, but growth is concentrated in marine finfish enterprises. From the analysis of turnover data for aquaculture businesses, we observe a small but steadily increasing contribution both to the overall economy (from 0,26% in 2014 to 0,31% in 2022) and to the primary sector (from 9,95% in 2014 to 11,20% in 2022). Notably, after 2019, there is a significant increase in turnover within the sector (+89.3% during 2019–2022), especially when compared to the previous period (2011–2019), which showed a slight decline (−4,62%). Additionally, data reveal the apparent dominance of marine aquaculture (99,2% of turnover in 2022), highlighting the strong momentum in producing export-oriented species such as sea bass and sea bream, which are in demand in international markets.

Continuing with the analysis of trade flows in the aquaculture sector, data show a substantial increase in imports of fishmeal (+49,42% in quantity and +97,85% in value) during the 2017–2022 period, and of fish oil (+38.06% in quantity and +137.11% in value) during 2019–2022. This reflects increased production and nutritional demands for farmed fish populations and indirectly indicates rising turnover and production activity, especially in marine aquaculture, the dominant sector. **Dependence on imports undermines resilience**, but also offers opportunities for domestic circular feed production.

Moreover, although fishmeal and fish oil imports remain a small share of total national imports (0,24% in 2022), their share has been rising (from 0,21% in 2010). This means aquaculture now contributes more to the volume and value of Greece's overall imports compared to the past, reflecting its growing importance within the agri-food sector.

However, the sector's near-total dependency on feed imports (mainly from countries such as Morocco, Norway, Germany, etc.) makes it vulnerable to external risks, such as global price fluctuations or international crises, which limit its long-term sustainability and resilience. Moreover, it should be noted that it takes 4,5 kilos of wild fish to make 1 kilo of fish meal and 20 kilos of wild fish to make 1 kilo of fish oil. So for producing 100,000 tons of fish meal that Greece imports, it uses 450,000 tons of wild fish.

Exports of the main finfish species (sea bream and sea bass) increased, but **their share in Greece's total exports declined**, revealing stagnation in global competitiveness (in volume from 0,29% in 2010 to 0,27% in 2022 and in value from 1,69% in 2010 to 1,19% in 2022). Totally, during 2010–2022, the Greek aquaculture sector saw increased exports of main species like sea bream, sea bass, and trout, both in volume and value, with robust performance after 2014. However, their share in Greece's total exports declined, both in volume (from 0,32% in 2010 to 0,28% in 2022) and in value (from 1,75% in 2010 to 1,23% in 2022), as the overall national export base expanded at a faster rate than the aquaculture sector. This suggests that other economic sectors have outpaced aquaculture (and specifically finfish) in export growth, hinting at possible issues in competitiveness or limited diversification within the industry.

Inefficiencies in leasing arrangements persist, especially in finfish farming zones. Specifically, after 2019, there's a significant gap between what is certified (expected to be collected) and what is collected in lease payments in the aquaculture sector. This indicates inefficiencies in revenue collection or increased delays/non-compliance in payments. The ratio of receivable balance to certified leases rose sharply after 2019 and remained high (from 66,21% to 75,79%) until 2023. This means that over two-thirds of the expected lease revenues remain uncollected each year, suggesting a persistent structural or administrative issue. The receivable ratio in aquaculture is much higher than the corresponding ratio in the overall state leasing revenues, highlighting that aquaculture is underperforming more severely than other sectors.

Overall the Key findings include:

- **Narrow Economic Footprint**: The sector has not translated high output into proportional socio-economic benefits. **Employment growth is minimal**, and **multiplier effects are weak**, especially when compared to sectors like tourism.
- **Employment Characteristics**: The workforce is **dominated by the 35–55 age group**, but the sector exhibits **low female participation (31,77%)**, especially in technical and managerial roles, limiting inclusivity and innovation.
- **Skills and Education Gaps**: While educational attainment has improved, **only 18,44% of employees hold higher education degrees**, compared to a national average of 39,25%, reflecting a **need for upskilling and R&D support**, particularly in finfish hatcheries and production units.
- **Low Wage Competitiveness**: Wages in aquaculture are **significantly below national averages**, and **declined faster during crises**, undermining the sector's attractiveness to skilled workers.
- **Production Dependence and Biological Risk**: The sector is **highly dependent on two species—sea bream and sea bass**, which raises serious concerns regarding **market and disease vulnerability**. Hatchery output for these species **declined sharply after 2018**, threatening future supply.
- **Weak Sectoral Linkages**: Input-output analysis shows **low integration with other economic sectors**, limiting spillover effects and regional benefits, although the sector retains high value-added internally.
- **Entrepreneurship Stagnation**: The sector is **mature but stagnant**, with **low startup rates**, high closure levels, and **concentration in just four regions**, exacerbating geographic imbalances and structural fragility.
- **Heavy Import Dependency**: Rising **fishmeal and fish oil imports** point to **feed-related vulnerabilities**, though they also indicate potential for **investments in domestic or circular aquafeed alternatives**.
- **Export Limitations**: Despite increased volumes, **finfish aquaculture's share in total Greek exports declined**, reflecting **stagnation in competitiveness and limited diversification**.
- **Leasing arrangements Inefficiencies**: Lease revenue collection is **consistently underperforming**, especially in finfish zones, with **over 66% of certified lease revenues remaining uncollected annually** - highlighting administrative inefficiencies.

