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Comparison of Six Environmental Impact Assessment Reports for Greek Aquaculture Operations

Final report for the Rauch Foundation
POAY Regional Units of Argolida, Arcadia and Methana

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Abbreviations and Acronyms

APC	Advanced Planning Consulting Business Advisors S.A.
DE	Municipality
EIA	Environmental Impact Assessment
EU	European Union
ELSTAT	Hellenic Statistical Authority
g	Gram(s)
HPHSAAY	Special Spatial Planning and Sustainable Development Framework for Aquaculture
kg	Kilogram(s)
km	Kilometre(s)
km^2	Square kilometre(s)
m	Metre(s)
PAY	Aquaculture Development Area
PE	Regional Units
POAY	Area of Organized Development of Aquaculture
ROVs	Remote Operated Vehicles
SCI	Sites of Community Interest
SEIA	Strategic Environmental Impact Assessment
SEIS	Strategic Environmental Impact Study
Stremma	1 stremma = 1000 square metres, plural = stremmata
SMPF	Spatial Management Plan Framework
SPA	Special Protection Areas
STP	Sewage Treatment Plants
t	(metric) tonne (e.g. 1,000 kilograms)
USD	United States Dollar

WWTP	Waste Water Treatment Plants

Disclaimer

This report is prepared from the original source reports in Greek. Every effort has been made to accurately provide English translations of the text from which these reviews are based. However, there may be some variations in the spelling of local names and differences in the acronyms and abbreviations used. Every effort has been made to standardise these throughout the reports.

Explanatory Notes

EIA report: The descriptions under the heading EIA report refer to the reported topic as described in the EIA report.

EIA analysis: The commentary described under the EIA analysis section are MEP's independent assessment of the reported section's quality and likely impact.

Assessment criteria

The following assessment categories have been used when considering various aspects of the EIA.

Critical weakness: A critical weakness refers to a significant flaw or deficiency in the EIA report that has the potential to substantially undermine the accuracy, comprehensiveness, or credibility of the assessment. This could include fundamental errors or omissions in data collection or analysis, failure to consider key environmental impacts, or lack of compliance with regulatory requirements. Critical weaknesses typically require urgent attention and correction to ensure the integrity of the assessment process and the validity of its conclusions.

Major weakness: A major weakness denotes a notable deficiency in the EIA report that, while not as severe as a critical weakness, still has a significant impact on the overall quality and reliability of the assessment. This may include inadequate documentation of methodologies, incomplete analysis of potential impacts, or insufficient consideration of alternative measures or mitigation strategies. Major weaknesses require substantial remediation to address deficiencies and improve the overall robustness of the assessment.

Weakness: A weakness refers to a less significant flaw or limitation in the EIA report that may detract from its effectiveness or thoroughness but does not severely compromise its overall validity or utility. This could include minor inconsistencies in data presentation, gaps in information, or shortcomings in the assessment of certain environmental factors. While weaknesses may not necessarily invalidate the assessment, they still warrant attention and corrective action to enhance the credibility and reliability of the findings.

Minor weakness: A minor weakness indicates a relatively minor or incidental flaw in the EIA report that has minimal impact on the overall quality or integrity of the assessment. This might include inconsistencies or minor omissions in documentation. While minor weaknesses may not significantly affect the substance of the assessment, they should still be addressed to ensure clarity, accuracy, and professionalism in the report.

Executive Summary

The Strategic Environmental Impact study was undertaken and resubmitted in 2021 for the proposed Organized Aquaculture Development Areas (POAY) in Argolida, Arcadia, and Methana. The report details the expansion of aquaculture across eleven zones. The study was undertaken by APC SA and was based on data collected and analysed in 2015.

The study adequately describes the existing laws, regulations, and governmental framework for aquaculture development and theoretical potential environmental impacts.

Environmental impacts

While the report describes the proposed changes and adheres to various regulations and details expansion plans, it lacks precise mapping for these expansions, limiting impact analysis. This is a minor weakness. Alternatives like the 'Zero Solution' were evaluated, but the report doesn't quantify additional nutrient outputs or the cumulative impact of multiple farms.

The 2015 environmental study indicates good conditions but may miss localised impacts due to distant sample sites.

The importance of the Natura 2000 network, especially concerning *Posidonia oceanica* seagrass meadows, is acknowledged, emphasizing the need for careful management. The Aquaculture Development Area (PAY) zone A9 is located within the Natura 2000 GR2510005 and so additional *Posidonia* mapping is required.

Pollution sources are identified, but the impact of aquaculture expansion on nutrient output isn't assessed.

The severity and extent of the impact on the environment is not quantified or assessed.

The report assumes that continuous improvements in aquaculture practices will minimise environmental impacts. However, it does not explore practical operational mitigation measures by farmers. The report also assumes that Greek and EU regulatory frameworks will ensure environmental management but enforcement is not always consistent, suggesting a need for mandatory guidelines to ensure high environmental standards in the sector.

The proposed monitoring system covers various environmental and social factors but lacks detailed implementation information. Mitigation measures are suggested for potential environmental degradation, but specific management strategies for waste disposal and effluent treatment are not thoroughly addressed. The report recognizes the need for further studies, particularly regarding the impact on Posidonia seagrass meadows, but detailed mapping and assessment are lacking.

Specifically, the study is weak in:

- **Insufficient quantification of nutrient output**: The report fails to quantify the additional nutrient output from the proposed expansion, crucial for assessing environmental impacts. This is a critical weakness.
- **Overlooked cumulative impacts**: The cumulative impact of multiple farms in a shared water body is not adequately considered, particularly regarding eutrophication and disease spread. This is a major weakness.
- **Limited localised impact assessment**: The 2015 field study did not sample sites close to existing farms, potentially missing localised environmental impacts. This is a minor weakness.

- **Inadequate detail in the monitoring system**: The proposed monitoring system lacks specifics on sampling methods, frequency, and thresholds. This is a minor weakness.
- **Omission of farm management measures:** The report does not address farm management measures for solid waste and effluent treatment from increased shore-based facilities. This is a minor weakness.
- **Lack of *Posidonia* seagrass impact assessment**: While acknowledging potential impacts on Posidonia seagrass meadows, the report lacks detailed mapping and assessment of these critical habitats especially in proposed area H of A9. This is a major weakness.

Social Impacts

The study does not provide sufficient quantification of the social impacts or provide sufficient recommendations on mitigation measures. In addition, there appears to have been no stakeholder consultation during the study to be able to find mutually agreed solutions to avoid conflict with other users of the space and the neighbouring communities and tourist trade in the Regional Units.

Specifically, the study is **insufficient** in:

- Quantifying planned new facilities (land and sea), use of inputs (feed and fingerlings) and employment opportunities This detail is required to quantify the changes that might occur with the expansion of production and project area. This is a major weakness.
- The maps providing indicative locations of the land-based facilities were not included in the report provided for this assessment. This is a major weakness.
- Quantification on the use of resources and how these will be addressed (road traffic, marine traffic, additional electricity supply, additional freshwater supply, etc.) within the level of infrastructure and services available in the Regional Units. This is a major weakness.
- Quantification, solutions and impact from the project outputs such as wastewater treatment, solid waste disposal and organic waste disposal. A major increase in production will generate a large wastewater treatment requirement from sewage, facility and equipment washing, etc. This, as well as the other solid and organic waste disposal, needs to be quantified to assess and predict scale and potential solutions. This is a major weakness.
- The study shows no evidence of stakeholder consultation and effort to find mutually agreed mitigation measures to reduce social impacts. This is a critical weakness.

1. Introduction

1.1 Background

The purpose of the Strategic Environmental Impact Study (SEIS) is to identify, describe and evaluate the environmental impacts that will result from the siting of an Aquaculture Organised Development Area (POAY) in the PAY A5 (Vourlia - Ormos Korakias, P.E. Argolida), A6 (Plateia Island, P.E. Argolida), A4.1 – A4.2 (Coasts of Arcadia, P.E.Arcadia), A9 (Methana-Troizinia, Islands), as well as the determination of actions to limit and mitigate the effects. The study also includes information on the assessment of the environmental impact of the establishment of the EIA, considering the existing assessment methods and the organisation of the proposed PAY.

Marine fish cage culture has become an increasingly important industry in Greece, contributing to both the economy and the food security of the country. However, the industry has also been associated with a number of beneficial and detrimental environmental impacts.

Environmental Impacts

The addition of nutrients into the marine environment, often referred to as "nutrient enrichment" or "pellet rain," involves the input of nutrients from uneaten fish feed and fish waste. These nutrients can stimulate the growth of natural prey organisms, such as plankton and benthic organisms, which are important in the marine food web. However, marine fish cage culture significantly impacts marine ecosystems. Nutrient-rich waste from fish, including nitrogen (N) and phosphorus (P), leads to eutrophication, causing excessive algae growth, reduced water clarity, and decreased oxygen levels, which can harm aquatic life.

Particulate waste like faeces and uneaten food increases organic sediment, affecting benthic organisms and seagrass beds, essential for ecosystem health. Chemicals used in fish cages can contaminate the environment, impacting benthic health. Additionally, fish cages can spread diseases and parasites to wild fish, with high fish densities accelerating pathogen transmission. Escaped farmed fish may also genetically dilute wild populations. These farms can disrupt natural habitats, predator-prey dynamics, and create noise pollution, further stressing marine environments.

Socio-economic Impacts

The marine fish cage farming industry plays a significant role in the economy and food security, offering substantial socio-economic benefits at both national and local levels. Nationally, it provides considerable job opportunities, contributes to foreign exchange earnings through exports, and supports economic diversification, especially in coastal regions where traditional fishing is declining. Locally, it generates employment in various sectors, aids in economic diversification, and contributes to community development through revenue that can be reinvested in projects like education and healthcare. Additionally, it supports local businesses by providing a reliable fish supply and stimulates skill development among workers.

However, the industry also presents socio-economic challenges. Environmentally, it contributes to pollution, disease spread, and habitat destruction. Socially, it often leads to tensions between fish farmers, traditional fishers, and local communities due to resource competition, lack of transparency in decision-making, and uneven distribution of benefits. Locally, the visual impact of fish cages can affect coastal aesthetics, potentially deterring tourism, while increasing local marine and road traffic, straining freshwater resources, and impacting housing markets due to worker demand. Balancing these benefits and drawbacks depends on careful management and interaction with local communities, highlighting the complexity of assessing the overall impact of the fish cage farming industry in Greece.

1.2 Study objective

A series of feasibility studies and Environmental Impact Assessments (EIAs) have been prepared for the designated Areas of Organized Aquaculture Development (POAY in Greek). The focus of this review is the SEIS prepared by APC and resubmitted in 2021 with field research carried out in collaboration with the Hellenic Centre for Marine Research and the Environmental & Marine Research Company of Greece in 2015.

The establishment of the POAY is carried out within the framework of the guidelines of the HPHSAAY and in the application of the provisions of article 10 of Law 2742/1999, as amended and in force (paragraph 7, article 30, Law 3889/2010) and the Decision No. 17239/2002 of the Ministry of Environment and Natural Resources "Determination of supporting documents, procedure, and conditions for the establishment of Areas of Organized Development of Aquaculture".

The area under study for the creation of the POAY belongs administratively to three Regional Units: the P.E. Argolida and Arcadia of the P.E. Peloponnese and the P.E. Islands of the Region of Attica. It includes a total of five Aquaculture Development Areas (PAYs; Category A), as defined in Decision No. 31722/4.11.2011 "Approval of the Special Spatial Planning and Sustainable Development Framework for Aquaculture and its Strategic Environmental Impact Study" (Government Gazette 2505/B/04.11.2011), and more specifically the following areas.

- A5 (Vourlia - Ormos Korakias, P.E. Argolida),
- A6 (Platia Island, P.E. Argolida),
- A4.1 - A4.2 (Coast of Arcadia, P.E. Arcadia),
- A9 (Methana-Troizinia, P.E. Islands).

The proposed POAY Argolida-Arcadia-Methana consists of eleven (11) Zones A, B, C, D, E, F, K, Z, H, T and I, for the farming of fish and has a total area of 30,350.8 stremmata[1] (productive area 1,636 ha) and a total annual capacity of 32.340 tons of fish and other cultivated aquatic organisms of economic interest.

The environmental assessment includes a description of the natural habitat, the anthropogenic environment, the fishing activity and the aquaculture activity.

[1] *A unit of land area mainly used in Greece and Cyrpus, equivalent to 1000 m^2*

2. APC Advanced Planning - Consulting Consultants S.A. (APC S.A.)

The contractor of the study for the preparation of the project "Establishment of an Area of Organized Development of Aquaculture, in the PAY. A5 (Vourlia - Ormos Korakias), A6 (Platia Island) of the P.E. Argolida, PAY A4.1 - A4.2 (Coast of Arcadia) of P.E. Arcadia and PAY. A9 (Methana-Troizinia) of the P.E. of the Islands." is the consultancy company APC Advanced Planning Consulting Consultants S.A. (APC S.A.), which is engaged in the provision of services for development and spatial planning, environmental issues and the preparation of investment studies and programmes, the planning, management and evaluation of national and Community programmes.

