



## **D.5. EVALUATION OF THE SOCIO-ECONOMIC IMPACT OF CONSERVATION ACTIONS**

**Final report on analysis of local economy  
Mar Menor (Spain)**

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## EXECUTIVE SUMMARY

The Mar Menor, a hypersaline coastal lagoon located in the southeast of Spain, stands as one of Europe's clearest examples of the link between environmental degradation and economic fragility. Over five decades, intensive irrigation agriculture, rapid tourism-led urbanisation and weak water management have pushed the lagoon into chronic eutrophication, destroying its biodiversity and undermining the local economy. The crises of 2016, 2019 and 2021, marked by algal blooms, anoxia and mass fish deaths, revealed how unsustainable development had turned a natural asset into a systemic economic liability. The 2008 financial crash halted construction but deepened dependence on agriculture and tourism; EU agricultural incentives drove further nutrient runoff from the Campo de Cartagena, while repeated ecological collapses eroded investor confidence and regional employment. Tourism, which attracts half of all Costa Cálida visitors, has suffered measurable revenue losses and price declines wherever pollution is visible. Fishing, once central to local identity, has shrunk in both fleet and landings despite short-term gains in pollution-tolerant species. Real-estate values around the lagoon have dropped by an estimated €4 billion compared with similar Mediterranean areas. Agriculture remains profitable and labour-stable but is responsible for roughly 85 percent of nutrient inputs, embodying the tension between short-term productivity and long-term sustainability. Overall employment data show a structural shift from construction toward services, leaving communities ever more exposed to environmental fluctuations that threaten tourism and hospitality jobs.

The LIFE Transfer project's seagrass transplantation initiatives demonstrate promising ecological outcomes, with high survival rates and habitat recovery; however, the scope and progress of these efforts limit immediate socio-economic benefits. Through the transplantation of the seagrasses *Cymodocea nodosa* and *Ruppia cirrhosa*, survival rates near 80 percent and clear improvements in water and sediment quality have been achieved, enhancing biodiversity and ecosystem services such as nutrient retention, carbon sequestration and nursery habitats for fish. These gains could, over time, reinforce sustainable tourism, artisanal fisheries and coastal resilience. Yet the project's limited scale and the persistence of diffuse agricultural pollution mean that its immediate economic effects remain modest. True recovery will depend on expanding restoration efforts, strengthening pollution control, and aligning agricultural, urban, and tourism practices with the lagoon's ecological capacity.

This report emphasises the need for integrated governance approaches that align ecological restoration with structural economic reforms. By fostering collaboration among stakeholders, advancing policy coherence, and promoting inclusive participation, these integrated strategies can support resilient socio-ecological systems. Ultimately, this will enable a transition towards a sustainable regional development model for the Mar Menor area, ensuring long-term benefits for the environment and local communities.



## INTRODUCTION

Mar Menor is a large coastal hypersaline lagoon in the Mediterranean basin, with a volume of 610 hm<sup>3</sup> and a maximum depth of almost 7 m. It is located in the Region of Murcia, in the southeast of Spain. The lagoon is separated from the Mediterranean Sea by a narrow sandy bar with five shallow channels that connect the two water bodies (Martínez-Alvarez et al. 2011). Both the lagoon and its surrounding wetlands possess an elevated natural value that have gained several regional, national and international protection declarations such as Regional Park, Ramsar International Area, Special Protected Area of Mediterranean Interest, and Site of Community Importance (Bernadeau-Esteller et al. 2023).

The Mar Menor lagoon has multiple uses for the inhabitants of its region, the main ones being tourism, agriculture, fishing and recreation. Apart from the economic value, the lagoon has acquired an emblematic meaning in the Region of Murcia (Guaita-García et al. 2021; Comité de Asesoramiento Científico del Mar Menor 2017). The adjacent watershed to the lagoon, known as Campo de Cartagena, has an area of 1270 km<sup>2</sup>, and its population amounted to 357,266 in 2017. The Campo de Cartagena watershed is drained by more than 20 ephemeral watercourses that flow into the Mar Menor lagoon. Since 1960s, human activity both in the lagoon and the watershed, has increasingly exerted a strong ecological pressure with a negative impact on water quality and biodiversity in the lagoon and its surrounding wetlands (Guaita-García et al. 2021). Human activities with the greatest impacts in the lagoon were/are (Ruiz et al. 2020):

1. Nutrient input. Since the 1980s, the lagoon has received inputs from urban wastewater, and agriculture and livestock activities. The most important source pointed out by scientific studies and reports is agriculture due to its permanent input of nutrients. In 1979, the Tajo-Segura transfer increased water availability leading to a ten-fold growth in the land under irrigation in the Campo de Cartagena watershed. For decades, nutrients from fertilisers have been discharged into the lagoon both through groundwater and through superficial ephemeral watercourses, which have acquired a permanent flow. This process has transformed the original oligotrophic state of the lagoon into a eutrophic state.
2. Metal contamination. Mining activity in the south of the lagoon led to the discharge of waste materials into the water during the first half of the 20th century. Later, mining residues were placed in specific deposits, but rainfall events still carry metal waste and mineral deposits to the lagoon. As result, some heavy metals have been detected at concentrations above the limits indicated by environmental quality criteria, both in the sediments and in the water column.
3. Coastal infrastructure for tourism. Urban-tourism and second-home growth in the 1960-1970s led to development of urban areas and infrastructure such as ports, dikes,



dredging, and beach regeneration, with a great impact on marine sea bottom, hydrodynamics and water quality.