In conclusion, despite its dominant position in terms of production volume and value, **finfish aquaculture in Greece exhibits a disproportionately narrow economic footprint**. It has failed to generate substantial socio-economic benefits or stimulate broader development outcomes. The sector suffers from **minimal employment growth**, **low wage competitiveness**, and **limited inclusivity**, with persistent gender gaps and underrepresentation of women in key roles. Its **heavy reliance on two species** (sea bream and sea bass) exposes it to biological and market shocks, while the **sharp decline in hatchery output** further undermines long-term sustainability. Structural weaknesses such as **limited inter-sectoral linkages**, **geographic concentration**, and **entrepreneurial stagnation** signal a lack of dynamism and innovation. Meanwhile, its **dependence on imported fishmeal and fish oil** raises serious concerns over resilience and supply chain vulnerability. Export performance, too, lags behind, as the sector's global competitiveness erodes over time. Finally, **administrative inefficiencies in lease collection**, especially in finfish zones, reflect poor governance and lost public revenue. Altogether, these findings cast doubt on the sector's capacity to fulfill its long-touted role as a driver of blue growth, suggesting that a strategic shift toward diversification, modernization, and better governance is urgently required.

Comparative Analysis and Key Conclusions

This section presents a comparative assessment of the aquaculture sector—particularly finfish aquaculture—against broader national economic trends and the tourism sector, which serves as a relevant benchmark due to its coastal, labor-intensive, and export-oriented nature. By examining long-term employment trends, economic multipliers, and contribution to GDP, the analysis aims to contextualize the sector's real impact within the Greek economy. Although finfish aquaculture has received significant financial and policy support, its limited job creation, low multiplier effects, and minimal contribution to national value-added raise critical questions about its long-term socio-economic relevance.

An analysis of employment data reveals that finfish aquaculture has failed to deliver meaningful job creation, despite moderate percentage gains in specific years. **Between 2002 and 2008, employment rose by 19,56%, yet this translated into just 811 additional jobs**—a negligible figure relative to national employment trends. **More critically, over the full period from 2002 to 2023, employment in the aquaculture sector actually declined by 1,13%,** even as overall national employment increased by 13,58%. **This stark contrast underscores the sector's persistent underperformance in generating jobs**, despite being export-oriented and having received substantial policy and financial support[13].

Additionally, during the same period (2002–2023), the share of aquaculture (and specifically finfish) employment **remained stagnant, hovering between 0,08% and 0,10% of total national employment**, reaffirming its marginal role as a national employer. **The sector also demonstrated high vulnerability to external shocks**, with employment plummeting during the economic crisis (−15,33%) and the COVID-19 pandemic (−8,68%), amounting to 760 and 368 job losses respectively. **These patterns reveal a structurally fragile sector with low employment resilience and limited capacity to absorb or protect labor in times of crisis**.

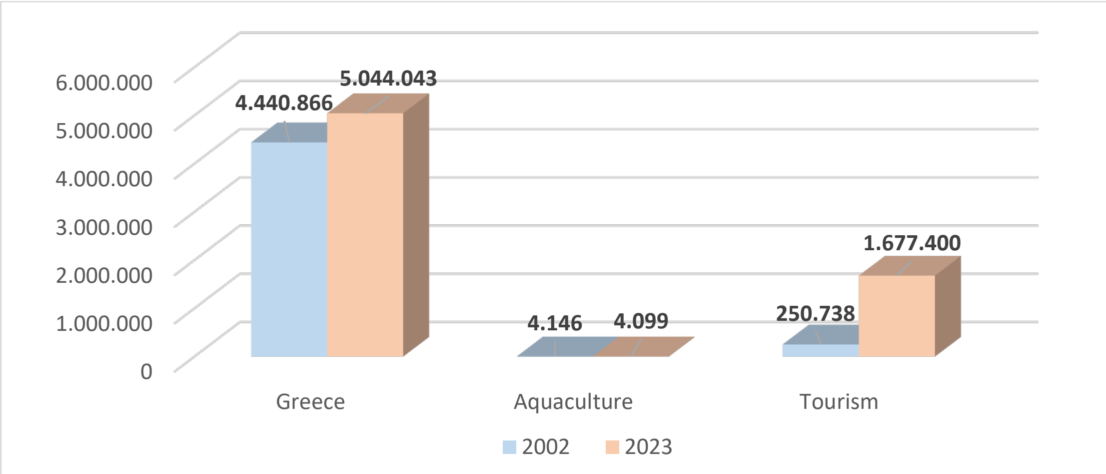
In stark contrast, the tourism sector has emerged as a powerhouse of job creation, employing over 1,5 million people and showing sustained upward trends. **Projections suggest further increases in both basic and high-skilled employment within tourism by 2030**, confirming its strategic economic importance. According to INSETE data, the overall contribution of tourism to the country's GDP was 19,1% in 2021, with a historic high of 33,4% in 2019.

[13] In productivity terms, it is worth noting that Scotland produces the same quantity of fish on half the number of employees.

Employment comparisons between aquaculture, tourism, and the overall economy (2002–2023) illustrate the negligible role of aquaculture, particularly finfish farming, in national job markets. **While tourism employment soared to nearly 1,7 million in 2023, aquaculture (and finfish subsector) showed only marginal growth—if not contraction—highlighting its status as a small-scale, low-impact employer**.

Ultimately, the contribution of aquaculture to national employment is minimal and diminishing, reinforcing its limited socio-economic role. The sector has a minimal increase in employment and shows a slight decrease over the years, emphasizing its limited role in the economy despite its potential. In contrast, tourism is a significant pillar of the economy, significantly boosting employment and contributing to the national GDP. **Despite policy expectations, the aquaculture sector and finfish farming has failed to scale in parallel with other high-performing industries such as tourism**, which continues to drive employment and GDP growth across multiple regions and demographic groups.

Graph 4.1: Employment in the years 2002 and 2023



Source: INSETE, Hellenic Statistical Authority, Own elaboration

From Employment Multipliers to Broader Economic Impact

Calculating employment multipliers using Input–Output Analysis reveals that the **fishing and aquaculture sector creates 18 jobs for every €1 million increase in final demand** - 13 direct and five indirect. This performance is below the national average multiplier (22 jobs), ranking the sector **16th out of 37 industries.** In contrast, **for every €1 million increase in demand for Greek tourism products, total (direct and indirect) employment increases by 25,8 jobs.**

This indicates that aquaculture is only a moderately dynamic sector in terms of job creation, performing better than some sectors (e.g., research, real estate management), **but clearly not a key employment engine for the Greek economy** - unlike sectors such as retail trade or tourism.