For the preparation of the report. APC S.A. collaborated with the Hellenic Centre for Marine Research and the Environmental & Marine Research Company of Greece.

APC Advanced Planning – Consulting Business Advisors S.A., based in Athens, Greece, has expertise in the field of aquaculture, specifically in conducting EIAs for marine fish cages. The company specialises in various sectors, including fisheries and aquaculture, rural and regional development, and the marine environment.

APC has undertaken the coordination of the project titled “Monitoring and assessment of the conservation status of Community interest fish fauna species in Greece”. This project was assigned by the Greek Ministry of Environment, Energy and Climate Change and involved collaboration with research institutions.

APC's international certifications include ISO 9001:2015 and ISO 27001:2013.

Experience:

- APC has experience in environmental studies and consulting suggesting capabilities in this area.
- Their portfolio showcases a wide range of environmental projects, including studies for renewable energy, infrastructure development, and waste management, demonstrating their familiarity with complex environmental assessments.
- This experience, coupled with their understanding of Greek regulatory frameworks, indicates their potential to navigate the specific requirements of marine fish cage EIAs.

Expertise:

- APC has a team of professionals with expertise in environmental engineering, biology, ecology, and related fields.
- Their website describes expertise in water quality modelling, marine ecology assessments, and environmental impact assessment methodologies, all of which are components of marine fish cage EIAs.

3. Analysis of Arcadia EIA

3.1 Scope of SEIA

EIA report: The area under study for the creation of the POAY, belongs administratively to three Regional Units of Argolida and Arcadia of the P.E. Peloponnese and the P.E. Islands of the Region of Attica. It includes a total of five Aquaculture Development Areas (PAY category A), as defined in Decision No. 31722/4.11.2011 "Approval of the Special Spatial Planning and Sustainable Development Framework for Aquaculture and its Strategic Environmental Impact Study" (Government Gazette 2505/B/04.11.2011.

- A5 (Vourlia - Ormos Korakias, P.E. Argolida),
- A6 (Platia Island, P.E. Argolida),
- A4.1 - A4.2 (Coast of Arcadia, P.E. Arcadia),
- A9 (Methana-Troizinia, P.E. Islands).

EIA analysis: The existing farms and planned new farms are marked on the maps but the expansion of the leased area of the existing farms is not marked.

3.2 Framework and objectives of the study

EIA report: The report covers the International, European community and national environmental protection objectives relevant to the project.

3.2.1 EU policies and regulations:

EIA report: The report lists and briefly describes the strategies and directives for coastal and inland water management.

- **The European and National coastal and island policy** is guided by the Directive on Integrated Coastal Zone Management (COM (2000) 547/27-9-2000), which sets the strategy for coastal area interventions. This directive emphasizes the importance of collaborative coastal zone planning, the harmonization of EU and national frameworks, and the implementation of integrated solutions at local and regional levels. A specific framework, which is yet to be established, will include the definition of coastal zones and management guidelines, especially for the critical zone located 100 meters (m) from the coastline.
- **Directive 2000/60/EC**, known as the Water Framework Directive, aims to integrate the management of water resources at the river basin scale. It encompasses all water types and redefines the concept of a river basin. Greek legislation has been harmonized with this directive, focusing on water protection and management.
- **River basin flood risk management plans** have been implemented under European Directive 2007/60/EC and incorporated into Greek law. These plans outline objectives for flood risk management, including necessary measures, priorities, and the assessment of potentially high flood hazard zones.
- **The bathing water quality monitoring program** has been systematically monitoring since 1988, in line with EU directives. It targets areas that attract significant numbers of bathers or are under environmental pressure, involving sampling, laboratory analysis, and macroscopic monitoring of the water and coastline.
- **The Bathing Water Directive (2006/7/EC)** register describes beach characteristics, identifies potential pollution sources, and assesses their impacts. Beaches included in the Monitoring Program are those that attract many bathers or have other significant interests.
- **The identity register and "Blue Flags"** program are integral to coastal management. The Bathing Water Identification Register officially designates national bathing waters. The "Blue Flags" program, managed by the Hellenic Society for the Protection of Nature, leverages the results from the monitoring program to facilitate participation in coastal management.
- **Directive 2008/56/EC**, known as the Marine Strategy Framework Directive, aims to achieve or maintain good environmental status of the marine environment by 2020. Its focus is on protecting and preserving the marine environment, preventing and reducing pollution, and safeguarding marine biodiversity and ecosystems. This directive has been harmonized into Greek law by Law 3983/2011.
- **The Blue Growth Strategy** supports the sustainable development of maritime and shipping sectors, recognizing seas and oceans as key economic drivers with potential for innovation and growth. It includes measures for marine knowledge, maritime spatial planning, and integrated maritime surveillance.
- **Directive 2014/89/EU, the Marine Spatial Planning Directive,** facilitates effective and sustainable planning of human activities at sea. It aims to reduce conflicts between sectors,

encourage investment, and protect the environment. This directive has been incorporated into Greek legislation by Law 4546/2018.

- **The Communication on Sustainable Development of Aquaculture** in the EU (COM/2013/229) addresses administrative procedures, spatial planning coordination, competitiveness, and a level playing field. It encourages Member States to simplify administrative processes, coordinate spatial planning, and strengthen the competitiveness of EU aquaculture.
- **The National Strategy for Biodiversity 2014-2029** aims to halt biodiversity loss and ecosystem function degradation in Greece by 2026. It focuses on the conservation, management, and restoration of biodiversity outside protected areas and includes a 15-year strategy with a five-year action plan.
- **The Common Fisheries Policy (Regulation EU 1380/2013**) covers the conservation of marine resources, management of fisheries, market measures, and economic support. Its principles include good governance, an ecosystem approach, a precautionary approach, and regional cooperation. The policy aims for sustainable, environmentally friendly fishing activities and the development of sustainable aquaculture.
- **The Operational Programme for Fisheries 2007-2013** envisions the sustainable development of the fisheries sector. Its strategic objectives include achieving a sustainable balance between fishery resources and fishing activities, developing sustainable aquaculture, and improving the sector's framework. This program funded actions for spatial planning and support for POAYs
- **The Operational Programme for Fisheries & Sea 2014 – 2020.** The Operational Programme for Fisheries & Sea 2014-2020 focuses on sustainable, innovative, and competitive aquaculture. Key objectives include technological advancement, enhancing enterprise sustainability, protecting aquatic biodiversity, and promoting high environmental and health standards. The program supports investments in aquaculture, quality improvement of products, diversification of enterprise income, and ecological management practices. It aligns with the broader strategic plan for Greek aquaculture, emphasizing administrative efficiency, resource access, sustainability, and industry-research synergies.

EIA analysis. The report adequately lists and briefly describes the international and EU directives and strategies covering sustainable aquaculture development and management of the marine environment, focusing on environmental protection, economic growth, and social well-being.

3.2.2 Greek policies and regulations.

EIA report: The report lists and briefly describes the Greek policies and regulations.

- **Marine Spatial Planning, under Law 4546/2018**, incorporates Directive 2014/89/EU. This planning includes national and regional strategies, with aquaculture as a key component.
- **The General Framework for Spatial Planning and Sustainable Development** aims to create a sustainable spatial development model with a strong emphasis on biodiversity conservation. It focuses on the sustainable development of fishing areas, coastal fisheries, and aquaculture, and encourages the modernization of aquaculture units, the adoption of environmentally friendly methods, and the development of POAYs.
- **The Special Spatial Planning Framework for Aquaculture** defines PAYs based on their suitability for aquaculture. These areas are classified into five categories (A-E) according to

their development level and environmental sensitivity. The study area specifically includes zones in Arcadia, Argolida, and the Islands.

- **Organised Aquaculture Development Areas (PAYs**) are created within the PAYs of categories A-D. These areas include zones designated for future leasing and water catchment. The study area features several proposed PAYs, each with varying capacities and conditions.
- **The Specific Framework for Aquaculture** establishes compatibility criteria for aquaculture units. These criteria focus on ensuring compatibility with tourism units, residential developments, port facilities, and other relevant factors.
- **The Special Spatial Planning Framework for Tourism**, which was initially approved and later annulled due to procedural issues, is currently awaiting a new framework. Until then, tourism development is being guided by existing Regional Spatial Plans.
- **The Special Spatial Planning Framework for Industry** provides guidelines for industrial development. This includes considerations for spatial planning and sustainable development, ensuring that industrial growth aligns with broader environmental and social goals.

Development compatibility with local Spatial Planning guidelines

- **Marine Spatial Planning, under Law 4546/2018**, incorporates Directive 2014/89/EU. This planning includes national and regional strategies, with aquaculture as a key component.
- **The General Framework for Spatial Planning and Sustainable Development** aims to create a sustainable spatial development model with a strong emphasis on biodiversity conservation. It focuses on the sustainable development of fishing areas, coastal fisheries, and aquaculture, and encourages the modernization of aquaculture units, the adoption of environmentally friendly methods, and the development of POAYs.
- **The Special Spatial Planning Framework for Aquaculture** defines PAYs based on their suitability for aquaculture. These areas are classified into five categories (A-E) according to their development level and environmental sensitivity. The study area specifically includes zones in Arcadia, Argolida, and the Islands.
- **Organised Aquaculture Development Areas (POAYs**) are created within the PAYs of categories A-D. These areas include zones designated for future leasing and water catchment. The study area features several proposed ODAIs, each with varying capacities and conditions.
- **The Specific Framework for Aquaculture** establishes compatibility criteria for aquaculture units. These criteria focus on ensuring compatibility with tourism units, residential developments, port facilities, and other relevant factors.
- **The Special Spatial Planning Framework for Tourism**, which was initially approved and later annulled due to procedural issues, is currently awaiting a new framework. Until then, tourism development is being guided by existing Regional Spatial Plans.
- **The Special Spatial Planning Framework for Industry** provides guidelines for industrial development. This includes considerations for spatial planning and sustainable development, ensuring that industrial growth aligns with broader environmental and social goals.
- **The Special Framework for Renewable Energy Sources** in Arcadia designates specific areas for wind energy development. Regulations for these areas include limits on land coverage by wind installations and require local authority agreement for expansion.

- **The Regional Spatial Planning Framework for the Peloponnese Region** is currently under revision, with an emphasis on managing coastal areas and development axes. Argolida faces significant water supply issues, while Arcadia has fewer problems. The framework proposes strengthening marine fishing infrastructure and supporting aquaculture activity. It also suggests modernizing livestock production and protecting agricultural land.
- **P.E. Argolida** is classified as an area with average priority for manufacturing. Spatial planning in this area focuses on maintaining the industrial zone around Argos and Nea Kio while avoiding expansion towards tourist and cultural areas. There is an emphasis on compatibility between industrial and tourism activities, with the potential for selective industrial location in tourist zones. Aquaculture development in this area should consider environmental sustainability and avoid conflicting with tourism.
- In **P.E. Arcadia**, there is a low priority for manufacturing, with a limited industrial presence centred in Tripoli. This area has the potential for developing alternative tourism forms without significant conflict with manufacturing. However, environmental impacts from electricity generation need addressing. The policy encourages maintaining a basic industrial fabric without strong artificial support, focusing instead on alternative development areas.
- **Methana**, part of the Attica Region, has historical significance for manufacturing. The manufacturing in Methana primarily serves local needs, and aquaculture development should align with these local service requirements.

EIA analysis. The report adequately lists and briefly describes the Greek directives and strategies covering sustainable aquaculture development and management of the marine environment, focusing on spatial planning.

The report also covers spatial planning for Argolida, Arcadia, and Methana and identifies the need for balancing industrial development with tourism and environmental sustainability. Aquaculture development must consider local service needs, environmental impacts, and compatibility with other activities, especially tourism.

3.2.3 Regional and local policies

EIA report: The report lists and briefly describes the regional and local policies.

- **The Special Framework for Renewable Energy Sources** in Arcadia designates specific areas for wind energy development. Regulations for these areas include limits on land coverage by wind installations and require local authority agreement for expansion.
- **The Regional Spatial Planning Framework for the Peloponnese Region** is currently under revision, with an emphasis on managing coastal areas and development axes. Argolida faces significant water supply issues, while Arcadia has fewer problems. The framework proposes strengthening marine fishing infrastructure and supporting aquaculture activity. It also suggests modernizing livestock production and protecting agricultural land.
- **The Landscape Study** indicates that Argolida and Arcadia belong to specific landscape zones, which influence the development of aquaculture in these areas.

EIA analysis: The report adequately describes the Regional and Local policies and regulations. It covers the local policies that affect the local communities but does not relate (or quantify) the impacts of the expansion of cage culture to the regional and local objectives.

3.2.4 The proposed POAY

EIA report: The report covers the POAY regulations and implementation.

Law 4269/2014 and Aquaculture Management

Law 4269/2014 addresses the procedural and management aspects of aquaculture in Marine Protected Areas, highlighting the need for effective management, regulatory compliance, and environmental monitoring to ensure sustainable aquaculture development.

Amendment of Law 2742/1999: Law 4269/2014 amends Law 2742/1999, mainly in terminology and spatial planning levels, indicating a need for substantive amendment of Article 10 of Law 2742/1999.