4. Organic contaminants input. There are many organic contaminants in the lagoon such as pesticides, polycyclic aromatic hydrocarbons, polychlorinated biphenyls, surfactant agents, drugs, and personal care and hygiene products. Their main entry routes are also very diverse: through groundwater and superficial watercourses, from urban, nautical and recreational activities, bathing, plastic waste in the Mar Menor surroundings, and atmospheric deposition of agriculture pesticides.

Availability of nutrients has been followed up in the lagoon by measuring chlorophyll concentration. Values obtained indicate that nutrient availability tended to increase slightly between 1980 and 2010. From 2012, chlorophyll values increased significantly until they reached exceptional levels in 2016, when the first ecological crisis took place. Phytoplankton growth caused a loss in water transparency and the unavailability of light for seagrass meadows provoked the disappearance of around 85% of the benthic vegetation cover (Ruiz et al. 2020).

Two more eutrophic crises took place in 2019, and 2021, leading to two anoxia events that caused massive death of aquatic species (Ruiz et al. 2020; Cabello and Brugnach 2023). Currently, water transparency and chlorophyll values indicate an apparent stability of the ecosystem. However, the lagoon continues receiving massive inputs of nutrients from anthropogenic sources, and some factors, such as, the increasing water temperature and the appearance of an anomalous “white water mass” indicate that the ecosystem is still vulnerable to environmental changes that can trigger new anoxia events (Ruiz et al. 2023).

Benthic macrophytes (seagrasses and macroalgae) incorporate large amounts of inorganic nitrogen in their tissues and constitute an important mechanism of resistance to eutrophication. In addition to the death of benthic macrophytes that occurred in 2016, seagrasses in the Mar Menor lagoon are also affected by the alteration of sedimentary and hydrodynamic dynamics as a result of coastal actions such as the dredging of sand or the placement of breakwaters (Ruiz et al. 2020).

With the aim of conserving seagrasses in the Mar Menor lagoon, the project LIFE Transfer is transplanting the species *Cymodocea nodosa* and *Ruppia cirrhosa* to areas less affected by anthropogenic change within the Mar Menor lagoon to ensure survival of populations in the long-term. Because of the role that benthic macrophytes play in the support of ecosystem services, transplants are expected to have a positive impact on local economy.



## OBJECTIVES

The main objectives of this socio-economic analysis of the LIFE Transfer are described below:

1. To establish a comprehensive understanding of the Mar Menor's socio-economic context by examining the interplay between macroeconomic trends, environmental disasters, and regional economic structure that has shaped the lagoon's trajectory over the past two decades.
2. To assess the potential economic impacts of Mar Menor's environmental degradation across key sectors, including tourism, fishing, real estate and agriculture, as well as employment.
3. To contextualise the challenges inherent in isolating the socio-economic impact of the LIFE Transfer seagrass transplantation project within the broader framework of multiple simultaneous restoration interventions.
4. To evaluate the LIFE Transfer project's ecological achievements and potential economic implications through a detailed SWOT analysis.
5. To explore the potential relationship between environmental restoration and sustainable economic development by examining how ecosystem services provided by restored seagrass meadows could contribute to long-term economic resilience across different sectors.

## CONTEXTUAL OVERVIEW OF THE SOCIO-ECONOMIC AND ENVIRONMENTAL CHALLENGES OF THE MAR MENOR

### Macroeconomic framework

The environmental and economic trajectory of the Mar Menor has been deeply influenced by a series of macroeconomic events spanning national and international scales. These economic shocks and policy changes have shaped the regional development patterns, agricultural intensification, and tourism dynamics that directly affect the lagoon's ecological health.

The financial crisis of 2008 transformed the Spanish economy and dramatically altered development pressures around the Mar Menor. Prior to the crisis, Spain experienced an unprecedented construction boom and the area around Mar Menor became a focal point for residential and tourism developments that increased pressure on the lagoon's ecosystem. When the crisis hit, the construction sector suffered a collapse and the real estate sector stopped growing along the coast, which reduced the development pressure but also pushing the local



economy to depend even more heavily on agriculture and tourism (Díaz, 2023; Fernández Ferrero et al. 2022; CREM, 2025).

Subsequent reforms to the European Union's Common Agricultural Policy encouraged productivity and water-intensive crops, indirectly promoting the practise of intensive agriculture that drives nutrient pollution into the lagoon. Spain became one of the largest beneficiaries of this policy, which provided substantial support for agricultural modernization (MAPA, n.d.; OECD, 2023).

In addition to the latter, global trends, such as economic crises, drought cycles linked to climate change, and rising energy and fertiliser prices, have all influenced local farming practices, water use, and the capacity for environmental management (MAPA, n.d.; OECD, 2023).