It is also important to note that, **despite receiving significant subsidies, aquaculture employment declined by 1,13% between 2002 and 2023.** This reflects a **failure to translate financial support into real socio-economic benefit.** Given the employment multiplier of 18 jobs per €1 million, **a more substantial employment boost would have been expected.**

These findings underscore the need to revise support policies—ensuring **more targeted business assistance, efficient resource allocation, and a stronger link between financial support and measurable employment and social impact outcomes**.

Continuing with the analysis of the sector's economic contribution, **it becomes evident that aquaculture is not a central pillar of the national economy**, although its relative significance has slightly increased. Specifically, aquaculture's share of the national Gross Value Added (GVA) rose from 0,31% in 2015 to 0,35% in 2023. **This modest increase shows a stabilizing (or slightly upward) trend, albeit with fluctuations.** The drop from 0.46% to 0.35% between 2022 and 2023 indicates **vulnerability to external factors**, such as prices, exports, and production costs.

In contrast, based on input-output analysis multipliers, **tourism generates an increase of €2,2 to €2,65 in GDP for every €1 in tourism activity. Thus, tourism's total contribution to the Greek economy in 2024 is estimated between €66,5 billion and €80,1 billion, accounting for 28% to 33,7% of GDP.** According to KEPE's multiplier, tourism's total contribution to GDP reached 61% in 2019 (KEPE, *Economic Developments*, Issue 45, 2021, p. 25).

In conclusion, although finfish aquaculture forms the backbone of Greek aquaculture, **its broader economic and employment impact remains marginal.** Despite receiving substantial policy support and subsidies, **the sector has underperformed in job creation**, **contributing less than 0,1% to national employment** and **experiencing a long-term employment decline**. **Its economic multipliers are modest**, and **its contribution to national GVA is stagnating**, especially when compared to the **tourism sector, which consistently drives employment, investment, and GDP growth**. **The finfish subsector's structural fragility, low employment resilience, and limited socio-economic spillovers cast doubt on its viability as a strategic pillar of blue growth**. Without major reforms toward diversification, innovation, and stronger socio-economic integration, finfish aquaculture risks remaining a high-cost, low-impact component of the Greek economy.

Data speak for themselves…

In summary, aquaculture (and consequently finfish subsector) in Greece is a technologically evolving and export-oriented sector with a **limited overall contribution to the national economy**. While there has been a significant increase in production and efficiency, **its contribution to the country's GDP remains low** and **highly vulnerable to external shocks**. Additionally, the sector's strong specialization in specific species (gilthead sea bream and European sea bass), **its overwhelming**

reliance on marine aquaculture, and heavy dependence on imports reveal limited diversification and increased risk.

From an employment perspective, the sector presents contradictory characteristics. While it offers mostly full-time and stable positions with permanent contracts, **it fails to follow national employment growth trends**. Its **contribution to employment is limited**, with **significant underrepresentation of women** and **low wages** that hinder the attraction of skilled labor. Although there is evidence of improved educational levels among the workforce, **the gap from the national average remains substantial**.

Finally, despite significant financial support, **the sector has not sufficiently converted these resources into tangible socio-economic benefits**, highlighting the need for more targeted and effective support policies.

The **finfish subsector in Greece is critical to economic strategy** and the rational allocation of public resources. It represents a long-standing but profoundly disproportionate investment in a sector that—despite initial expectations—**has failed to deliver, either in terms of employment or broader socio-economic returns**.

The data speak for themselves:

- **Aquaculture's contribution to GDP** was just **0,35% in 2023**, and even that declined **from 0,46% in 2022**, showing volatility and stagnation.
- Despite receiving public funding, the sector failed to grow: **a 1,13% employment drop between 2002 and 2023**, even while national employment rose by 13,58%.
- **Employment in aquaculture declined from 4.146 in 2002 to 4.099 in 2023** — a net loss of jobs over 21 years, despite substantial public subsidies.
- **Finfish subsector employs just below 0,10% of the national workforce**, compared to over 1,6 million in tourism, which accounts for up to 33% of national employment.
- **Employment multiplier: only 18 jobs per €1 million increase in final demand** (13 direct, 5 indirect), compared to 25,8 in tourism, which outperforms in both scale and impact.
- **Women remain underrepresented**, accounting for **only 31,77% of the workforce**, well below national and sectoral averages.
- **Only 18,44% of aquaculture workers hold higher education degrees**, compared to 39,25% national average, signaling a persistent skills gap.
- **Wages in aquaculture** are consistently lower than national averages and **declined by over 25% between 2012 and 2021**, making the sector unattractive to skilled labor.
- **Part-time workers saw a dramatic 31.57% drop in wages**, increasing insecurity for vulnerable groups like youth and seasonal staff.
- **Fish farming is dangerously dependent on two species (sea bream & sea bass),** which account for over 90% of hatchery output — a biological and market risk.
- **Hatchery production for both species declined by 25% since 2018**, threatening future sector resilience.

- Imports of fishmeal and fish oil surged **(+97.85% in value for fishmeal; +137.11% for fish oil**), exposing the sector to global supply chain vulnerabilities.
- **More than 66% of certified lease revenues remain uncollected annually post-2019**, especially in finfish zones, revealing deep administrative inefficiencies.

Time for a Policy Shift

Greece stands at a critical economic crossroads. At a time when public resources are scarce and policy choices must be strategic, **the continued prioritization of finfish aquaculture no longer holds up to scrutiny**. While the sector has long been framed as a pillar of rural development and export growth, the evidence reveals a starkly different reality: **low economic returns, stagnant employment, fragile competitiveness, and mounting environmental and administrative concerns**.