- **Institutionalization Procedure**: Entities interested in aquaculture submit a comprehensive application to the Spatial Planning Directorate, including feasibility studies, maps, environmental assessments, and producer consent. The Directorate reviews the application, consults with relevant departments, and puts the Spatial Management Plan Framework (SMPF) to public consultation. Following proposal approval, a decree is issued defining the POAY's location, boundaries, cultivation forms, species, and total capacity.
- **Management of POAY**: Management is assigned to a relevant entity by the Secretary General of the Decentralized Administration. The managing body can involve various legal forms, including private and public sector participants. The operator provides opinions on new unit establishments, manages the host, monitors environmental quality, and ensures compliance with established terms.
- **Regulation and Operation**: The POAY regulation includes installation conditions, rights and obligations, management of common facilities, and financial aspects. These include managing water break areas, restoring spaces post-closure, and waste management.
- **Current Status and Challenges**: As of June 2021, only four POAYs have been established in specific marine areas. The current framework has disadvantages, particularly for POAYs established before the Specific Framework's implementation. The success of aquaculture establishments depends on monitoring and guidance from competent authorities.
- **Role of Management Entity**: The entity monitors the implementation of operational terms and legislation, aiding the work of State Audit Authorities. It works with local authorities and does not replace State Audit Authorities.

Role of POAY

The lack of a spatial plan for aquaculture led to negative public perception and competition with other activities. The Special Framework established later defined PAYs and set criteria for compatibility with other uses.

The establishment of POAY in regions like Argolida, Arcadia, and Methana is expected to boost marketing dynamics, improve public trust, and enhance the negotiating power of production units. The Management Entity will play a key role in mediating and implementing necessary strategies for the effective marketing and promotion of aquaculture products.

The establishment of POAYs, such as in regions like Argolida, Arcadia, and Methana, leads to improved implementation of hygiene standards. This is achieved through organized management systems that facilitate better adherence to hygiene rules. The sustainable operation of these plants plays a significant role in maintaining the hygiene of the products. An essential part of this

process is the development of the necessary infrastructure, such as hatcheries, nurseries and packing, which are constructed and operated under hygiene regulations. Furthermore, the time from product elimination to market placement is reduced, enhancing the overall quality of the products.

Advantages of aquaculture development

Strengthening sectoral employment: The aquaculture sector boosts employment, particularly in disadvantaged and island regions. It employs a significant number of qualified personnel in management, organization, production, and skilled labour roles. Personnel are increasingly specialized due to technological advancements and automation. Nationally, direct employment in aquaculture ranges from 4,000-5,000, with indirect employment around 5,000-6,000 (as reported within the EIA and attributed to the General Directorate of Fisheries). Manpower requirements depend on factors like capacity, distance from shore, infrastructure, and cage size. For example, a 300 tonne (t)/year unit typically requires 7 people.

Contributing to market structure Improvement: The aquaculture market structure is similar across the territory, with products marketed through various channels like retail, commercial departments, and marketing companies. A significant portion of production, sometimes up to 80%, is exported, mainly to Europe. However, farms located on remote islands face transport costs and delays. Retail products must carry specific information as per national and EU legislation. Two producer organizations are operating that follow EU regulations. There's a recognized need for better promotion in domestic and foreign markets. The Government have implemented initiatives with substantial budgets for promoting Mediterranean aquaculture species.

According to the EIA, there has been an emphasis on informing consumers about the nutritional value and safety of aquaculture products in order to address misinformation. By educating consumers and exploring new markets, the companies hope that demand can be significantly increased.

Food Safety and Hygiene: The safety and hygiene of aquaculture products are governed by a robust regulatory framework established by EU and national regulations. Operators in the sector actively control and monitor the quality of feed and the environment in which aquaculture is practised. The entire process, from the elimination of products to their packaging, is meticulously managed to ensure they are suitable for consumption. The Hazard Analysis and Control Principles (HACCP) system is a critical component of this process, ensuring food safety. In shellfish farming, specific regulations are in place, including restrictions on farming near sewer outflows and in contaminated areas. Additionally, compliance with Directive 2006/113/EC is mandatory to maintain the required water quality for shellfish aquaculture.

Infrastructure Creation for Aquaculture Development: The creation of infrastructure is a pivotal aspect of integrated sustainable management in aquaculture development areas. An overview of fish farming units reveals a variety of necessary components. Floating installations and equipment encompass floating fish cages, dicots, antifouling and bottom-set nets, mooring facilities, beacons, work exercises, waterborne transport, and production management equipment such as fish sorters, feeding systems, cranes, and other essentials like lighting, generators, and net cleaning machines. Accompanying facilities, as detailed in Section 3.1 of the EIA, are also integral to these units.

Fish hatcheries, categorized as supporting facilities, require a range of infrastructure for phytoplankton production, live food production, genitor management, hatching, weaning,

development, and fattening of juveniles. This also includes necessary offices, laboratories, and systems for water circulation, oxygen, and heat supply. Additionally, fresh fish packing plants are essential for packaging, gutting or filleting, grading, boxing, freezing, and ice production of seafood fish.

Infrastructure projects are comprehensive and include components such as access roads, boat docking areas, waste disposal and destruction sites, wastewater treatment, and energy supply networks. The establishment of a POAY brings significant benefits, particularly in facilitating the provision of land-based infrastructure and opening financing opportunities. A notable advantage of establishing a POAY is the potential for sharing land-based facilities among different units, optimizing resource utilization and efficiency.

EIA analysis: The report adequately covers the POAY regulations, scope and role of the POAY in planning and managing aquaculture development.

4. Existing environmental situation

EIA report: Field research conducted in June 2015 in the framework of the study of the Hellenic Centre for Marine Research entitled "Assessment of the ecological quality of the marine environment for the establishment of POAY in areas of Argolida, Arcadia and Methana" will be presented. The sampling mission was carried out with the oceanographic vessel "FILIA".

The state of the environment in the POAY area, as assessed can be summarised as follows:

Seabed type: The coastline is predominantly rocky, interspersed with coarse-grained beaches. The submarine area features rocky formations with moderate to steep slopes.

Geochemical analysis of sediment: Sediment samples showed high sand content, especially near aquaculture farms.

Organic carbon, nitrogen, and phosphorus concentrations were very low, indicating an absence of significant pollution sources.

Metal contaminants (Zn, Ni, Pb, Cu, Cr) were comparable to other coastal areas in Greece and did not exceed EPA environmental regulation limits.

Zoobenthos: Macrofauna, sensitive to organic enrichment, indicated good environmental conditions at most stations, except for one with moderate status. Previous studies also reported no significant impact on zooplankton from aquaculture operations.

Seagrasses: Phytobenthos, consisting of macroalgae and marine angiosperms, are indicators of ecological status. No *Posidonia oceanica* meadows were observed near operating farms. Ecological quality, assessed using the EII index, showed no poor or incomplete vegetation quality. In Vourlia Bay, where many aquaculture units operate, the condition was rated high.

Phytoplankton: Phytoplankton, consisting of single-celled plants in the sea, forms the base of the marine food chain and is a good indicator of changes in the marine environment. The study aimed to assess the trophic level and quality of the marine ecosystem, aligning with European directives for marine water quality monitoring. Chlorophyll-a concentration and the qualitative and quantitative structure of phytoplankton populations were analysed. Results showed expected characteristics and values for phytoplankton in the region and season, with diatoms predominating at all stations.

Zooplankton: Zooplankton, particularly copepods, are key components of the pelagic food chain and indicators of ecosystem health. The study assessed changes in mesozooplankton biocoenoses due to the creation of an Organized Aquaculture Development Area. Biomass and abundance of mesozooplankton were found to be high across surveyed areas. The composition of mesozooplankton was dominated by copepods, followed by copepods and chaetognaths, with a notable presence of pteropods in some areas.

The report concludes that the environmental assessment of the POAY area revealed a marine ecosystem with good water quality, characterized by high oxygenation, low nutrient and chlorophyll-a levels, and heavy metal concentrations within safe and expected ranges. These findings suggest that the area is well-suited for sustainable aquaculture development, maintaining a healthy balance in its marine environment.

EIA analysis:
The field study of the area undertaken by the Hellenic Centre for Marine Research showed that present environmental conditions in the area were comparable to other coastal areas and bays in Greece, indicating no significant negative impact from present aquaculture activities in the area.

However, the sample sites were not close to the existing farms so the local impacts of the farms within the leased area were not evaluated.

4.1 Natura 2000 network

EIA report: In the P.E. Argolida region, there is no area included in the Natura network directly within the study area. However, nearby areas like the Akronafplia and Palamidi (GR2510003) possess significant floral, faunal, and historical value. This area, characterized by its steep rocky terrain and endemic plant species, also hosts several vertebrate and invertebrate species protected under the Community Directive 92/43/EEC and the Bern Convention.

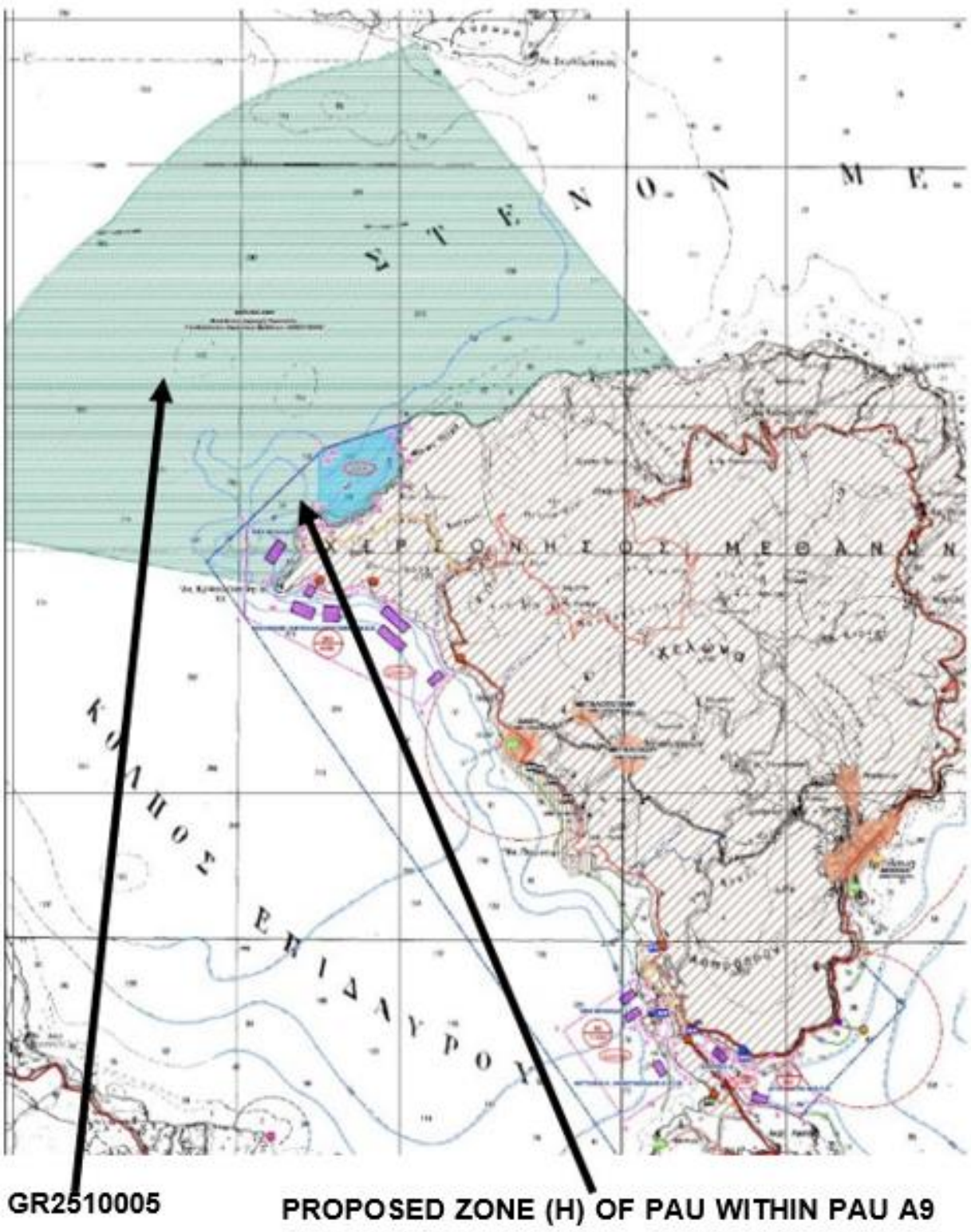
In P.E. Arcadia, the "Mount Parnonas and Malevi area" (GR2520006) and "Monastery of Elona and the Leonidio Gorge - Mana Cave and Blue Lake" (GR2520005) are designated as SCIs. These areas are known for their rich biodiversity, including endemic plant species and significant vertebrate fauna. The Moustos Lagoon (GR2520003) and the "Mountains of Eastern Laconia" (GR2540007) also form part of the Natura 2000 network, featuring diverse habitats and species.