The COVID-19 pandemic disrupted tourism and highlighted the economy's vulnerability to both external shocks and environmental decline. During this pandemic, the Costa Cálida, the coastal area which includes the municipalities of Águilas, Cartagena, Mazarrón, San Javier, San Pedro del Pinatar, La Unión, and Los Alcázares, experienced a dramatic decline in tourism, with strict lockdowns and the closure of hospitality establishments causing the sector's activity to drop to nearly zero during April and May 2020. This had an immediate and severe economic impact, given the area's heavy reliance on visitors, and highlighted the vulnerability of the local economy to external shocks. Despite this collapse in tourism, agricultural activities remained relatively stable, which helped maintaining employment but also contributed to the environmental deterioration through nutrient runoff (INE, n.d.).

More recently, rising input costs have created both challenges and incentives for adopting more sustainable farming methods, and EU Green Deal funds have opened new channels for restoration projects, such as seagrass transplantation and improved wastewater treatment. These actions are coordinated through the Spanish government's Marco de Actuaciones Prioritarias (MAPMM), directly aligned with Green Deal objectives of zero pollution and biodiversity recovery. While this momentum offers unprecedented opportunities for ecological restoration, success will ultimately depend on continued investment, long-term governance, and overcoming barriers that have historically favoured short-term economic gains over environmental balance (MITECO, 2022).

The macroeconomic context reveals that the Mar Menor's environmental crisis reflects broader structural economic issues rather than isolated local management failures. Effective recovery strategies must address these underlying drivers, requiring policy interventions that align economic incentives with ecosystem health (Gomez & Maestu, 2023).



## Environmental disasters timeline in the Mar Menor

The Mar Menor has experienced a cascade of environmental disasters spanning over four decades, resulting from both human activities and natural factors that have progressively degraded this unique ecosystem:

**1970s-1980s:** The ecological crisis began in the early 1970s with the widening of the El Estacio channel, altering salinity levels and allowing invasive species to colonise the lagoon. The 1979 Tajo-Segura water transfer system transformed the surrounding area into intensive irrigated agriculture, creating the foundation for future nutrient pollution (Buey Cañas, 2024; Heezen & Fernández-López, 2022).

**1990s-2000s:** Intensive agriculture expanded to 60.000 hectares, with nitrate and phosphate levels gradually increasing from urban discharges and agricultural runoff. Metal mining activities and coastal development along La Manga added additional stressors to the ecosystem (Buey Cañas, 2024; Heezen & Fernández-López, 2022).

**2010-2015:** High nitrate concentrations were detected along the western shore, particularly from the Albujión watercourse. Annual nutrient inputs reached 4.000-5.000 tons, with 85% originating from industrial agriculture, overwhelming the lagoon's natural absorption capacity (Heezen & Fernández-López, 2022; Esteve-Selma, 2021).

**2016:** A massive phytoplankton bloom turned the lagoon turbid, blocking sunlight and causing an 85% die-off of benthic flora. This marked the fundamental shift from a benthic-controlled to a plankton-controlled ecosystem, establishing chronic eutrophication (Esteve-Selma, 2021).

**2019:** Severe anoxia in autumn 2019 caused massive fish and fauna deaths, with tons of dead marine life washing ashore. The crisis was exacerbated by torrential rains from the September DANA weather event, which carried additional agricultural runoff into the compromised lagoon (Heezen & Fernández-López, L. 2022; Esteve-Selma, 2021).

**2021:** Another major mortality event in August 2021 killed an estimated five tons of fish and crustaceans due to anoxia. This demonstrated the lagoon's inability to withstand normal seasonal temperature variations (Esteve-Selma, 2021; Smith, 2022).

**2022-2025:** The lagoon remains in a chronically hypoxic state, prone to periodic crises during late summer and early autumn (Esteve-Selma, 2021).

This progression illustrates how four decades of intensive human activity have systematically destroyed the Mar Menor's natural resilience, creating a chronically unstable ecosystem that



threatens both environmental integrity and regional economic stability. Despite restoration efforts like the LIFE Transfer project, fundamental pollution sources persist, maintaining the ecosystem's vulnerability to recurring environmental disasters.

## Challenges in assessing the socio-economic impact of LIFE Transfer project

Demonstrating the direct socio-economic impact of the seagrass transplantations carried out by the LIFE Transfer project in the Murcia region is inherently complex. This complexity arises because the Mar Menor ecosystem's restoration is not driven by a single intervention but by a suite of coordinated activities implemented simultaneously. Multiple environmental recovery measures, which include reducing nutrient inputs, improving wastewater treatment, restoring natural habitats and changing agricultural practices, interact to improve the lagoon's health. This multidimensional context makes it challenging to isolate and attribute socio-economic changes purely to transplant actions.

The Marco de Actuaciones Prioritarias para Recuperar el Mar Menor (MAPMM) is a clear example of the complexity described above, as it represents one of the many measures that are carried out to improve the Mar Menor's environmental health by developing a broad range of projects. This group of measures is a comprehensive policy framework designed to coordinate the diverse interventions required to restore the lagoon's ecological health. The MAPMM recognises that recovery of the lagoon demands simultaneous progress across multiple fronts, including reducing nutrient inputs, restoring habitats, improving water quality, and managing land-use pressures in the surrounding basin (MITECO, 2022).