Despite receiving **decades of generous national and EU subsidies**, the sector has failed to deliver on its promises. **Employment has declined over a 21-year period**, value-added remains negligible, and **dependency on two species and foreign inputs exposes the entire system to biological, economic, and geopolitical risks**. Wage levels are not only unattractive but have eroded over time, disincentivizing skilled labor and innovation. **Women and youth remain largely excluded**, and regional concentration limits the benefits to just a handful of areas.

Persisting with large-scale investment in a sector that has underperformed for two decades is not only inefficient—it is a misuse of public trust and resources. It diverts funding from high-impact areas, rewards inefficiency, and delays critical transitions toward green, knowledge-based, and inclusive economic models.
This study sends a clear message: **it is time to reassess the role of finfish aquaculture in national development strategy**. A realignment of investment and policy support is urgently needed—one that prioritizes sectors with proven ability to generate jobs, stimulate innovation, foster regional cohesion, and align with the European Green Deal's sustainability objectives.

Greece cannot afford to subsidize stagnation. It must invest in sustainable growth.

Bibliography

Ababouch, L., Nguyen, K.A., Castro De Sousa, M., Fernandez-Polanco, J. (2023) Value chains and market access for aquaculture products, Journal of the World Aquaculture Society, 54(2), pp. 527-553

Alexander, S.P., Kelly, E., Marrion, N.V., Peters, J.A., Faccenda, E., Harding, S.D., Pawson, A.J., Sharman, J.L., Southan, C., Buneman, O.P., Cidlowski, J.A., Christopoulos, A., Davenport, A.P., Fabbro, D., Spedding, M., Striessnig, J., Davies, J.A. and CGTP Collaborators (2017). THE CONCISE GUIDE TO PHARMACOLOGY 2017/18: Overview. British journal of pharmacology, [online] 174 Suppl 1(Suppl Suppl 1), pp.S1–S16. doi:https://doi.org/10.1111/bph.13882.

Allsopp, M., Johnston, P., and Santillo, D. (2008), *Challenging the Aquaculture Industry on Sustainability*, Greenpeace Research Laboratories, University of Exeter, UK.

Alsaleh, M., & Wang, X. (2024). Aquaculture growth and coastal tourism development in the context sustainable blue economy. Sustainable Development. doi:https://doi.org/10.1002/sd.3224.

Armbrecht, J., & Skallerud, K. (2019). Attitudes and intentional reactions towards mariculture development–local residents' perspective. Ocean & Coastal Management, 174, 56-62.

Asche, F., Cojocaru, A. and Sikveland, M. (2018) Market shocks in salmon aquaculture: The impact of the chilean disease crisis, Journal of Agricultural and Applied Economics 50(2), pp. 1-15

Asche, F. and Dahl R. E. (2015) Price Volatility in Seafood Markets: Farmed vs. Wild Fish, Aquaculture Economics & Management, 19(3), pp.316-335.

Bostock, J., McAndrew, B., Richards, R., Jauncey, K., Telfer, T., Lorenzen, K., Little, D., Ross, L., Handisyde, N., Gatward, I. and Corner, R. (2010). Aquaculture: global status and trends. Philosophical Transactions of the Royal Society B: Biological Sciences, 365(1554), pp.2897–2912. doi:https://doi.org/10.1098/rstb.2010.0170.

Bostock, J., Lane, A., Hough, C. and Yamamoto, K. (2016). An assessment of the economic contribution of EU aquaculture production and the influence of policies for its sustainable development. Aquaculture International, 24(3), pp.699–733. doi:https://doi.org/10.1007/s10499-016-9992-1.

Bouwmeester, M. M., Goedknegt, M. A., Poulin, R., & Thieltges, D. W. (2021). Collateral diseases: Aquaculture impacts on wildlife infections. *Journal of Applied Ecology, 58*(3), pp. 453-464.

Brugère, C., Bansal, T., Kruijssen, F., & Williams, M. (2023). Humanizing aquaculture development: Putting social and human concerns at the center of future aquaculture development. *Journal of the World Aquaculture Society, 54*(2), 482–526.

Cabello, F.C. (2006). Heavy use of prophylactic antibiotics in aquaculture: a growing problem for human and animal health and for the environment. Environmental Microbiology, 8(7), pp.1137–1144. doi:https://doi.org/10.1111/j.1462-2920.2006.01054.x.

Cai, Z., Chen, M., Ye, P. and Yip, P.S.F. (2022). Socio-economic determinants of suicide rates in transforming China: A spatial-temporal analysis from 1990 to 2015. The Lancet Regional Health - Western Pacific, [online] 19, p.100341. doi:https://doi.org/10.1016/j.lanwpc.2021.100341.

Cai J., Chan H. L., Yan X., and Leung P. (2023) A global assessment of species diversification in aquaculture, Aquaculture, 576, 739837.

Cappell, R., & Nimmo, F. (2020). 9 Sustainable European Fisheries: Are We There Yet?. *Too Valuable to be Lost: Overfishing in the North Atlantic since 1880*, 161.

Chan H. L., Cai J. and Leung, P. (2024) Aquaculture production and diversification: What causes what?, Aquaculture, 583, pp. 1-14.

Cugier, P., Thomas, Y. and Bacher, C. (2022). Ecosystem modelling to assess the impact of rearing density, environment variability and mortality on oyster production. Aquaculture Environment Interactions, [online] 14, pp.53–70. doi:https://doi.org/10.3354/aei00428.

Dahl R. E. (2017), A study on price volatility in the aquaculture market using value-at-Risk (VaR), Aquaculture Economics & Management 21(1), pp.1-19

Duarte, C.M., Wu, J., Xiao, X., Bruhn, A. and Krause-Jensen, D. (2017). Can Seaweed Farming Play a Role in Climate Change Mitigation and Adaptation? Frontiers in Marine Science, [online] 4. doi:https://doi.org/10.3389/fmars.2017.00100.

Elias, M., Choudhury, A., Tavenner, K., Ragasa, C., Paez Valencia, A. M., Choudhury, A., and de Haan, N. (2024). Towards gender equality in forestry, livestock, fisheries and aquaculture. *Global Food Security, 41*, 100761.