North-north-west of Methana, the "Pausanias marine area - submarine volcanoes of Methana" (GR2510005) is part of the network. This area is notable for its hydrothermal fields, sandy and muddy sediments, reefs, and P*. oceanica* meadows, hosting a variety of marine species.

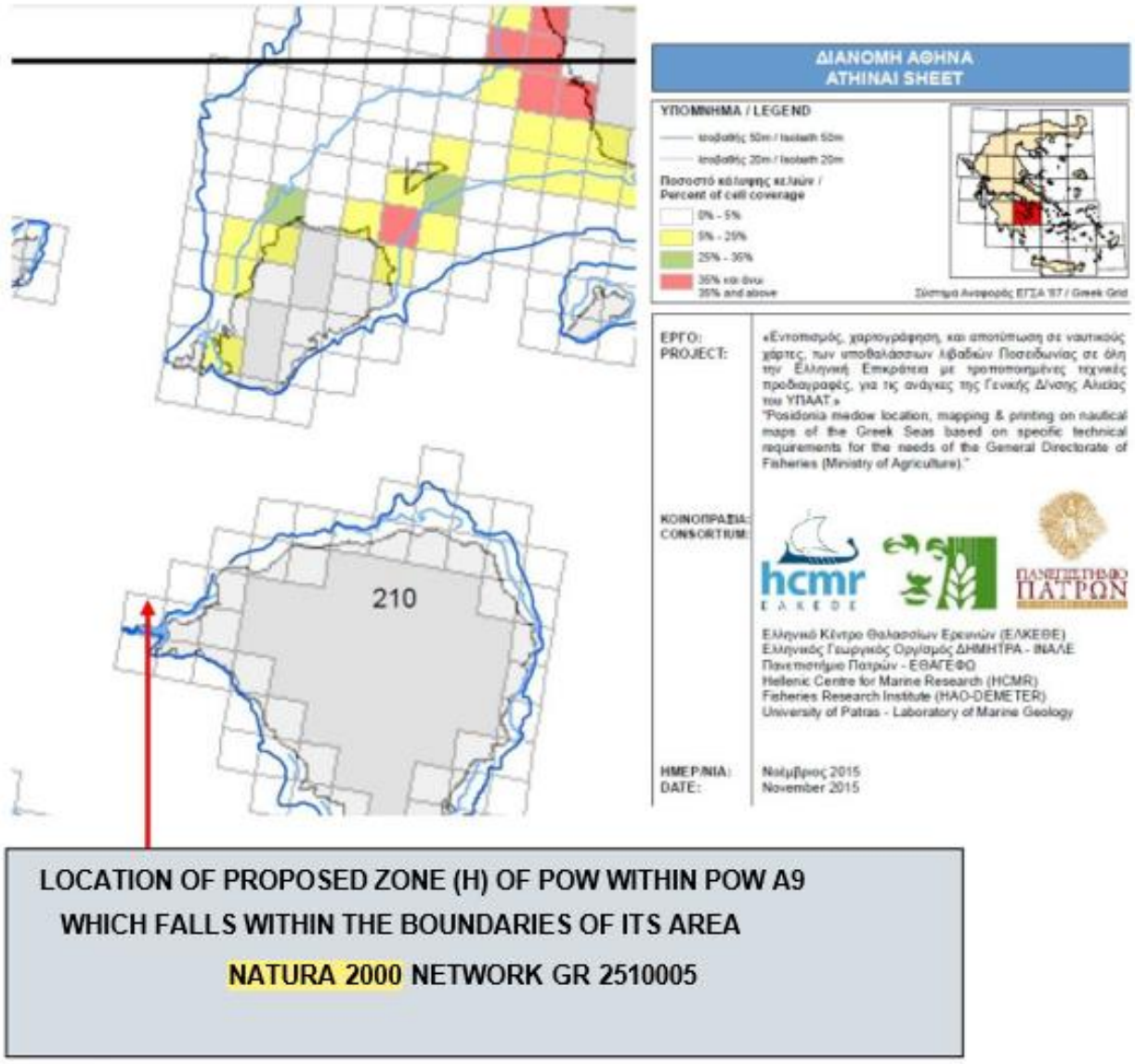
The conservation status of these areas varies, with some habitats like sandbanks (1110) and P. oceanica meadows (1120) being of particular concern due to their sensitivity to environmental changes. The presence of *P. oceanica* meadows is a critical factor, as their habitat is ideal for aquaculture but can be negatively impacted by incorrect siting of farms. Law 3937/2011 prohibits the establishment of fish farms over these meadows within Natura 2000 areas.

Reefs (1170) are another significant habitat, often hosting diverse benthic communities. These habitats are common but can vary significantly in ecological conditions and species composition.

EIA analysis: The Natura 2000 network, encompassing Special Protection Areas (SPAs) and Sites of Community Importance (SCIs), plays an important role in conserving natural habitats and species habitats significant at the European level. In the context of aquaculture development and its potential impact on the Natura 2000 network, it's essential to consider the specific areas within the network that are relevant to the study area.



The proposed zone H within A9 falls within the Natura 2000 network. However, studies by HCMR (Hellenic Centre for Marine Research) found very little evidence of Posidonia beds in the proposed area.



The development of aquaculture in these regions requires careful consideration of these protected areas and species, particularly concerning *P. oceanica* meadows and reef habitats. Proper management and adherence to environmental regulations are essential to ensure that aquaculture development does not adversely impact these valuable and sensitive ecosystems.

There should be systematic Posidonia seagrass bed mapping in the proposed area to ensure that new or expanded aquaculture activities do not impact this sensitive species.

4.2 Sources of pollution

EIA report: The environmental pressures in the study area arise from both point and diffuse sources of pollution. Point sources include urban wastewater from settlements with sewerage networks and treatment plants, livestock farming, industrial and mining activities, and uncontrolled waste disposal sites. Additionally, landfills and quarrying activities contribute to pollution. Diffuse

sources primarily involve runoff from agricultural activities, livestock farming, and urban areas without centralized wastewater treatment.

Key wastewater treatment plants (WWTPs) in the area serve settlements like Astros, Tolo, Kranidi, and Methana, with some wastewater being transported by tankers from other settlements. Large hotels in the area also have their own treatment facilities, often reusing treated water for irrigation. Waste management involves several landfills, some of which are active or not fully remediated, located in areas like Leonidi, Tyros, Tolo, and Methana.

Agricultural activities contribute to organic pollution through fertilizer and pesticide residues, which can lead to eutrophication of surface waters. The areas of Leonidi in Arcadia and the Argolian plain are identified as vulnerable to NO_3- pollution from agriculture. Livestock farming, both intensive and free grazing, is prevalent in the area, with cattle and poultry farming being particularly significant.

Industrial activities, mainly related to the primary sector like agricultural and livestock processing, exert environmental pressure. Food processing, meat preservation, and olive mills, especially during the olive harvesting season, contribute to organic load discharges. Mining and processing units of marble and aggregates in the Asini district also impact the environment.

Groundwater overuse is a significant issue, particularly in the Argolic Field, where over-pumping for irrigation has led to a drop in groundwater levels and salinization of soils due to marine intrusion. This over-pumping affects the chemical state of the groundwater system, leading to an increase in pollutants.

EIA analysis: The environmental pressures in the study area stem from a combination of urban, agricultural, industrial, and overused groundwater sources as well as the present fish production from aquaculture. These pressures affect both the quality and quantity of water resources, with the overall ecological status of coastal systems in the Argolic Gulf and Western Saronic Gulf being assessed as moderate, and the outer Saronic Gulf as good. The report does not assess the impact of the additional nutrient output from the proposed aquaculture expansion.

4.3 Theoretical environmental impact assessment

EIA report: The environmental characteristics of the proposed area for the POAY in Argolida, Arcadia, and Methana indicate a good-to-high environmental status, with low nutrient concentrations and phytoplankton biomass, and chemical pollution below recommended limits. The water column is well oxygenated, and the steep seabed slope and great depths of unit placement minimise the impact on the benthic ecosystem. No significant ecological changes or irreversible environmental damage due to aquaculture have been reported in the Mediterranean or globally.

The impact of aquaculture on Greek ecosystems is multifaceted. Floating marine aquaculture farms, hatcheries, packaging facilities, and land-based associated facilities are the primary contributors. Despite aesthetic impacts, substantial environmental damage is generally non-existent. Studies show minimal effects on water column chemical parameters, plankton, and benthic fauna, with most impacts confined within 50-150 m of the cages. The ecological quality near farms in semi-enclosed bays is more degraded compared to open coasts.

The most significant environmental concern is the impact on *P. oceanica* meadows, crucial for biodiversity. The introduction of alien species and genetically modified organisms poses potential risks, although strict regulatory compliance is necessary. Overall, aquaculture practices have

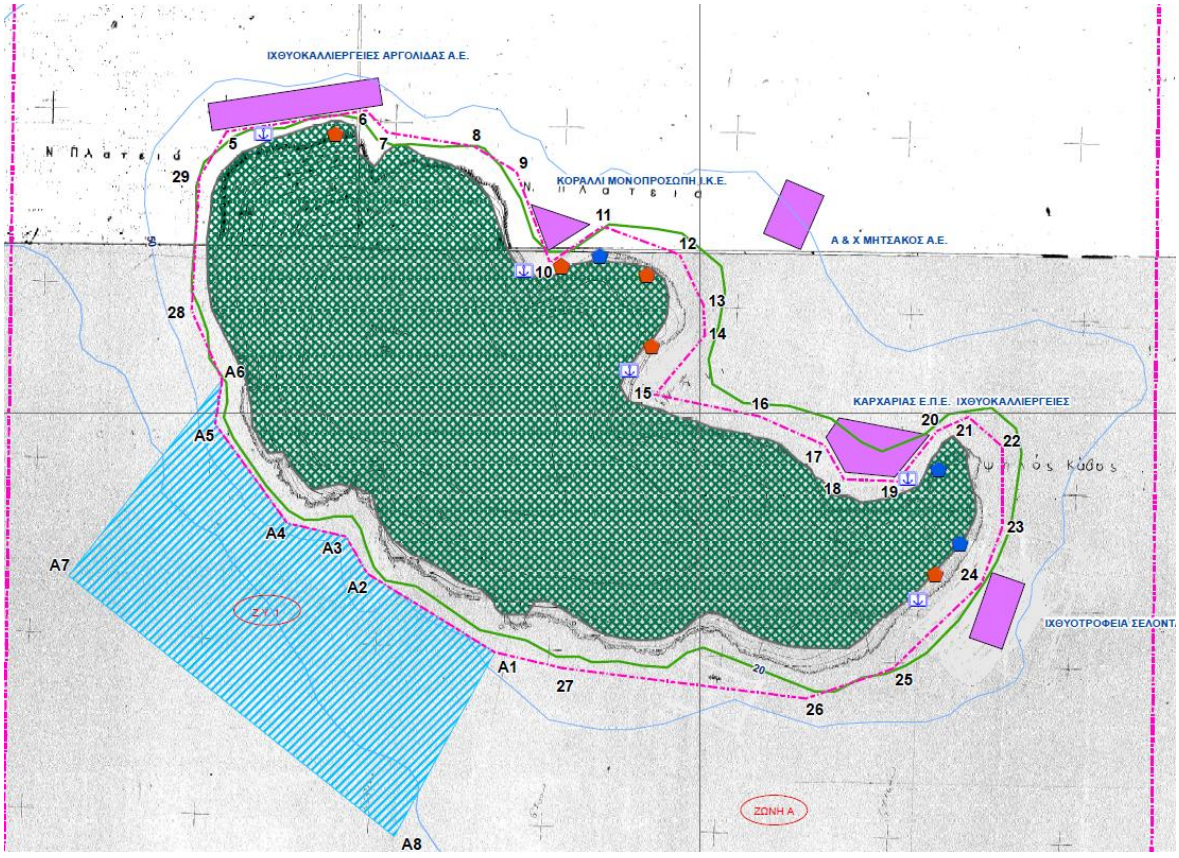
evolved to minimize environmental impacts, with farmers prioritizing high-quality farming environments to maintain profitability and product quality.

The environmental impacts of aquaculture on land are primarily aesthetic, altering the natural landscape and occasionally restricting access to coastal areas. However, these installations are often in inaccessible or less attractive areas for recreational use. Aquaculture also has positive environmental impacts, such as reducing pressure on wild fish stocks and providing limited protection for indigenous fish populations and habitats. It is less harmful to the marine ecosystem compared to other coastal zone activities like industry or mass tourism.

Historically, aquaculture faced challenges due to a lack of know-how and comprehensive legal frameworks, leading to environmental degradation. However, these issues are now largely addressed through improved technology, knowledge, and a strict legal framework, focusing on environmental protection and sustainable resource management. Innovations include optimized feeding protocols, genetic selection for disease resistance, monitoring of water parameters, and improved waste management. The EU's stringent regulatory framework governs various aspects of aquaculture, ensuring minimal environmental impact. This framework covers therapeutic substances, feed ingredients, transport and welfare of farmed animals, and water quality standards. Despite past issues, current aquaculture practices in Greece do not cause substantial or irreversible environmental alterations.