Key actions under the MAPMM include upgrading and expanding municipal wastewater treatment plants to reduce urban pollution entering the lagoon. Agricultural practices are targeted through the limitation and improved control of fertiliser use, promotion of more sustainable and efficient irrigation methods, and the gradual reduction of irrigated farmland around the lagoon. Restoration of natural buffer zones such as wetlands and floodable areas aims to enhance the natural filtration and denitrification of nutrients before they reach the lagoon waters (MITECO, 2022).

The plan also involves continuous monitoring using satellite imagery and in-situ data to assess water quality and ecological recovery indicators. Public awareness and stakeholder coordination mechanisms form another pillar of the MAPMM to ensure active engagement of farmers, municipalities, and citizens in conservation efforts (MITECO, 2022).

Demonstrating the socio-economic impact of specific measures like the seagrass transplantations of the LIFE Transfer project is challenging due to the overlapping effects of these many coordinated actions. The MAPMM reflects this complexity, highlighting that while



ecosystem restoration projects create essential environmental benefits, attributing direct economic improvements in local communities purely to individual ecological measures requires long-term integrated assessments that consider multiple influences simultaneously. In addition, it is essential to combine ecological restoration with adaptive governance and sustained socio-economic support to achieve a genuine and lasting recovery of the Mar Menor.

## KEY ECONOMIC AREAS

The environmental degradation of the Mar Menor has generated significant economic impacts across multiple sectors that form the foundation of the regional economy. The tourism sector, which accounts for approximately 50% of Costa Cálida visitors and generates significant accommodation revenue, faces direct challenges from water quality deterioration and periodic ecological crises. The fishing industry confronts a complex paradox where traditional species decline while pollution-tolerant species like prawns temporarily increase, fundamentally altering the sector's structure and sustainability.

The real estate market has experienced substantial corrections, with environmental degradation estimated to have erased over €4 billion in property values along the Mar Menor coastline. Conversely, the agricultural sector maintains economic stability despite being responsible for 85% of nutrient pollution entering the lagoon, creating a fundamental tension between short-term productivity and long-term ecosystem health. These sectorial impacts converge in the employment market, where the regional economy has shifted from construction-dominated to services-dominated unemployment, creating new vulnerabilities to environmental quality fluctuations.

The following analysis examines each sector to understand the potential economic consequences of environmental degradation and studies the possibility in which ecosystem recovery might support sustainable regional development.

### Tourism sector

From a socio-economic point of view, the Mar Menor is a key tourism area and a major source of development for the Region of Murcia, attracting both Spanish and international visitors during the tourist season. This unique coastal area has become a fundamental economic engine, with tourism data from 2024 showing that the Mar Menor area (including La Manga) attracted approximately 50% of all visitors to the Costa Cálida, the coastal area that includes the municipalities of Águilas, Cartagena, Mazarrón, San Javier, San Pedro del Pinatar, La Unión, and Los Alcázares, while accounting for 49% of the region's total accommodation capacity (Murcia Diario, 2024). Because of this heavy economic dependence, the tourism sector has become one



of the most vulnerable to environmental problems affecting the lagoon's marine environment. The worsening ecological conditions not only threaten the area's natural beauty but also put at risk the jobs and economic opportunities that have grown around this tourism-based economy, making environmental restorations efforts essential for the region's long-term economic health.

The extent of this environmental-economic relationship becomes evident through multiple research studies that quantify the direct impacts on tourism performance. Empirical evidence confirms that Mar Menor's environmental deterioration has direct negative impacts on the tourism sector, as demonstrated by research analysing the relationship between marine contamination and accommodation pricing. Fernández Ferrero et al. (2022) found a strong negative correlation between pollution levels and Airbnb prices, with contamination variables showing statistical significance at the 1% level across 2017-2019. The study revealed clear spatial patterns where La Manga del Mar Menor, with the lowest contamination levels, commands the highest accommodation prices, while severely polluted areas like San Pedro del Pinatar and Los Alcázares exhibit systematically lower pricing. Using satellite data measuring chlorophyll density as a contamination proxy, the research demonstrates that market participants actively price environmental quality into accommodation rates, providing quantitative evidence of measurable economic losses for the tourism sector due to environmental degradation.

Additional empirical research reinforces the broader economic impacts of Mar Menor's environmental degradation across multiple business sectors. Aparicio Serrano's (2022) doctoral study analysing 3.210 companies in the Mar Menor coastal area found that marine pollution significantly increases business failure probability, with environmental degradation being a more significant factor than traditional financial indicators.

Despite these proven environmental-economic impacts, tourism statistics reveal a complex narrative of resilience and vulnerability in the Costa Cálida area. Analysing the data related to overnight stays and the number of tourists shown in Figure 1, Costa Cálida experienced sustained growth of 18.1% in visitor numbers during 2015 and 2019. The years 2016 and 2017 recorded the highest year-on-year increases (+6.4% and +6.3% respectively), coinciding with significant investments in hotel infrastructure (CREM, 22 August 2025, Murcia Economía, 2025). The year 2020 represented the largest decline, during April and May 2020, tourist activity was null due to the mandatory closure of establishments under the State of Emergency (CREM, 22 August 2025). Tourism recovery exceeded expectations, with 2023 establishing a new historical record in both visitors and overnight stays (Figure 1).