Engle, C. R., & van Senten, J. (2022). Resilience of communities and sustainable aquaculture: Governance and regulatory effects. *Fishes, 7*(5), 268

Erol, S. (2022) Financial and economic impacts of the COVID-19 pandemic on aquaculture in Türkiye and financial policy recommendations, Marine Policy, 146, pp. 1-12.

Euronews. (2023). 'Help us save Poros': Tiny Greek island threatened by fish farm. [online] Available at: https://www.euronews.com/green/2023/06/08/tiny-greek-island-threatened-by-fish-farm-set-to-dominate-25-per-cent-of-its-land-and-sea.

Europa.eu. (2021). Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52021DC0236.

FAO (2024). The State of World Fisheries and Aquaculture 2024: Blue Transformation in Action. Food and Agriculture Organization of the United Nations; 2024.

Fernández Sánchez, J. L., Le Breton, A., Brun, E., Vendramin, N., Spiliopoulos, G., Furones, D., and Basurco, B. (2022) Assessing the economic impact of diseases in Mediterranean grow-out farms culturing European sea bass. *Aquaculture, 547*, pp. 1-9.

Froehlich, H.E., Gentry, R.R. and Halpern, B.S. (2017). Conservation aquaculture: Shifting the narrative and paradigm of aquaculture's role in resource management. Biological Conservation, [online] 215, pp.162–168. doi:https://doi.org/10.1016/j.biocon.2017.09.012.

Garlock, T., Asche, F., Anderson, J., Ceballos-Concha, A., Love, D. C., Osmundsen, T., & Pincinato, R. B. M. (2022). Aquaculture: The missing contributor in the food security agenda. Global Food Security, 32, 100620.

Global Seafood Alliance, 2023, available online at https://www.globalseafood.org/advocate/aquaculture-tourism-an-unexpected-synergy-for-the-blue-economy/

Herrera-Racionero, P., Martínez-Novo, R., Lizcano, E., & Miret-Pastor, L. (2020). Sea-based aquafarming and traditional fishery: Oceans apart? Journal of Rural Studies, 78, pp. 123-130.

Hindar K, Ryman N, Utter FM (1991) Genetic effects of cultured fish on natural fish populations. Can J Fish Aquat Sci 48:945–957

Holmer, M., Argyrou, M., Tage Dalsgaard, Danovaro, R., Díaz-Almela, E., Duarte, C.M., Frederiksen, M., Grau, A., Ioannis Karakassis, Núria Marbà, Mirto, S., Marta Aguilar Pérez, Pusceddu, A. and Manolis Tsapakis (2008). Effects of fish farm waste on Posidonia oceanica meadows: Synthesis and provision of monitoring and management tools. Marine Pollution Bulletin, 56(9), pp.1618–1629. doi:https://doi.org/10.1016/j.marpolbul.2008.05.020.

Karakassis, I., Pitta, P. and Krom, M.D. (2005). Contribution of fish farming to the nutrient loading of the Mediterranean. Scientia Marina, 69(2), pp.313–321. doi:https://doi.org/10.3989/scimar.2005.69n2313.

Karakassis, I, Pitta, P. and Krom, M.D. (2005). Contribution of fish farming to the nutrient loading of the Mediterranean. Sci. Mar., 69: 313-321.

Katranidis, S, Nitsi E, Vakrou A. (2003). Social acceptability of aquaculture development in coastal areas: the case of two Greek Islands. Coastal Management, 31:37–53.

Klaoudatos, S.D. (n.d.). Environmental impact of aquaculture in Greece. Practical experiences. [online] Available at: https://www.researchgate.net/publication/260404542_Environmental_impact_of_aquaculture_in_Greece_Practical_experiences.

Krkosek, M., Ford, J.S., Morton, A., Lele, S., Myers, R.A. and Lewis, M.A. (2007). Declining Wild Salmon Populations in Relation to Parasites from Farm Salmon. Science, 318(5857), pp.1772–1775. doi:https://doi.org/10.1126/science.1148744.

Kusumawati, A., & Utomo, H. S. (2020). Effects of sustainability on WoM intention and revisit intention, with environmental awareness as a moderator. Management of Environmental Quality: An International Journal, 31(1), 273-288.

Lazzari, N. (2021). Assessment of the Spanish marine social-ecological associations and its implication for integrated management of coastal and marine systems. Ub.edu. [online] doi:https://hdl.handle.net/2445/181753.

Leontief, W. (1986). Input-output economics, 2nd edition, Oxford University Press, New York.

Livas, P. (1994). Input-Output Analysis, Stamoulis Publications, Athens (in Greek)

Ly, C. (2024). Salmon farms are increasingly being hit by mass die-offs. [online] New Scientist. Available at: https://www.newscientist.com/article/2421227-salmon-farms-are-increasingly-being-hit-by-mass-die-offs/. [Accessed 18 Feb. 2025].

Luna, M., Llorente, I., and Luna, L. (2023). A conceptual framework for risk management in aquaculture. *Marine Policy, 147*, pp. 1-10.

Martinez-Porchas, M. and Martinez-Cordova, L.R. (2012). World Aquaculture: Environmental Impacts and Troubleshooting Alternatives. The Scientific World Journal, [online] 2012(1), pp.1–9. doi:https://doi.org/10.1100/2012/389623.

Martinis, A., Halvatzaras, D., & Kabassi, K. (2011). Promotion of Eco-Tourism Using the Practice of Wikipedia: The Case-Study of Environmental and Cultural Paths in Zakynthos. https://core.ac.uk/download/10931697.pdf

Miller, R. and Blair, P. (2022). Input–output analysis, foundations and extensions, 3rd edition. Cambridge University Press, New York.

Munday, B.W., Eleftheriou, A., Kentouri, M. and Divanach, P. (1994). Quantitative statistical analysis of the literature concerning the interaction of the environment and aquaculture – Identification of gap and lacks. J. Appl. Ichthyol., 10: 319-325.