EIA analysis: The report describes the potential impacts of aquaculture on the environment, local infrastructure and services but does not quantify the increased level of impact locally at each farm and cumulatively in common water bodies.

For example, there are presently 5 fish farms along the coasts of Plateia island in zone A6.



Plateia Island of Argolida Zone A6

Farm	Marine area (stremmata)	Present production (t/year)
1	40	390
2	10	150
3	20	230
4	33,15	419
5	20	230
	123.15	**1,419**

The minimum distance between farms is 500 m.

The planned expansion for this area is for one additional farm (6) a total leased area of 240 stremmata (95% increase) and 4,500 t production (196% increase). This cumulative impact of almost 3 times the present production and may cause a cumulative impact on water quality around the island. The increased nutrient output needs to be quantified to be able to assess the scale of this risk.

The cumulative impact of multiple fish cage farms in a water body can significantly affect the ecosystem, particularly concerning eutrophication, the spread of fish diseases and parasites.

- **Eutrophication**: Fish farms release nutrients such as N and P into the water through fish excrement and uneaten feed. These nutrients can accumulate due to limited water exchange. High nutrient levels can lead to eutrophication, characterized by increased algae levels in the water and, in extreme cases, can cause algal blooms. These blooms can deplete oxygen in the water (hypoxia), harm marine life, disrupt the ecological balance and sometimes cause fish kills.
- **Spread of fish diseases and parasites**: Cage farms that are close to each other can facilitate the rapid spread of diseases and parasites, such as sea lice and isopods. These pathogens can affect not only farmed fish but also wild populations if they escape or interact with wild fish.

These impacts can affect water quality, fish farm operations, and local coastal communities.

- **Impact on water quality**: The accumulation of dissolved nutrients from fish waste and uneaten feed can deteriorate water quality. This degradation can manifest as increased turbidity, reduced oxygen levels, and altered chemical composition of the water.
- **Fish farm operation**: The cumulative impacts of multiple farms can lead to a decline in the health and productivity of the fish stocks. Over time, farms may face increased costs due to the need for more disease treatments and potentially lower yields due to disease outbreaks or environmental stressors.
- **Effect on local coastal communities**: Local communities may experience both direct and indirect impacts. Directly, poor water quality can affect recreational activities, tourism, and the health of local fisheries. Indirectly, the community might face economic challenges if the sustainability of the aquaculture industry is compromised. Additionally, conflicts can arise between fish farmers and other stakeholders, such as local fishermen or conservation groups, over resource use and environmental concerns.

The new planned farm is located in an area that may have *Posidonia* seagrass meadows and so the area needs to be researched and any seagrass areas mapped.

Marine fish farms can have a significant impact on *Posidonia* seagrass beds in the Mediterranean, with negative effects ranging from reduced seagrass growth and density to the destruction of meadows. These impacts can extend over a considerable distance from the fish farm, depending on the factors involved.

The main impacts of fish farms on *Posidonia* seagrass beds are nutrient enrichment and smothering with organic particulate matter. Fish farms generate large quantities of organic waste, including faeces, uneaten food, and unused medications. This organic matter can leach into the surrounding water, leading to an increase in nutrient levels, particularly N and P.

Excessive nutrients can stimulate the growth of algae and other phytoplankton, causing a process known as eutrophication. This excessive algal growth can shade out *Posidonia* seagrasses, reducing their ability to photosynthesize and ultimately leading to their decline.

The negative impacts of fish farms on *Posidonia* seagrass beds are most severe close to the farm. However, the effects can extend for several hundred meters depending on the specific conditions.

5. Project description

5.1 Proposed expansion

EIA report: The POAY comprises the following areas.

- A5 (Vourlia - Ormos Korakias, P.E. Argolida),
- A6 (Platia Island, P.E. Argolida),
- A4.1 - A4.2 (Coast of Arcadia, P.E. Arcadia),
- A9 (Methana-Troizinia, P.E. Islands).

The proposed POAY Argolida-Arcadia-Methana consists of eleven (11) Zones A, B, C, D, E, F, K, G, H, I, I for the farming of main fish of a total area of 30,350.8 stremmata (productive area 1,636 stremmata) and a total annual capacity of 32,340 t of fish and other aquatic organisms of economic interest can be cultivated.

Table summarizing the current state and planned expansion for each zone:

Zone	Current Farms	Current Annual Capacity (t)	Current Leased Area (stremmata)	Expansion: Additional Farms	Expansion: Increased Capacity (t)	Expansion: Expanded Area (stremmata)
A	5	1,419	123.15	Potential for 1 new unit	4,200	240
B	8	2,410	253	-	6,800	420
C	1	350	35	-	2,000	100
D	1	150	20	-	880	50
E	1	475	30	-	2,650	100
F	2	517.5	40	-	860	46
K	None	N/A	N/A	N/A	N/A	N/A
G	2	1,211.5	115.1	-	8,600	320
H	2	588	56	-	4,360	260
I	1	150	10	-	1,130	60
I	2	225	20	-	860	40
Total	25	7,496	702.25		32,340	1,636
Expansion					24844	933.75
%					331%	133%

The report explains the following;

- The expansion plans across the zones generally involve increasing both the annual capacity and the leased area.
- The expansions are achieved through a combination of enlarging existing units and establishing new ones.
- Environmental considerations, such as maintaining distances between units and respecting coastal distances, are emphasized.
- The use of floating cage systems is consistent across zones.
- Land-based ancillary facilities are planned to support the aquaculture units, adhering to urban planning and environmental laws.

Other infrastructure and equipment will be provided by the Management Entity, which includes office equipment and the establishment of a communication network with POAY units.

EIA analysis: The report adequately describes present aquaculture production for each zone in terms of the number of farms, leased area and production and the proposed increase. However, it does not map the location of the increased leased area on the maps. This does not allow the analysis of how the impacts of one farm may overlap with neighbouring farms.

5.2 Expected environmental impacts

EIA report: The report describes the expected impacts of marine fish cage farming on the environment and is categorised into various aspects;

Impact on the aquatic environment. Marine aquaculture farms, including fish cages and shellfish cages, have a direct impact on the aquatic environment. The installation and operation of these farms can visually alter the natural coastal landscape, causing aesthetic concerns. However, this alteration is reversible and does not lead to substantial environmental damage.

Impact on geochemical characteristics. Studies have shown that fish farms release dissolved wastes, primarily ammonia (NH_3) and phosphate (PO_4^{3-}), which have little effect on nutrient concentrations in the water column near the farms. Any increase in nutrient concentrations is time-limited and follows an intra-day pattern. In contrast, the impacts of solid waste, including unused food and faeces, can be more readily detectable, leading to changes in sediment characteristics beneath the cages. These effects are influenced by bathymetry, farm size, and substrate type.

Effects on plankton. Fish farms do not significantly affect plankton assemblages in terms of abundance and diversity. Microplankton plays a crucial role in controlling phytoplankton cells through grazing, preventing phytoplankton blooms even under continuous nutrient supply from fish farms.

Impact on benthic fauna. Sedimentation of particulate matter from fish farms can affect benthic organisms. While none of the examined fish farms showed excessive pollution, changes in the benthic biotic community occurred beneath the cages, reducing diversity and favouring small opportunistic species. However, these effects were limited to within 25 m from the cage boundaries.

Impact on fish fauna. The presence of fish farms increases fish abundance and biomass by a factor of two, enhancing diversity at intermediate spatial scales (1-20 km). This response is linked to the oligotrophic regime in the Aegean Sea, where even small nutrient inputs lead to increased fish populations. In contrast, fish farms in the North Atlantic had minimal effects on wild fish populations.

Impact on biodiversity. While some species may be affected by aquaculture, it is not certain that biodiversity is threatened. Risk occurs when essential habitats are severely altered or populations of k-selected species are significantly reduced. In Greece, the oligotrophic characteristics of the seas are maintained, and large k-selected organisms have not suffered declines. However, the impact on *P. oceanica* meadows is significant and endangers biodiversity.

Positive environmental impacts. Aquaculture helps reduce pressure on wild fish stocks by supplying products to meet increasing demand. Current legislation also provides protection for

indigenous fish populations and habitats by prohibiting fishing activities within leased areas around fish cages.

Continuous improvement and regulatory framework. The aquaculture sector has evolved significantly over the past two decades, with improvements in technology and practices aimed at minimizing environmental impact. Strict regulatory frameworks at the national and European levels govern various aspects of aquaculture, including food quality, fish feed ingredients, and water quality.

EIA analysis: The report describes the expected environmental impact of aquaculture but does not attempt to quantify the additional nutrients that will be released into the environment from the increased production and the impact on local infrastructure and services. Therefore, there is no estimation of the severity or extent of the impact on the environment.

The report assumes that continuous improvements in aquaculture practices, including better nutrition protocols, selective breeding, disease prevention methods, and waste management will minimise environmental impacts. However, there are practical operational mitigation measures that can be undertaken by the farmers which is not explored. The report also describes the Greek and the European Union regulatory frameworks that govern various aspects of aquaculture to protect the environment and ensure the quality of products. These regulations are not always fully enforced and there should be some mandatory good practice guidelines that the farmers have to follow to ensure high environmental standards in the sector.

5.3 Mandatory assessment of alternatives and choice.

EIA report: For the selection of zones in the proposed POAY, various alternatives were examined and ultimately rejected based on specific criteria and the current institutional framework.

These alternatives included:

1. Zero Solution: This involved not establishing a POAY in the study area, which was contrary to the guidelines of the Special Framework for Aquaculture. This option was rejected as it would continue the less advantageous 'point' basis location of units and not integrate the environmental dimension effectively.

2. Alternatives for determining the number, location, size, and capacity of zones:

- **Reduction in number of zones**: This was dismissed to include all existing successful farms in the area.
- **Alternative locations for zones**: Other areas within the PAYs did not meet all the terms and conditions required for establishing PAYs and operating fish farming units.
- **Different extent of zones:** Smaller zones would hinder the development of aquaculture activity, while larger zones were unnecessary and restricted by other activities.
- **Variation in total capacity of farms**: The proposed capacity was calculated based on a mathematical formula with a maximum limit for environmental protection. Higher capacities were possible but deemed inappropriate for ecological balance.
- **Alternative siting of water dewatering sites**: The chosen sites were optimal due to similar environmental conditions to existing units and proximity for cost-effectiveness and support.

The final plan for establishing the POAY as detailed in Chapter 4 and shown on the attached maps, was chosen based on the existing situation of operating units, their long-term operational data, and compliance with the terms and conditions of the Special Framework for establishing PAYs and operating fish farming units.

The proposed expansion and the selection criteria

Zone	Total Area (stremmata)	Productive Area (stremmata)	Total Capacity (t/year)
A	7,441.0	240	4,200
B	8,167.0	420	6,800
C	1,375.9	100	2,000
D	213.9	50	880
E	855.4	100	2,650
F	787.4	46	860
K	596.8	0 (water drainage)	0 (water drainage)
G	5,157.3	320	8,600
H	3,816.8	260	4,360
Th	1,409.7	60	Not specified
I	529.6	40	1,130
I	Not specified	Not specified	860

The criteria taken into account for the selection of the zones and their organisation (location, area, capacity) are as follows:

- the state of the environment (suitability - ecological quality)
- existing aquaculture units
- other uses (existing and potential).

EIA analysis: The report considers the zero option of not increasing aquaculture production in the zones and the proposed expansion plan based on the Greek Government formula for estimating sustainable carrying capacity. It also considers variations on the proposed development plan but does not quantify the additional nutrient output from the expansion and the potential impact on the environment. The report also does not take into consideration the cumulative impact of many farms in a common water body.

6. Proposed Monitoring and Mitigation Measures

6.1 Monitoring parameters

EIA report: A monitoring system is proposed to protect the aquatic environment and ensure satisfactory aquaculture production. This system aligns with Law 3199/2003, Decree 51/2007, and Directive 2008/56/EC (Marine Strategy Framework Directive). Continuous monitoring is essential for effective environmental management and understanding ecosystem changes. The monitoring parameters, as specified in the Circular of the Secretary General of the Natural Environment and Waters, include water and sediment parameters at coastal and inland aquaculture units.

The monitoring system for POAY implementation will focus on biodiversity, flora, fauna, protected areas, water, air, soil, climate factors, and human health. Goals include minimizing aquaculture's environmental impact, protecting marine species and habitats, managing and disposing of residues, improving water quality, reducing waste, and protecting cultural and archaeological heritage. This approach aims to ensure the hygiene and safety of fishery products, create jobs, improve living conditions, and enhance the coastal landscape's aesthetics.

Biodiversity, flora, fauna, and protected areas:

- Minimize the environmental impact of aquaculture activities.
- Ensure the protection of marine species and their habitats.
- Conduct systematic monitoring to assess the quality of the marine environment.
- Implement strategies for the management and proper disposal of residues in both marine and terrestrial environments.

Water, air, soil, and climate factors:

- Systematically monitor the quality of the marine environment.
- Strive to minimize the environmental impact of aquaculture.
- Reduce the production of liquid, solid, and gaseous waste.
- Enhance the protection of the water environment and improve its quality characteristics.
- Work towards reducing emissions of air pollutants and mitigating the impacts of climate change.