The upward trajectory continued into 2024-2025, with preliminary data showing sustained growth momentum. The first half of 2025 registered 715,634 visitors, representing a 36% increase compared to the same period in 2024. This performance projects an estimated annual total exceeding 1.3 million visitors for 2025, which would represent more than double the pre-



pandemic peak (Murcia Economía, 2025; Ciudad de Murcia, 2025; Comunidad Autónoma de la Región de Murcia, 2025) (Figure 1).

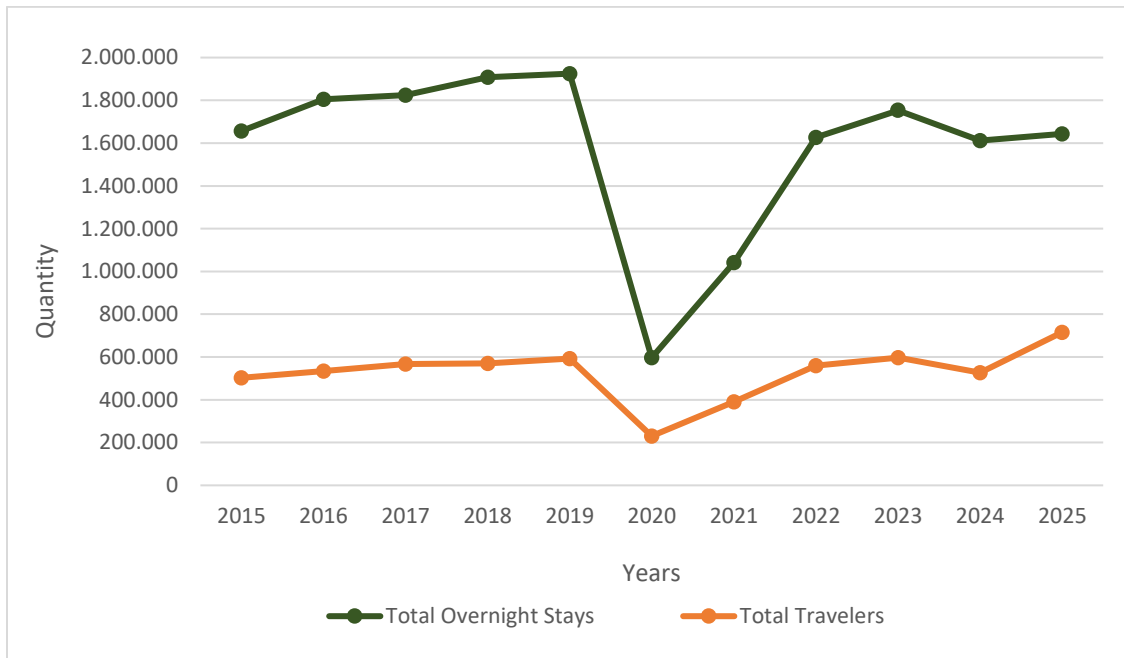


Figure 1. Tourism trends on the Costa Cálida: Travelers and overnight stays 2015-2023. National Statistics Institute (INE).

Costa Cálida has demonstrated strong operational resilience in its hotel sector over the decade. The percentage of hotels open remained stable around 85-90% before the pandemic, dipped to 55% in 2020 due to mandatory closures, and swiftly recovered to pre-pandemic levels by 2024. Maximum room occupancy rates show an even more positive trend, rising from 84.2% in 2015 to a historic peak of 93.2% in 2025, surpassing all previous records. This indicates not just a return to normal activity, but a notable advancement in Costa Cálida’s competitiveness and appeal compared to the pre-pandemic era (Comunidad Autónoma de la Región de Murcia, 2025, INE, n.d.) (Figure 2).