Naylor, R.L., Goldburg, R.J., Primavera, J.H., Kautsky, N., Beveridge, M.C.M., Clay, J., Folke, C., Lubchenco, J., Mooney, H. and Troell, M. (2000). Effect of aquaculture on world fish supplies. Nature, 405(6790), pp.1017–1024. doi:https://doi.org/10.1038/35016500.

Neofitou, N., Papadimitriou K., Domenikiotis C., Tziantziou L., Panagiotaki, P. (2019a). GIS in environmental monitoring and assessment of fish farming impacts on nutrients of Pagasitikos Gulf, Eastern Mediterranean. Aquaculture 501: pp. 62-75.

Neofitou, N. (2016). Waste feed from fish farms of the Eastern Mediterranean andattraction of wild fish. Universal Journal of Geoscience, 4(5): 112-115.

Nimmo, F., Cappell, R., Huntington, T. and Grant, A. (2011). Does fish farming impact on tourism in Scotland? Aquaculture Research, 42, pp.132–141. doi:https://doi.org/10.1111/j.1365-2109.2010.02668.x.

Norman, R. A., Crumlish, M., & Stetkiewicz, S. (2019). The importance of fisheries and aquaculture production for nutrition and food security. Revue Scientifique et Technique / Scientific and Technical Review, 38(2), 395-407.

Outeiro, L., Villasante, S., & Oyarzo, H. (2018). The interplay between fish farming and nature based recreation-tourism in Southern Chile: A perception approach. Ecosystem services, 32, 90-100.

Papoutsoglou, S.E. (2000). Monitoring and regulation of marine aquaculture in Greece: licensing, regulatory control and monitoring guidelines and procedures. Journal of Applied Ichthyology 16: 167–171.

Perles-Ribes, J. F., Rámon-Rodríguez, A., Jiménez, M. S., Such-Devesa, M. J., & Aranda-Cuellar, P. (2023). Aquaculture in tourist destinations: the need to consider economic aspects in environmental impact studies. Current Issues in Tourism, 26(22), 3671-3685.

Petridi, C., Malichudis, St., Litsardakis, Alex. (2023). Fish farms on Poros: Why the residents are against it. [online] Solomon. Available at: https://wearesolomon.com/mag/format/feature/fish-farms-on-poros-why-the-residents-are-against-it/ [Accessed 1 Mar. 2025].

Piedrahita, R.H. (2003). Reducing the potential environmental impact of tank aquaculture effluents through intensification and recirculation. Aquaculture, 226(1-4), pp.35–44. doi:https://doi.org/10.1016/s0044-8486(03)00465-4.

Pnevmatikos, T. (2017), Structural Changes and Regional Policy in Greece: Evaluation Methodology and Empirical Investigation, Doctoral Dissertation, University of Thessaly (in Greek)

Primavera, J.H. (1997). Fish predation on mangrove-associated penaeids. Journal of Experimental Marine Biology and Ecology, 215(2), pp.205–216. doi:https://doi.org/10.1016/s0022-0981(97)00046-4.

Sadat, M. M., & Chang, L. H. (2016). The impact of environmental quality of revisiting intention. Journal of Quality Assurance in Hospitality & Tourism, 17(2), 209-223.

Salazar, C., Jaime, M., Cárdenas Retamal, R., & Baquedano, M. (2023), Women engagement, psychological traits, and gender gaps in the small-scale seaweed aquaculture in Chile. *Reviews in Aquaculture, 15*(4), 1540–1553.

Tan, S. Y., Sethupathi, S., Leong, K. H., & Ahmad, T. (2023). Challenges and opportunities in sustaining the aquaculture industry in Malaysia. Aqua-culture International, 32(1), 489–519.

Troell, M., Joyce, A., Chopin, T., Neori, A., Buschmann, A.H. and Fang, J.-G. (2009). Ecological engineering in aquaculture — Potential for integrated multi-trophic aquaculture (IMTA) in marine offshore systems. Aquaculture, [online] 297(1-4), pp.1–9. doi:https://doi.org/10.1016/j.aquaculture.2009.09.010.

Tsikoti, C. and Genitsaris, S. (2021). Review of Harmful Algal Blooms in the Coastal Mediterranean Sea, with a Focus on Greek Waters. Diversity, [online] 13(8), p.396. doi:https://doi.org/10.3390/d13080396. [Accessed 18 Feb. 2025].

Whitmarsh, D. and Palmieri, M.G. (2011). Consumer behaviour and environmental preferences: a case study of Scottish salmon aquaculture. Aquaculture Research, 42, pp.142–147. doi:https://doi.org/10.1111/j.1365-2109.2010.02672.x.

Wu, R.S.S. (1999). Eutrophication, Water Borne Pathogens and Xenobiotic Compounds: Environmental Risks and Challenges. Marine Pollution Bulletin, [online] 39(1), pp.11–22. doi:https://doi.org/10.1016/S0025-326X(99)00014-4.

Κλαουδάτος, Σ., Κλαουδάτος, Δ. (2010). Κατασκευές υδατοκαλλιεργητών συστημάτων Θαλάσσιες – Λιμνοθαλάσσιες – Χερσαίες. Προπομπός, σελ. 25-56.

Main References

European Market Observatory for Fisheries and Aquaculture Products (EUMOFA), https://eumofa.eu/

Eurostat, https://ec.europa.eu/eurostat

Government Gazette Issue (FEK 7315 B’/2025)

General Commercial Register (G.E.MI.), https://statistics.businessportal.gr/

Hellenic Statistical Authority, https://www.statistics.gr/en/home/

Hellenicparliament.gr. (2025). Αρχείο Πολυμέσων. [online] Available at: https://www.hellenicparliament.gr/Vouli-ton-Ellinon/ToKtirio/Fotografiko-Archeio/#34e47f8a-7b3c-4a02-be2a-a8af00b5954f [Accessed 20 Feb. 2025].