Population, human health, physical assets, cultural, architectural, and archaeological heritage, landscape:

- Ensure the hygiene and safety of fishery products.
- Support the population in disadvantaged areas by creating employment opportunities and improving living conditions.
- Enhance working conditions for all involved in the sector.
- Protect and augment the aesthetic appeal of the landscape in coastal areas.

EIA analysis: The report provides a list of environmental and social criteria that should be monitored but gives insufficient information on the sampling location, frequency, analysis and thresholds.

6.2 Proposed general mitigation measures

EIA report: To prevent and minimise the environmental impacts of aquaculture, specific methodologies have been adopted in the selection of Zones for the POAY in various regions of Greece. These methodologies include:

- **Local nutrient increase**. To control the local increase in nutrients, aquaculture units in the proposed POAY zones are established in areas with strong hydrodynamics, at suitable depths (at least 18 m), and sufficiently exposed to open sea currents to disperse nutrients effectively.
- **View/landscape alteration**. Although the alteration of the landscape by aquaculture facilities is unavoidable, it is minimized by locating units in areas with no significant development activities or land use conflicts. The organized placement of units in POAY zones also positively enhances the landscape character.

The report specifically recommends that if environmental degradation is detected, the following measures are proposed.

- Suspension of capacity increase if not yet at proposed levels.
- Reduction of production capacity to levels set by specific Ministry circulars if relocation isn't possible.
- Suspension of the unit if it cannot be relocated.
- Relocation of the unit to a better location.
- In production zones, temporary relocation from production zones is planned if ecosystem degradation is detected. Specific relocation zones are outlined for different units.
- Production sites maintain their original area and capacity and must comply with distance regulations from neighbouring units.
- The relocation process follows the relevant Law 4282/2014.
- Units can return to their original locations if, after inspection, the ecosystem is found to have recovered.

EIA analysis: The reports cover the theoretical mitigation measures that are covered by regulations for the management of farms (Law 4282/2014) in terms of level of production, suspension or relocation if farms are found to significantly impact the environment. However, the report does not cover farm management measures to minimise the impact from;

- **Disposal of solid waste and animal by-products**. Increased fish production will also result in increased solid waste disposal, particularly the responsible disposal of fish mortalities. Dead fish will need to be transported to designated disposal facilities which employ appropriate methods to minimize environmental harm, such as incineration or specialised composting systems. There is no quantification or description for this in the report.
- **Treatment of effluents from increased shore-based support facilities**. The expansion of fish production at sea will also require the expansion of support facilities onshore. These will include hatcheries, fish packing and processing facilities, net washing facilities. These facilities will require significant effluent discharge and sewage treatment. The report has not quantified these or measures to treat this waste.

6.3 Main additional studies and surveys required

EIA report: The report recommends the following studies;

- POAY studies of the required accompanying and supporting onshore facilities should be under the responsibility of the Management Entity, which in the first stage will concern the precise identification of the projects by category, number and size (e.g. surface area, volume, capacity, etc.).
- Construction studies and therefore their costing will follow at a later stage.
- Infrastructure studies for port facilities and road network improvement projects that serve the needs of POAY The studies will be carried out by competent bodies of Local Authorities and the State, as appropriate, after the relevant actions of the Management Body of the POAY in the framework of its cooperation with the bodies concerned.
- Monitoring studies for the aquatic environment, the data of which will form the basis for the assessment of water quality over time, for possible medium-term adaptation

EIA analysis: The report recommends further studies for the improvement of infrastructure and services to support the expansion and increase in fish production.

The report also acknowledges that there may be *Posidonia* seagrass meadows in the area of the fish farms and they may be impacted. This means that there is a risk that farms that are expanding (together with their increase footprint impact) as well as new farms could impact Posidonia beds that are close by. There is therefore a need for Posidonia seagrass mapping to identify areas unsuitable for aquaculture.

Mapping the present location and quality of *Posidonia* seagrass meadows requires a combination of direct and indirect methods.

Indirect methods offer more efficient and cost-effective options for mapping seagrass distribution. These methods utilize remote sensing techniques, such as satellite imagery to detect and map patterns on the seabed that are indicative of seagrass presence. Optical satellite sensors, such as Landsat and Sentinel-2, can detect the spectral signature of seagrass meadows, which is distinct from the surrounding seabed due to the presence of chlorophyll pigments. However, satellite imagery is limited by water clarity, as turbid waters can obscure the seabed and hinder the detection of seagrasses.

Once, Posidonia seagrass has been identified close to fish farms, the direct methods should be used to undertake underwater surveys using remotely operated vehicles (ROVs) to visually inspect the seabed and identify the presence and extent of seagrass meadows followed by scuba diving to monitor the quality of *Posidonia* seagrass meadows. This involves assessing various parameters, such as seagrass density, cover, and biomass, which provide insights into the health and vitality of the meadows.

7. Social Analysis of the EIA

In Greece, fish cage culture, with its associated marine port facilities, fish hatcheries and processing units, has become an important industry, contributing to both the economy and the food security of the country. However, social tensions between fish farmers, the traditional fishing industry, and local communities are a common occurrence in regions where fish cage culture is practiced. These tensions arise from a variety of concerns, including the environmental impact of fish farms, the distribution of benefits from the industry, and the potential for conflict over resources.

7.1 Socio-economic benefits

7.1.1 Socio-economic benefits at the country level

Job creation. Fish cage culture employs a significant number of people in Greece, from farm workers to fish farmers to technicians and managers. According to the Hellenic Aquaculture Producers Organisation (2021), the industry directly employs 3,871 people and it is estimated directly and indirectly employs about 12,000 people[2].

Export earnings. Greece is a major exporter of farmed fish, with exports of over €300 million per year. This contributes significantly to the country's foreign exchange earnings.

Economic diversification. Fish cage culture provides an important source of income for coastal communities, particularly in areas where traditional fishing has declined. This helps to diversify the economy and reduce reliance on a single industry.

7.1.2 Socio-economic benefits at the local community level

Job creation. Fish cage culture can create jobs in construction, operation, maintenance, and processing. This can be a major benefit for local communities, particularly in areas where employment opportunities are limited.

Economic diversification. Fish cage culture can provide an additional source of income for local communities, which can help to diversify the economy and reduce dependence on a single industry.

Community development. Fish cage culture can generate revenue that can be reinvested in community development projects, such as education, healthcare, and infrastructure.

Increased local demand for goods and services. Fish cage culture can increase the demand for goods and services provided by local businesses, such as transportation, construction, maintenance, and supplies. This can stimulate economic activity and create jobs in the local community.

Fish supply for local businesses. Fish cage culture can provide a reliable source of fresh fish for local businesses, such as restaurants, hotels, and fishmongers. This can help to reduce reliance on imported fish and support local food systems.

Skill development. Fish farms can provide training and education to local workers in aquaculture, marine biology, and other relevant fields. This can enhance their skills and employability, making them more competitive in the job market.

[2] https://fishfromgreece.com/wp-content/uploads/2023/10/HAPO_AR23_WEB-NEW.pdf

7.1.3 Food security benefits at the country level

Increased fish production. Fish cage culture has helped to increase the production of fish in Greece, making it a more self-sufficient country in terms of fish supplies.

Supplementing wild fisheries. Fish cage culture can help to supplement wild fisheries, which have been under pressure due to overfishing and environmental degradation.

Reducing reliance on imports. Fish cage culture helps to reduce Greece's reliance on imported fish, which can be expensive and can contribute to food insecurity.

7.2 Socio-economic drawbacks

7.2.1 Drawbacks at the country level

Environmental impact. Fish cage culture can have a negative impact on the environment, including pollution from fish waste, the spread of diseases and parasites, and habitat destruction.

Conflict with traditional fisheries. Fish cage culture can conflict with traditional fishing practices, leading to competition for resources and disruption of fishing grounds.

7.2.2 Drawbacks at the country level

Social tensions. Fish cage culture can lead to social tensions between fish farmers, traditional fishers, and local communities, as there may be concerns about the environmental impact and the distribution of benefits.

Competition for resources. Fish farms compete with traditional fishers for resources, such as fishing grounds. This competition can disrupt traditional fishing practices and reduce the livelihood opportunities for traditional fishers.

Lack of transparency and participation. The decision-making process for fish cage culture projects is often opaque, and traditional fishers and local communities may not have a say in the size of farms and where the farms are located. This lack of transparency can lead to resentment and distrust.

Lack of benefits sharing. Traditionally, the profits from the fishing industry have been shared among the fishers and the local communities. With fish cage culture, the profits often flow to the fish farmers and the companies that own the farms, with little benefit to the local communities.

7.2.3 Drawbacks at the local level

Visual impacts on seascape. The presence of fish cages can alter the natural beauty of coastal areas, affecting the aesthetics of the seascape. The large floating structures of fish cages and feeding barges can be visually unappealing, disrupting the natural views and creating an industrial feel to the shoreline. This can be particularly noticeable in areas with pristine coastlines or with significant tourism value.

Impacts on coastal tourism and yachting. Fish cages can potentially deter tourists and yachters from visiting coastal areas, negatively impacting the local tourism industry. The sight of fish cages can diminish the perceived natural beauty of the coastal landscape, reducing the appeal for recreation and relaxation. This can be particularly detrimental for tourist destinations that rely on the pristine beauty of their coastlines.

Local marine traffic. Fish cage culture operations can increase local marine traffic, as vessels are required to transport fish, feed, and supplies to the farms, and to collect and transport fish

away from the farms. This increased traffic can disrupt the movement of other vessels, such as fishing boats and pleasure craft, and can also increase the risk of collisions and accidents.

Local road traffic. The construction and operation of fish farms can also increase local road traffic, as trucks are needed to transport materials and supplies to the farms, and to carry away waste and by-products. This increased traffic can put a strain on local infrastructure and can also contribute to air pollution.

Freshwater resources. Fish cage culture operations can consume large amounts of freshwater, which is used for cleaning fish tanks, diluting waste, and maintaining optimal water quality. This can place stress on freshwater resources, particularly in areas where freshwater is already scarce.

Housing for workers. The expansion of fish cage culture can lead to an increase in the demand for housing for workers, as fish farms need a steady supply of labour to operate efficiently. This can put pressure on local housing markets and can lead to higher housing costs such as rents.

7.2.4 Assessing the balance of benefits and drawbacks

The socio-economic impacts of marine fish cage culture in Greece are complex and there is no easy answer to whether the benefits outweigh the drawbacks. The industry has the potential to provide significant economic and food security benefits, however, it is important to manage the environmental and social impacts carefully.

The overall balance of benefits and drawbacks, as outlined in Sections 7.1 and 7.2, depends on how the industry is managed and how it interacts with local communities.

7.3 Scope of the SEIA

EIA study*:* The area being studied for the creation of a POAY belongs administratively to three Regional Units, the P.E. of Argolida and Arcadia, in the Peloponnese and P.E. Islands of the Attica Region. It includes a total of five PAYs:

- A5 (Vourlia – Ormos Korakias, P.E. Argolida),
- A6 (Platia Island, P.E. Argolida),
- A4.1 (Coast of Arcadia, P.E. Arcadia),
- A4.2 (Coast of Arcadia, P.E. Arcadia),
- A9 (Methana-Troizinia, P.E. Islands).

The location of each of the Aquaculture Development Areas is described as defined in No. 31722/4.11.2011 Decision “Approval of a Special Spatial Planning Framework and of Sustainable Development for Aquaculture and its Strategic Environmental Impact Study” (Government Gazette 2505/B/04.11.2011). The study also states that the environmental assessment includes a description of the natural habitat, the anthropogenic environment, the fishing activity as well as the aquaculture activity.

The proposed POAY Argolida-Arcadia-Methana consists of eleven (11) Zones A, B, C, D, E, F, K, Z, H, T and I, for the farming of fish. The location and the number of existing aquaculture units are described with their tonnage and leased areas. Growth proposals are described in the production zones A, B, C, D, E, F, H, Z, T and I. Growth can arise through the expansion of existing units or the creation of new units. Maximum limits are placed in each of the zones in terms of leased area and the maximum annual tonnage capacity of each of the zones. A necessary condition for all of the above is the arrangement of the distances between the units, the observance of the distances from the coast and a minimum depth.

In Zone K there are no existing aquaculture units and this zone is reserved for recreational use. However, there is an area within the zone that has been identified for the relocation of units for environmental reasons should it be required.

The natural environment of the proposed area for the creation of POAY Argolida – Arkadias – Methanon is described, and it is concluded that the environmental characteristics of the specific area advocate the characterisation of the area as suitable for aquaculture development.

EIA analysis*:* The purpose and objectives of the study as required by the EU and Greek legislation and the infrastructure and compatibility of the planned development with the available development criteria for the Regional Units are described in Chapter 3 of the EIA. A general description of the POAY is given in Chapter 4 and includes details of the associated land-based infrastructures and equipment required by the sea-based units. The number of docking facilities and other directly associated land-based infrastructures required are noted. However, the land requirements of the supporting facilities are not estimated neither is the labour requirement, but it is noted that the supporting facilities (packing stations and fish hatcheries) are insufficient even for the needs of the existing units. The description of the project does not mention that any stakeholder or community engagement and consultation was to be or had been undertaken during the study.