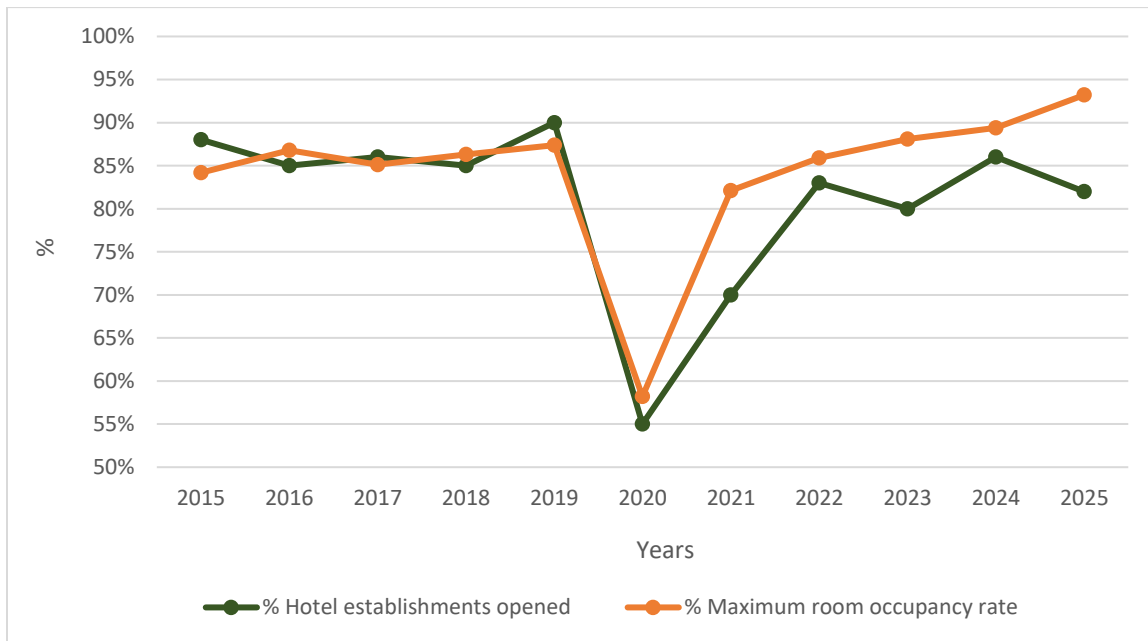


Figure 2. Average value of number of hotel establishments opened (%), occupancy rate per bed and maximum room occupancy rate (%) in the Costa Cálida 2015-2025. National Statistics Institute (INE).

Figure 3 shows the average total tourism employment in the Region of Murcia between 2017 and 2025, as there were no data from 2015 and 2016. The sector experienced steady growth from 51.241 jobs in 2017 to a pre-pandemic peak of 56.000 in 2019, driven by ongoing expansion and sustained demand. Despite the environmental challenge in 2019 that causes severe algal blooms and fish deaths, the sector saw historical employment highs in 2018-2019, which suggests strong underlying demand and possible effectiveness of mitigating policies or alternative offers in periods just after the crisis event. However, qualitative sources indicate that localized losses in the Mar Menor zone were partly offset by increased activity in other coastal segments (e.g., Cartagena, Mazarrón) (ITREM, 2018).

In 2020, the COVID-19 pandemic caused a sharp decline to 30.000, marking a 46% contraction and reflecting the impact of widespread closures and restrictions. Recovery began in 2021, with employment rebounding to 38.500 (+28%), followed by accelerated normalisation in 2022, reaching 47.200 jobs. From 2023 onwards, the trend shifted to robust expansion, with record figures in 2024 (64.892) and a new historic high in 2025 (66.186, January-July average).

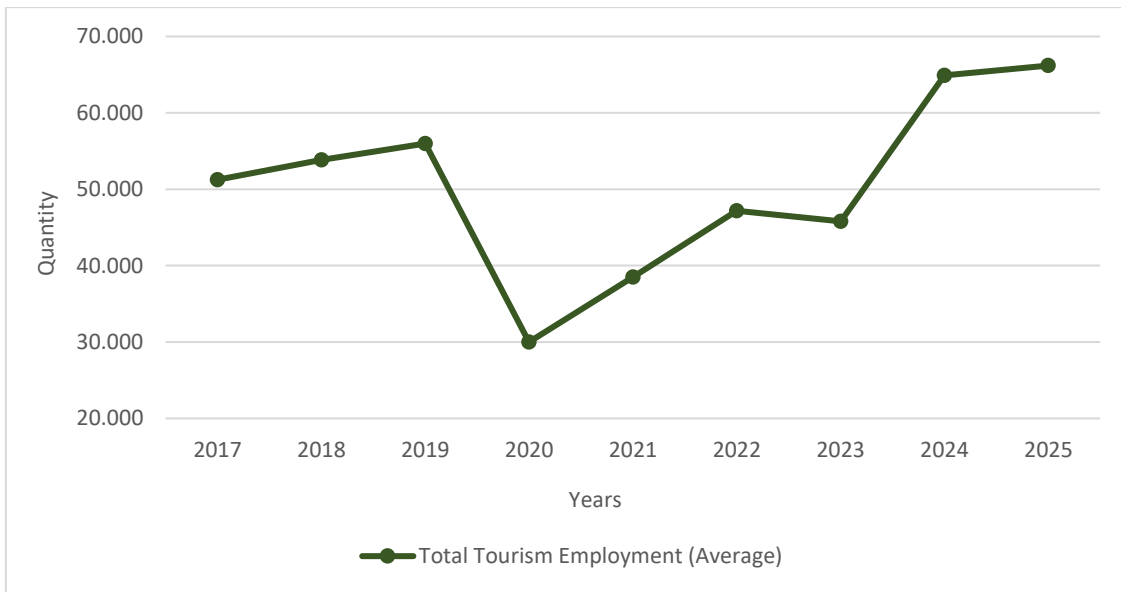


Figure 3. Average number of staff employed in the tourism sector in the Murcia Region since between 2017 and 2025. INE, ITREM, Turespaña.

## Fishing sector

The fishing sector in the Region of Murcia, while economically modest, represents a critical case study of environmental-economic interdependence. The Mar Menor's contamination demonstrates how environmental degradation can fundamentally alter traditional economic activities, creating both immediate challenges and unexpected opportunities. The prawn fishery's paradoxical increase during eutrophication illustrates the complex relationships between ecosystem disruption and economic outcomes (National Geographic España, 2021; Turismo Marinerio Murcia, 2018; Maldita Ciencia, 2021).

Long-term sector sustainability depends critically on Mar Menor's environmental restoration. Without effective contamination control and ecosystem recovery, the fishing sector faces continued degradation of its resource base and eventual economic unviability. The sector's adaptation strategies demonstrate resilience and innovation but cannot substitute for effective environmental protection measures (Maldita Ciencia, 2021; WWF España, 2020).