Lex - 52021DC0236 - EN - EUR-Lex. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021DC0236 [Accessed 20 Feb. 2025].

Ministry of Labour and Social Security, Mechanism of Labour Market Diagnosis, https://mdaae.gr/

Overview of EU aquaculture (fish farming). [online] Available at: https://oceans-and-fisheries.ec.europa.eu/ocean/blue-economy/aquaculture/overview-eu-aquaculture-fish-farming_en [Accessed 18 Feb. 2025].

Sustainable blue economy. [online] Available at: https://oceans-and-fisheries .ec.europa.eu/ocean/blue-economy/sustainable-blue-economy_en [Accessed 15 Feb.. 2025].

The European Maritime, Fisheries and Aquaculture Fund (EMFAF) Frequently asked questions. (n.d.). Available at: https://oceans-and-fisheries.ec.europa.eu/document/download/add11fe0-45ca-4ff0-afd2-f10708d8daad_en?filename=emfaf-faq_en.pdf. [Accessed 18 Feb. 2025].

The State of World Fisheries and Aquaculture 2024. Available at: https://openknowledge.fao.org/items/06690fd0-d133-424c-9673-1849e414543d

[Accessed 18 Feb. 2025].

Union for the Mediterranean (2024). Towards a Sustainable Blue Economy in the Mediterranean. Available at: https://south.euneighbours.eu/publication/ towards-a-sustainable-blue-economy-in-the-mediterranean-region-2024-edition/. [Accessed 14 Mar. 2025].

Union for the Mediterranean (2024). 2nd Union for the Mediterranean Stakeholder Conference on Sustainable Blue Economy: Outcomes and Main Messages. Available at: https://medblueconomyplatform.org/wp-content/uploads/2024/03/2nd-ufm-sk-conf-sbe-outcomes-main-messages.pdf [Accessed 14 Mar. 2025].

ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ Υπουργείο Αγροτικής Ανάπτυξης και Τροφίμων Γενική Διεύθυνση Αλιείας Διεύθυνση Υδατοκαλλιεργειών (2022). Πολυετές Εθνικό Στρατηγικό Σχέδιο για την Ανάπτυξη των Υδατοκαλλιεργειών για τη νέα προγραμματική περίοδο 2021-2030, Πολυετές Εθνικό Στρατηγικό Σχέδιο Για Την Ανάπτυξη Των Υδατοκαλλιεργειών Για Τη Νέα Προγραμματική Περίοδο 2021-2030.

Appendix

Table A1: Total Employment Multipliers (2020)

Ranking	Economic Sectors	Total Employment Multipliers
1	Retail trade	56
2	Crop and animal production, hunting and related activities	45
3	Personal and household services activities	45
4	Accommodation and food service activities	41
5	Education	39
6	Wood industry and manufacture of wood and cork products (except furniture), manufacture of basketry and wickerwork products	34
7	Health, social welfare, and activities of organizations	31
8	Construction	29
9	Forestry and logging	28
10	Other business activities	27
11	Publishing and printing activities	27
12	Manufacture of furniture and other manufacturing industries n.e.c.	26
13	Recreational, cultural, and sports activities	25
14	Food, beverage, and tobacco industry	24
15	Public administration and defense; compulsory social security	23
16	Fishing and aquaculture	18
17	Textile, clothing, leather, and fur industry	18
18	Manufacture of metal products	17
19	Manufacture of other non-metallic mineral products	17
20	Wholesale trade and motor vehicle trade	17
21	Rental and leasing activities	16
22	Transportation	16
23	Manufacture of rubber and plastic products	16
24	Manufacture of machinery and equipment	16
25	Paper manufacturing and production of paper products	15
26	Water collection, treatment, and supply	15
27	Manufacture of chemicals and pharmaceutical products	14
28	Post and telecommunications	14
29	Manufacture of electrical machinery and equipment	14
30	Sanitation, recycling, sewage, and waste management	14
31	Manufacture of coke and refined petroleum products	12
32	Financial intermediaries	11
33	Manufacture of motor vehicles	11
34	Mining and quarrying	10
35	Electricity, gas, steam, and air conditioning supply	9
36	Scientific research and development	8
37	Real estate management	2

Source: Hellenic Statistical Authority, Own elaboration

Table A2: Direct Employment Multipliers (2020)

Ranking	Economic Sectors	Direct Employment Multipliers
1	Retail trade	51
2	Personal and household services activities	43
3	Education	37
4	Crop and animal production, hunting and related activities	32
5	Accommodation and food service activities	31
6	Health, social welfare, and activities of organizations	23
7	Other business activities	21
8	Forestry and logging	19
9	Public administration and defense; compulsory social security	17
10	Construction	17
11	Publishing and printing activities	16
12	Recreational, cultural, and sports activities	15
13	Wood industry and manufacture of wood and cork products (except furniture), manufacture of basketry and wickerwork products	14
14	Fishing and aquaculture	13
15	Manufacture of furniture and other manufacturing industries n.e.c.	12
16	Wholesale trade and motor vehicle trade	9
17	Water collection, treatment, and supply	8
18	Rental and leasing activities	8
19	Post and telecommunications	7
20	Financial intermediaries	7
21	Manufacture of other non-metallic mineral products	7
22	Sanitation, recycling, sewage, and waste management	6
23	Transportation	6
24	Food, beverage, and tobacco industry	6
25	Manufacture of metal products	5
26	Manufacture of machinery and equipment	5
27	Textile, clothing, leather, and fur industry	4
28	Manufacture of rubber and plastic products	4
29	Electricity, gas, steam, and air conditioning supply	3
30	Paper manufacturing and production of paper products	3
31	Manufacture of chemicals and pharmaceutical products	3
32	Manufacture of motor vehicles	2
33	Scientific research and development	2
34	Mining and quarrying	1
35	Manufacture of electrical machinery and equipment	1
36	Manufacture of coke and refined petroleum products	1
37	Real estate management	0