Review of content

In order to consider the social status of the SEIS the following should be covered in the report.

- Demographics
- Employment and unemployment
- Tourism
- Infrastructure and services
- Economic conditions
- Land use
- Cultural heritage
- Protection of human and public health

7.3.1 Demographics

EIA study*:* In the region of the Peloponnese and according to the census data of EL.STAT. 2011, in the last ten years (2001-2011) in the municipalities (DE) of Asini and Kranidi in the Regional Unit of Argolida, a slight decrease in the population was recorded. In the DE of Kranidi, this reduction reached 6.9%, a percentage corresponding to that of the DE of Argolida, while the population of Asini decreased by 2.8%.

In the Regional Unit of Arcadia, in the Municipality of North Kynouria during the years 2001 – 2011 a population decrease of 16.8% was recorded, a percentage that was greater than the equivalent of the DE of Arcadia (-10.9%). In DE of Tyros and Leonidou, during the same period, a small population increase was recorded at 1.2% and 8.2% respectively.

In the Attikis region the regional unit of Methana, in the period 2001- 2011 had a population decrease of 20.9%. This percentage far exceeds the corresponding one for all the P.E. Islands (-2.1%).

EIA analysis*:* The EIA study considers that the creation of the POAY will strengthen the economy and the development of the local communities since new employment positions will be created.

However, the EIA study does not consider the educational level of the population of these regions nor evaluate the potential number of jobs that can be created by the fish farms, their quality and whether this can be met by local recruitment.

Without an evaluation of the potential total number of jobs that exist and would be created it is not possible to explore the potential disruption to traditional ways of life and community dynamics. Without analysis of the number of potential jobs in these diverse regions, it is impossible to analyse the strain the proposal will make on local infrastructure (roads, fresh water and sewage, healthcare and schools) due to population influx and the effect of increased economic activity.

7.3.2 Employment -Unemployment

EIA study*:* In 2011 the permanent population of the study area was 34,722 persons of which 33.5% (11,613) are employed, 6% unemployed and 60.3% economically inactive.

In the whole of the study area, 53.4% of the economically active population is employed in the tertiary sector. In all the regions of the study, the percentage of the population working in the tertiary sector exceeds 50%, except for the municipality of Leonidou where the figure is 44.4%. The tertiary sector includes administrative, educational and commercial services in the urban centres of the region. In the coastal areas businesses are active in the provision of leisure and tourism services.

EIA analysis*:* No quantification of the personnel required for the proposed increased production is provided and without this information, it is difficult to assess the effect on the unemployment rate in the region.

The transportation of the workforce, and the ability of the unemployed population to reach places of employment, between the communities in the municipalities and the proposed POAY has not been considered in the study.

7.3.3 Tourism

EIA study*:* No analytical study on the tourism sector in the study area has been carried out. Within the study area of the POAY the regulations pertaining to the status of the land use within the urban planning regulations is considered in the study and areas for tourist development or restrictions on tourism are mentioned. It was noted that in the Leisure Tourism Zones defining the extra urban Tourism Recreation Zones is imperative and particularly important.

EIA analysis*:* Through the creation of spatial zones in the POAY the potential for negative spatial impacts is avoided, while at the same time, emphasis is placed on any planned new uses to avoid future conflicts due to competing uses (e.g. aquaculture and tourism). However, without an analysis of the tourism sector it is not possible to fully evaluate the spatial organisation of the POAY in relationship to other competing sectors.

7.3.4 Infrastructure

EIA study*:* The study concludes that the area of the POAY has basic infrastructure networks (road network, ports, electricity and electrical supply).

Port infrastructure

PAY A.5 and A.6 (P.E. Argolida): The port facilities in the area are the following:

There are configured piers for the docking of fishing vessels and tourist boats on the beach of Koilada Kranidi.

- Private jetty on the west side of the village of Thini.
- Tourist boat shelter (marina) at Porto Helio for 149 tourist boats
- Tourist boat shelter (marina) at Ermioni

- In the wider area there is the inter-provincial Port of Nafplio serving commercial and tourist traffic.

PAY A.4.1 and A.4.2 (P.E. of Arcadia): The entire area of Kynouria does not have the necessary infrastructure for docking and does not have a sea connection. The port facilities in the area are the following:

- Port of Tire, used for mooring fishing boats. – The approach to the port has problems in the winter months due to conditions and insufficient infrastructure protection
- Agios Andreas Beach Port – used for docking of fishing boats
- Port of Paralio Astros used for fishing boats and yachts ~ 300 boats

PAY A.9 (Methana): The port facilities in the area are the following:

- A fishing shelter in Vathi, as well as landscaped jetties, boat mooring south of the port
- The Methana ferry with routes to Poros, Aegina and Patras
- Fish and yacht shelter in Methana south of the ferry

Road infrastructure

PAY A.5 and A.6 (P.E. Argolida):

- There are 2 main axis roads in the area: the Ethniki road Corinth – Tripoli and Corinth - Nafplio. Provincial roads provide coastal access and extends south to Iria. Access to the municipality of Karanidiou takes place from the Athens-Corinth-Archaia Epidavros-Traxeia- Porto Heli.
- In the region PAY A5 the axis to the coastal section of Municipality of Asinis occurs using the coastal road axis to Ormos Vourlia and then due to its geography by dirt track. A network of tarmac and dirt tracks allows coastal access to south Kranidou. Access in the area of PAY 6 is only by boat.

PAY A.4.1 and A.4.2 (P.E. Arcadia):

- The area is served by a local provincial road network The road network is not particularly developed in South Kynouria and has low accessibility due to geographical restrictions with long travel times required.
- There is a road axis along the coastal beach area beach from Ag Andreas to Ormos Tyros however many areas are inaccessible. The Bournia peninsula is only accessible to Ormos Fouski

PAY A.9 (Methana):

- Axis to the municipality of Methana is from the coastal road connecting Korinth – ancient Epidavros and Methana. The road network of the peninsula is satisfactory and there is a central main axis and branching out a network of tarmacked and dirt tracks allowing access to the coast.

Rail transport: This is non-existent in the areas of the study

Air transport: The main international airport is in Athens however the military airports of Kalamata and Tripoli act as civilian airports during the summer charter season.

EIA analysis*:* A detailed analysis of how the current infrastructure will affect the development of the project, the way goods are transferred, boats stored and moored seems to be very weak. Some areas are only accessible by boat or dirt tracks and while considered satisfactory the understanding is that a lot of work would need to be carried out to have a truly functional road network and ports that would cover the needs of the POAY.

7.3.5 Freshwater supply and sewage

EIA study:

PAY A.5 and A.6 (P.E. Argolida):

- The municipality of Asinis faces a significant water supply problem due to the poor quality and insufficient quantity of water channelled into the water supply network. The area is supplied with water mainly from private boreholes and wells and there is no drinking water treatment plant, so it is available in the networks directly from the water intakes. The quality of the water is unsuitable for water supply due to a high content of chloride and nitrate (NO_3-) ions and the pipes are made of asbestos in their major part.
- In the municipality of Asinis, the irrigation network is old and lacks full coverage of cultivated areas, resulting in insufficient irrigation of crops, especially during the summer months when water shortages are observed. In addition, uncontrolled drilling for irrigation results in groundwater flooding.
- There is no sewage network in the studied area sewage system and the settlements are covered by septic tanks. In Tolo there is a Sewage Treatment Facility to which the sewage from the settlements of Drepano, Asini, Iria and Karnezeiko are transported by tanker. The settlement of Kranidi has biological cleaning through the sewerage network and the wastewater from the Porto Heli settlements is also transferred to it.

PAY A.4.1 and A.4.2 (P.E. Arcadia):

- The study area is served by boreholes and wells. Problems occur during the summer months sufficiency due to increased demand in coastal settlements. To cover the needs for irrigation of the crops, the waters of the rivers Alfeios, Ladonas and Lousios are used.
- In the studied area there is no sewage network and the settlements are served through septic tanks and underground absorption systems, or by storing them in watertight tanks and transporting them with tanker vehicles. There is one Wastewater Treatment Plant in Astros which however does not serve the study area.
- In Leonidio a project “Draining Leonidou and wastewater treatment facility” with the creation of an EEL unit to serve the residential unit of Leonidou (Leonidio, Plaka, Lakkos) is also planned. According to the project schedule, its completion is expected on the 8th /2021.

PAY A.9 (Methana):

- The spa town of Methana is supplied by two springs which are located in the plain of Troizina and from there through a network supply to other settlements of the Methana peninsula. In periods of increased rainfall, there is a problem of NO_3- in the drinking water and a study has been prepared for the supply of denitrification systems. There is no irrigation network on the peninsula and growers are served by irrigation boreholes.
- In N.E. Methanon, at Bishmiza there is a Wastewater Processing Facility at a distance of approximately 2 km from the city of Methanon. The municipal wastewater of the city of

Methana, and the wider area, is directed to the facility and the treated sewage is disposed of in the sea.

EIA analysis: The EIA study does not quantify the freshwater requirement for the population or for irrigation and whether the supplies can meet the requirement or any additional requirement of the new proposed facilities. There will be a requirement for the following:

- Worker drinking water
- Cleaning water (tanks, packing facility, etc.
- Domestic toilet water
- Water for ice (harvesting, packing)

7.3.6 Telecommunications and electrical energy network infrastructures

EIA study:

PAY A.5 and A.6 (P.E. Argolida):

- **Telecommunication –** In the study area good modern and fibre optic communication networks are present and the area is covered by fixed and mobile connections.
- **Energy** – Energy at the time of the study was generated from the lignite generation plant in Megalopoli and distributed through the electrical network by DEH. Electric power of 38MW is generated by the Malia Gliata wind farm.

PAY A.4.1 and A.4.2 (P.E. Arcadia):

- **Telecommunication –** The area is covered by a fixed and mobile telecommunication network.
- **Energy** - in the study area electricity is supplied from the DEH network and no severe problems in electrical distribution are observed although some northern areas have difficulties in the agricultural sector.

PAY A.9 (Methana):

- **Telecommunication** – no particular problems are reported and telephone and internet access is considered satisfactory.
- **Energy** - in the study area electricity is supplied from the DEH network and no severe problems in electrical distribution are observed.

EIA analysis: Without more detailed information especially for the region of Methana it is not possible to assess whether the telecommunication infrastructure is capable of meeting modern demands.

The study does not consider the supply capacity or the requirement for electricity in the study area. Without any detailed information, it is not possible to assess whether the electrical generation and distribution infrastructure can meet the areas demands and satisfy the requirements for the POAY. The EIA does not quantify the electrical demands of the proposed new land-based facilities.

7.3.7 Electricity supply

EIA report: The report states that the operation of the floating facilities is not expected to affect the electricity networks of the wider area and that the electricity supply needs can be covered either by the local grid or by generators.

EIA analysis: The SEIA does not mention the electrical distribution network of the region. Neither is the source of electrical generation or its capacity mentioned in the report. The onshore facilities will require significant electrical consumption for net cleaners, ice production, processing facilities, refrigeration and cold storage. No recommendations or requirements for the increased aquaculture sector are mentioned in the report.

7.3.8 Health and Welfare Infrastructures

EIA study: No mention of provision of care or health services are mentioned for the study area.

EIA analysis: Without an assessment of health care from local services it is not possible to assess if this will be affected by the POAY.

7.4 Environmental impacts

1. Noise and light pollution
2. Landscape
3. Cultural heritage

7.4.1 Impacts of noise and light pollution

EIA study: The study does not consider the impact of any noise and light pollution from the facilities in the proposed areas of the POAY.

EIA analysis: The study does not consider the impact of any noise and light pollution from the facilities in the proposed areas of the POAY. Generally, perimeter mooring warning lights at night and land security lighting at night are used. It is prudent to have flashing warning lights at night at the perimeter of the sea cage sites together with radar reflectors to prevent collision of boats with the cages at night. The flashing lights can be designed to be shielded from the light penetrating the water and causing light pollution. Unshielded lights might affect sea turtle behaviour, esp. in terms of nesting. In addition, low-intensity lighting is used to protect the sea cage units, to avoid stress to fish populations during storms.

The SEIA does not consider the noise impact from fish hatchery production facilities.

The SEIA does not consider the noise from reversing forklift vehicles around the packing stations which may impact nearby residential sites.

7.4.2 Impacts on the landscape

EIA study: The EIA study recognises that in the regulations the coastal landscape and environment must be respected. Descriptions of the landscape and protected environments in the study area are described and areas of outstanding natural beauty considered. The study considers that the visual alteration of the natural coastal landscape, by the installation of land and sea infrastructures, is a basis for criticism.

The location of the units in organized organised aquaculture development areas contributes positively to strengthening the character of the landscape.