The Mar Menor case demonstrates that environmental protection and economic viability must be addressed together, not as separate issues. When pollution destroys marine ecosystems, fishing communities cannot simply adapt through economic strategies alone, they need effective environmental restoration combined with economic support measures.

The loss of relevance of the fishing activity within the economic activities of this coastal area is reflected in the reduction of fishing boats and, therefore, on the population dedicated to this



activity. To understand this change and its current situation, three basic statistical variables have been evaluated in the main Mar Menor ports: the evolution of the number of vessels, the census of fishermen and the volume of fish landed. The graphs of this data are shown below. The graphs display data up to 2023, as official figures for 2024 and 2025 are not yet available.

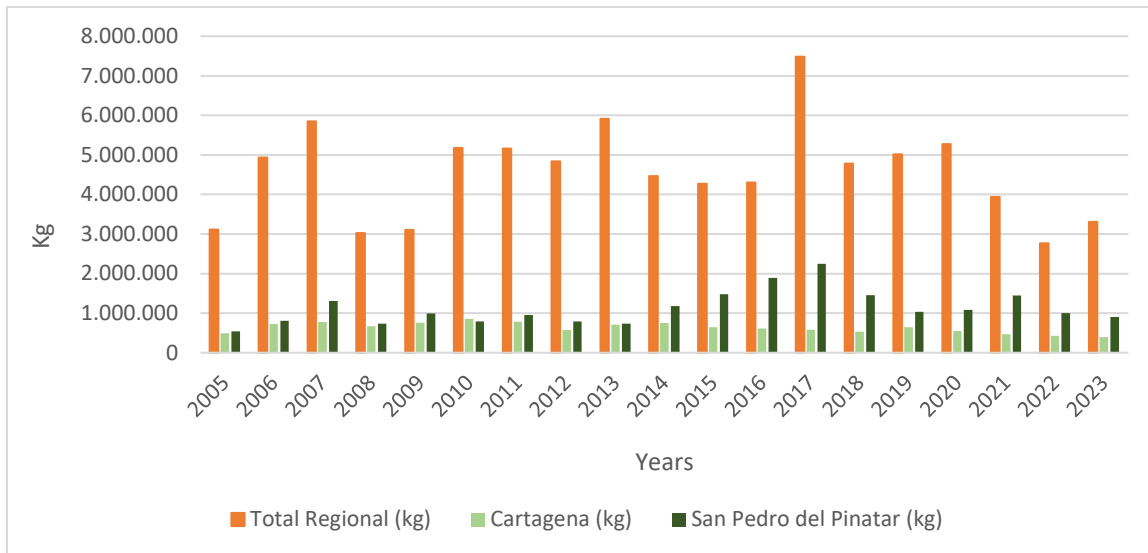


Figure 4. Evolution of fish landed (kg) in the Region of Murcia, in the municipality of Cartagena and in San Pedro del Pinatar ports. Centro Regional de Estadística de Murcia (CREM, 2025).

The integrated analysis of fleet, employment, and landings data reveals a fisheries sector under transformation pressure from environmental degradation, economic constraints, and structural changes. The sector faces fundamental sustainability challenges while exhibiting adaptive capacity and tactical flexibility.

The most interesting finding is that San Pedro del Pinatar's fleet grew during Mar Menor environmental crises. From 2017-2023, landings decreased by 59%, however, the fleet increased by 30.2%. This phenomenon suggests strategic adaptation mechanisms, such as, specialised targeting, particularly prawns that benefit from eutrophication, and government aid to facilitate vessel acquisition (Ministerio de Agricultura, Pesca y Alimentación, 2019).

The data provides important evidence for integrated management approaches linking environmental restoration with economic transition. The quantified correlation between ecological health and economic performance offers a robust foundation for evidence-based policy interventions promoting both environmental recovery and sectoral sustainability.