Source: Hellenic Statistical Authority, Own elaboration

Table A3: Indirect Employment Multipliers (2020)

Ranking	Economic Sectors	Indirect Employment Multipliers
1	Wood industry and manufacture of wood and cork products (except furniture), manufacture of basketry and wickerwork products	20
2	Food, beverage, and tobacco industry	18
3	Manufacture of furniture and other manufacturing industries n.e.c.	14
4	Crop and animal production, hunting and related activities	13
5	Textile, clothing, leather, and fur industry	13
6	Manufacture of metal products	13
7	Manufacture of electrical machinery and equipment	13
8	Paper manufacturing and production of paper products	12
9	Construction	12
10	Manufacture of rubber and plastic products	12
11	Publishing and printing activities	12
12	Manufacture of coke and refined petroleum products	11
13	Manufacture of chemicals and pharmaceutical products	11
14	Manufacture of machinery and equipment	11
15	Manufacture of other non-metallic mineral products	11
16	Accommodation and food service activities	11
17	Recreational, cultural, and sports activities	10
18	Transportation	9
19	Manufacture of motor vehicles	9
20	Rental and leasing activities	9
21	Mining and quarrying	9
22	Health, social welfare, and activities of organizations	8
23	Forestry and logging	8
24	Wholesale trade and motor vehicle trade	8
25	Sanitation, recycling, sewage, and waste management	7
26	Post and telecommunications	7
27	Other business activities	6
28	Electricity, gas, steam, and air conditioning supply	6
29	Scientific research and development	6
30	Water collection, treatment, and supply	6
31	Public administration and defense; compulsory social security	6
32	Fishing and aquaculture	5
33	Retail trade	5
34	Financial intermediaries	4
35	Education	2
36	Real estate management	2
37	Personal and household services activities	2

Source: Hellenic Statistical Authority, Own elaboration

Table A4: Technological coefficients per sector (2020)

Ranking	Economic Sectors	Technological coefficients
1	Manufacture of coke and refined petroleum products	0,9159
2	Manufacture of metal products	0,7085
3	Wood industry and manufacture of wood and cork products (except furniture), manufacture of basketry and wickerwork products	0,6851
4	Paper manufacturing and production of paper products	0,6742
5	Textile, clothing, leather, and fur industry	0,6669
6	Manufacture of electrical machinery and equipment	0,6661
7	Manufacture of rubber and plastic products	0,6316
8	Construction	0,6284
9	Food, beverage, and tobacco industry	0,6246
10	Manufacture of other non-metallic mineral products	0,6160
11	Manufacture of machinery and equipment	0,5789
12	Manufacture of chemicals and pharmaceutical products	0,5784
13	Publishing and printing activities	0,5716
14	Manufacture of furniture and other manufacturing industries n.e.c.	0,5705
15	Transportation	0,5659
16	Sanitation, recycling, sewage, and waste management	0,4997
17	Wholesale trade and motor vehicle trade	0,4957
18	Electricity, gas, steam, and air conditioning supply	0,4953
19	Post and telecommunications	0,4872
20	Manufacture of motor vehicles	0,4673
21	Crop and animal production, hunting and related activities	0,4596
22	Recreational, cultural, and sports activities	0,4511
23	Rental and leasing activities	0,4341
24	Mining and quarrying	0,4117
25	Accommodation and food service activities	0,4090
26	Other business activities	0,4006
27	Retail trade	0,3878
28	Water collection, treatment, and supply	0,3624
29	Health, social welfare, and activities of organizations	0,3609
30	Scientific research and development	0,3244
31	Forestry and logging	0,3108
32	Fishing and aquaculture	0,2986
33	Financial intermediaries	0,2479
34	Public administration and defense; compulsory social security	0,2256
35	Personal and household services activities	0,1616
36	Real estate management	0,1049
37	Education	0,0938

Source: Hellenic Statistical Authority, Own elaboration

Table A5: Value added coefficients per sector (2020)

Ranking	Economic Sectors	Value added coefficients
1	Education	0,9062
2	Real estate management	0,8951
3	Personal and household services activities	0,8384
4	Public administration and defense; compulsory social security	0,7744
5	Financial intermediaries	0,7521
6	Fishing and aquaculture	0,7014
7	Forestry and logging	0,6892
8	Scientific research and development	0,6756
9	Health, social welfare, and activities of organizations	0,6391
10	Water collection, treatment, and supply	0,6376
11	Retail trade	0,6122
12	Other business activities	0,5994
13	Accommodation and food service activities	0,5910
14	Mining and quarrying	0,5883
15	Rental and leasing activities	0,5659
16	Recreational, cultural, and sports activities	0,5489
17	Crop and animal production, hunting and related activities	0,5404
18	Manufacture of motor vehicles	0,5327
19	Post and telecommunications	0,5128
20	Electricity, gas, steam, and air conditioning supply	0,5047
21	Wholesale trade and motor vehicle trade	0,5043
22	Sanitation, recycling, sewage, and waste management	0,5003
23	Transportation	0,4341
24	Manufacture of furniture and other manufacturing industries n.e.c.	0,4295
25	Publishing and printing activities	0,4284
26	Manufacture of chemicals and pharmaceutical products	0,4216
27	Manufacture of machinery and equipment	0,4211
28	Manufacture of other non-metallic mineral products	0,3840
29	Food, beverage, and tobacco industry	0,3754
30	Construction	0,3716
31	Manufacture of rubber and plastic products	0,3684
32	Manufacture of electrical machinery and equipment	0,3339
33	Textile, clothing, leather, and fur industry	0,3331
34	Paper manufacturing and production of paper products	0,3258
35	Wood industry and manufacture of wood and cork products (except furniture), manufacture of basketry and wickerwork products	0,3149
36	Manufacture of metal products	0,2915
37	Manufacture of coke and refined petroleum products	0,0841

Source: Hellenic Statistical Authority, Own elaboration