EIA analysis: The EIA study does not quantify the number or size of additional land-based facilities that are expected to be constructed or their location[3]. This is a major omission as it does

[3] With similar scale cage farms, the onshore facilities would typically include: (i) tank-based fish nursery facilities, (ii) offices & accommodation for key staff, (iii) net washing, net repair & net stores; (iv) feed stores, (v) jetty & cranes, (vi) fish packing facility with fish box storage, (vii) maintenance workshop with stores, (vii) spare materials area (cage pipes and stanchions) and (viii) parking area for trucks live fish tanks, etc.

not take into consideration the necessary land services and infrastructure requirements that are needed to support the expansion, road traffic increase, freshwater requirement, electricity requirement, housing requirement, sewage and water treatment, etc. Without quantification of these facilities and their locations, it is not possible to make an informed judgment on impact on the landscape. The SEIA study does not take into consideration the visual seascape and impact on yachting in the area and the use of sheltered space and bays.

7.4.3 Impact on cultural heritage

EIA review: The SEIA lists the archaeological sites within the regional units and concludes that within the boundaries of the 5 areas of aquaculture development there are no protected archaeological sites according to the provisions of Law 3028/2002 “for the protection of antiquities and in general of cultural heritage”

EIA analysis: The proposed aquaculture development areas appear to be free of important historical cultural heritage and all relevant regulations would have to be followed before the construction of any facilities.

7.5 Identification of residential /spatial impacts

EIA review: The SEIS considered in each of the aquaculture development areas includes the siting of the aquaculture units in relation to other users in the areas given that the zoning and the radius of influence would be 1000m from the aquaculture sites. The PAY’s only have residential areas at much greater distances than 1000 m. The study provides indicative locations of the land-based facilities on maps.

EIA analysis: The EIA study does not estimate the additional land-based facilities that will be required or provide the area required for the location of the facilities. The EIA does not attempt to quantify the amount and type of land use change. The maps providing indicative location of the land-based facilities were not included in the report provided for this assessment.

The support facilities will include coastal installations such as jetties, net washing facilities including net washing effluents (organic and solid waste). Without quantification of such facilities the impact cannot be assessed. The net washing process creates high nutrient effluent that needs treatment before being released back to the sea. Net washer effluent is small volume but has high nutrient loading and inorganic particle loading (mussel shells). This requires a high level of treatment as well as sludge and solid waste disposal.

7.5.1 Impacts related to Infrastructure

EIA Review: The purpose of the creation of POAY is the concentration of aquaculture activity in areas where organized units already exist, and this will minimize any negative effects of the POAY in the spatial organization of the wider region

EIA analysis: Under infrastructure, the study does not state where the freshwater supply for the PAY’s will come from. In addition, it does not mention any electrical supply requirements and whether these can be covered either by the local grid or by generators.

Both floating and land units require the existence of road infrastructure for the distribution of products.

The EIA study does not estimate the increase in road traffic. The expansion of production will cause significantly higher levels of road traffic on the existing poor road infrastructure. Road traffic might include:

- Feed deliveries to the feed store
- Deliveries of fry from hatcheries to the onshore nursery unit
- Harvested fish delivered to the packing facilities and from the packing facilities to the main markets
- It is estimated that there will be a need for an additional 300 workers and these workers will have to travel to the farms and back to home daily.

The EIA study does not estimate the increase in marine traffic. There will also be a significant increase in marine vessel traffic, e.g.,

- Changes of nets (nets taken to shore to be washed, nets taken out)
- Feed supply to each cage
- Fish harvesting
- Cage servicing
- Divers' inspection of each cage
- Cage security at night

7.6 Social impact

7.6.1 Population

EIA report: The EIA study expects the proposed POAY to enhance the employment intensity of the aquaculture sector in the study area, reducing unemployment and activating local potential, providing significant growth and employment opportunities.

Aquaculture farms are usually located in arid and/or remote areas. It is well known that in Greece such areas face problems, mainly due to the absence of development structures to retain the new population.

EIA analysis: The EIA study does not estimate the increase in workers and skilled personnel required for the proposed increase in production and without analysis it is difficult to assess the effect on the unemployment rate. Given that many of these areas are remote and the study does not state the effect on developmental structures such as housing, schools and healthcare and no proposals are made as to how these can be addressed.

7.6.2 Human health

EIA report: The assembly operations of the fish cages are not expected to cause any risk of harm to human health, provided that all necessary measures for the safety of personnel as required by applicable legislation are taken.

EIA analysis: No mention is made of the use of chemicals, vaccines and anaesthetics used on farms.

7.6.3 Economic impact

EIA report: The EIA study states that the aquaculture sector currently employs directly and indirectly about 10,000 workers, mainly in the periphery of the country. Many of these jobs are located in remote areas and the development of aquaculture has a positive impact on the economies of local communities. This is reinforced by the potential for developing alternative

forms of tourism (fishing tourism, fish tourism, diving tourism) in combination with productive activities, boosting the income of producers, and diversifying and enriching the tourist product of a region.

EIA analysis: No stakeholder engagement has been made to determine current employment levels and gauge the potential employment levels required with proposed levels of production.

7.6.4 Solid waste disposal

EIA report: The study report states that the 5 ADA's do not have organised sanitary waste landfill provision although provision for a waste treatment unit, a sanitary landfill and 2 waste transfer stations have been contracted and are due to be completed in 2023.

EIA analysis: The EIA report does not estimate the scale, or type of solid waste that will be generated or give any details on how and where the solid waste will be disposed of. The report does not mention the main sources of solid waste which include:

- Feed bags
- Discarded nets
- Fish mortalities
- Net washer sludge and shells

Other waste streams (such as lubricating oils, accumulators, batteries, waste electrical and electronic equipment including light bulbs, tyres, end-of-life vehicles) are not mentioned and should be collected and delivered to licensed collectors or approved alternative management systems.

7.6.5 Housing

EIA report: The EIA study does not mention any additional housing needs for the workers.

EIA analysis: There will be a need for additional housing for technicians and managers who may be brought in from outside the region. An increase in additional workers will pressure availability (and rental price) for year-round accommodation.

7.7 Stakeholder consultation

EIA report: The study reports that one of the purposes of the company "POAY Arglolidos Arkadias SA" established and registered in 2016 is the preparation of studies related to the purposes of the company and the promotion of the conclusions to the stakeholders.

EIA analysis: No details of any stakeholder consultation are given in the report, and this should be a central element in planning and operation of the POAY. If this is the case, then there is a serious omission in the EIA study. There is no mention of social responsibility measures for the local community.

8. Conclusions

The SEIA conducted by APC, while comprehensive in certain aspects, reveals significant shortcomings in addressing the full spectrum of environmental and socio-economic impacts associated with aquaculture expansion that would be expected in a SEIA. The study effectively outlines existing legal frameworks and potential environmental impacts, facilitating the process of increasing production licenses and establishing new farms. However, its analysis of environmental impacts, particularly in quantifying and assessing cumulative effects, is inadequate.

The EIA report for the proposed POAY in Argolida, Arcadia, and Methana outlines the expansion plans across eleven zones, emphasizing environmental considerations and the use of floating cage systems.

The report covers the relevant policies and regulations at the EU, national, regional and local levels well.

The report details the current state and planned expansion for each zone, including increases in annual capacity and leased area. However, it lacks specific mapping of the increased leased area, limiting the analysis of overlapping impacts between neighbouring farms.

The EIA report evaluates alternatives, including the 'Zero Solution' and variations in the number, location, size, and capacity of zones. The chosen plan is based on existing operational data and compliance with environmental frameworks. However, the report does not quantify the additional nutrient output from expansion or consider the cumulative impact of multiple farms in a shared water body.

The environmental situation is assessed using data from a 2015 field study by the Hellenic Centre for Marine Research. The findings indicate good environmental conditions, with low nutrient concentrations and minimal pollution. However, the study's sample sites were not close to existing farms, potentially overlooking localized impacts.

The Natura 2000 network's role in conserving habitats and species is acknowledged, with specific attention to *P. oceanica* meadows and reef habitats. The report emphasizes the need for careful management to prevent negative impacts on these sensitive ecosystems.

Pollution sources in the study area include urban wastewater, agricultural runoff, and industrial activities. The report outlines the existing wastewater treatment infrastructure but does not assess the impact of additional nutrient output from the proposed aquaculture expansion.

The report describes the expected environmental impact of aquaculture but does not attempt to quantify the additional nutrients that will be released into the environment from the increased production and the impact on local infrastructure and services. Therefore, there is no estimation of the severity or extent of the impact on the environment.

The report assumes that continuous improvements in aquaculture practices, including better nutrition protocols, selective breeding, disease prevention methods, and waste management will minimise environmental impacts. However, there are practical operational mitigation measures that can be undertaken by the farmers which is not explored. The report also describes the Greek and the European Union regulatory frameworks that govern various aspects of aquaculture to protect the environment and ensure the quality of products. These regulations are not always fully enforced and there should be some mandatory good practice guidelines that the farmers have to follow to ensure high environmental standards in the sector.

The EIA proposes a monitoring system to protect the aquatic environment and support aquaculture production, focusing on various environmental and social factors. However, it provides limited information on sampling location, frequency, analysis, and thresholds.

Proposed mitigation measures aim to minimize environmental impacts, such as local nutrient increase and landscape alteration. The report suggests suspending or reducing production capacity if environmental degradation is detected but lacks specific farm management measures for solid waste disposal and effluent treatment from increased shore-based facilities.

Additional studies and surveys are recommended for infrastructure improvement and environmental monitoring. The report acknowledges the potential impact on Posidonia seagrass meadows but lacks detailed mapping and assessment of these areas.

Weaknesses of the study:

- **Inadequate mapping of expansion areas:** The report fails to provide detailed mapping of the increased leased areas for aquaculture expansion. This omission makes it challenging to accurately assess the spatial overlap and potential cumulative impacts of neighbouring farms. Precise mapping is crucial for understanding the spatial distribution of environmental impacts and for planning effective mitigation strategies.
- **Lack of nutrient output quantification:** The EIA does not quantify the additional nutrient output expected from the expansion of aquaculture operations. Nutrients such as N and P, typically released from fish feed and waste, can significantly impact marine ecosystems, potentially leading to eutrophication. Without this quantification, it's difficult to predict the extent of potential environmental degradation and to plan appropriate countermeasures.
- **Overlooking cumulative impacts:** The study does not adequately address the cumulative environmental impacts of multiple aquaculture operations within a shared water body. This oversight is significant, as the collective impact of several farms could be substantially different from the impact of individual farms in isolation. Factors like nutrient loading and the spread of diseases need to be evaluated in a cumulative context.
- **Limited assessment of localised impacts:** The 2015 field study conducted by the Hellenic Centre for Marine Research did not include sampling sites close to existing farms, potentially overlooking the direct impacts of these farms on the local marine environment. Localised studies are essential to understand the specific impacts of aquaculture operations on the immediate surrounding areas.
- **Insufficient detail in monitoring system:** While the report proposes a monitoring system, it lacks detailed information on critical aspects such as sampling locations, frequency, analysis methods, and threshold values for action. A well-defined monitoring plan is essential for early detection of environmental degradation and for implementing timely mitigation measures.
- **Insufficient specific farm management measures:** The report does not provide detailed measures for managing solid waste and effluents from increased shore-based facilities. As aquaculture operations expand, so does the need for effective waste management strategies to prevent environmental contamination.
- **Incomplete assessment of Posidonia seagrass meadows:** The report acknowledges the potential impact on Posidonia seagrass meadows but lacks a comprehensive assessment, including detailed mapping and evaluation of these habitats. Posidonia meadows are crucial for marine biodiversity and their degradation could have far-reaching ecological consequences.

Furthermore, the study *does not* provide sufficient quantification of the social impacts or provide sufficient recommendations on mitigation measures. In addition, there appears to have been no stakeholder consultation during the study to be able to find mutually agreed solutions to avoid conflict with other users of the space and the neighbouring communities and tourist trade in the Regional Units.

Specifically, the study is **insufficient** in:

- Quantifying planned new facilities (land and sea), use of inputs (feed and fingerlings) and employment opportunities This detail is required to quantify the changes that might occur with the expansion of production and project area.

- The maps providing indicative locations of the land-based facilities were not included in the report provided for this assessment.

- Quantification on the use of resources and how these will be addressed (road traffic, marine traffic, additional electricity supply, additional freshwater supply, etc.) within the level of infrastructure and services available in the Regional Units.

- Quantification, solutions and impact from the project outputs such as wastewater treatment, solid waste disposal and organic waste disposal. A major increase in production will generate a large wastewater treatment requirement from sewage, facility and equipment washing, etc. This, as well as the other solid and organic waste disposal, needs to be quantified to assess and predict scale and potential solutions.

- The study shows no evidence of stakeholder consultation and effort to find mutually agreed mitigation measures to reduce social impacts.

In conclusion, while the SEIA by APC provides a foundational understanding of the legal and theoretical environmental aspects of aquaculture expansion, it falls short in thoroughly assessing and mitigating the cumulative environmental and socio-economic impacts. This gap highlights the need for a more holistic and inclusive approach to aquaculture governance and planning, one that encompasses the full range of environmental, social, and economic considerations.

9. References

- Greece - National Aquaculture Legislation Overview. https://www.fao.org/fishery/en/legalframework/gr/en?lang=en
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