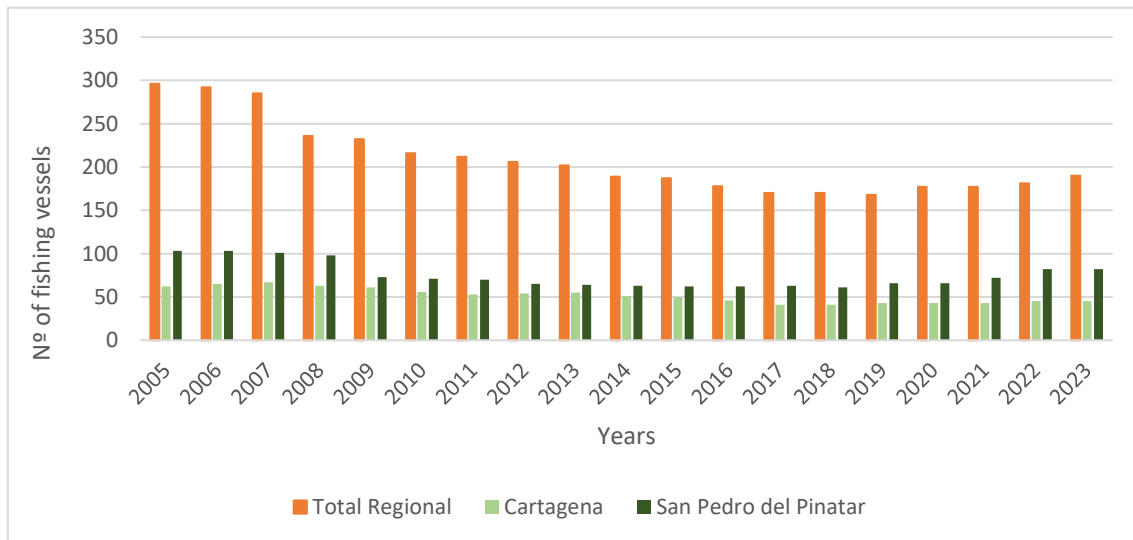


Figure 5. Evolution of the number of fishing vessels in the Region of Murcia, in the municipality of Cartagena and in San Pedro del Pinatar. Centro Regional de Estadística de Murcia (CREM, 2025).

The figures also show that the reduction in the number of vessels and in the workers in maritime fishing is a constant in the Region of Murcia over the last 20 years (Figure 5 and Figure 6). In this context, it is important to examine some factors that might have contributed to this situation:

- The fishing industry is affected by increasing fuel prices, which significantly raise operating expenses for shipowners.
- The EU plays a key role in fisheries management through the Common Fisheries Policy (CFP). Recent reforms have introduced long-term management strategies, including multi-annual recovery plans for overexploited stocks and multi-annual management plans for other fish populations (European Commission, n.d.).
- The social perception of the profession. Fishing is often regarded as a low-status occupation. Unlike jobs with fixed salaries, fishermen's income depends on the quantity of their catches and the prices obtained at auction, adding financial uncertainty to the profession.

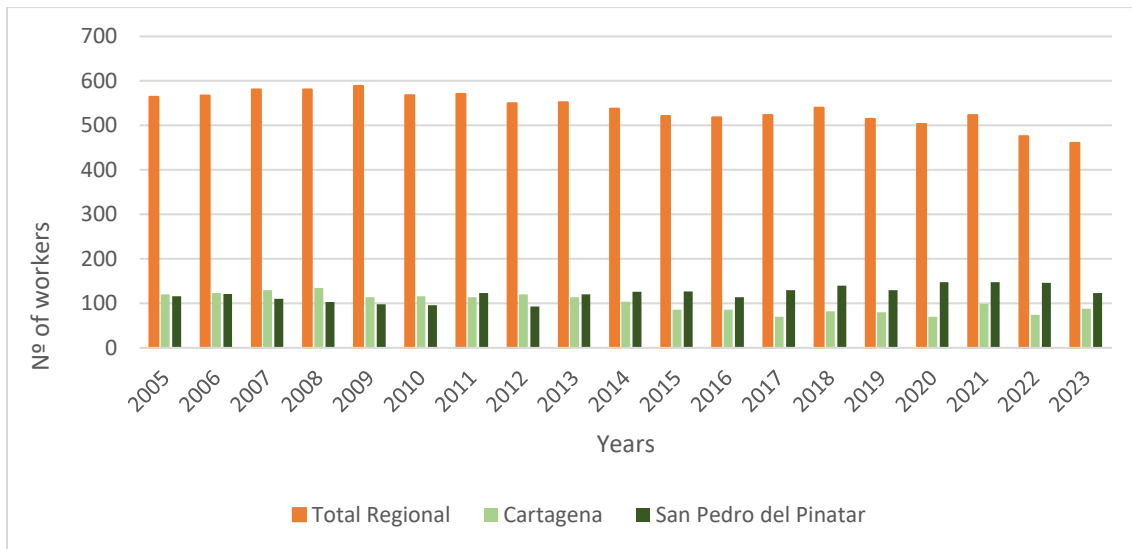


Figure 6. Evolution of the number of workers in maritime fishing. Centro Regional de Estadística de Murcia (CREM, 2025).

Future viability of Murcia's fisheries sector depends on successful navigation of this environmental-economic nexus, requiring innovative approaches that recognise both ecological constraints and community adaptation capacity. The datasets analysed provide essential baseline information for monitoring progress toward this challenging sustainability transition.

### Real estate sector

The environmental deterioration of the Mar Menor has had a substantial impact on the real estate sector in the Region of Murcia and the Costa Cálida, especially in towns directly surrounding the lagoon. For decades, the Mar Menor was a prime attraction for residents and tourists, with clear waters, thriving ecosystems, and increasing residential developments. However, since multiple episodes of mass fish mortality and algal blooms became public, especially in 2016, 2019, and 2021, the area's reputation has suffered, resulting in direct negative economic effects on housing demand, prices, and investment (Bank of Spain, 2024; Euro Weekly News 2021).

House prices on the Mar Menor coastline have experienced stagnation and, in some cases, a marked slowdown in growth compared with similar tourist-oriented coastal areas in Alicante. According to a 2024 analysis by the Bank of Spain, while property prices in just over the border in southern Alicante rose by 43% over several years following 2015, house prices on the Mar Menor remained essentially stagnant, leading to a 43% lower return on property investment in the affected area. It is estimated that environmental degradation has erased more than €4



billion in real estate value for the Mar Menor coastal zone, reflecting both the reduced attractiveness for new buyers and a discount applied to properties perceived as being at environmental risk (Bank of Spain, 2024; Euro Weekly News 2021).

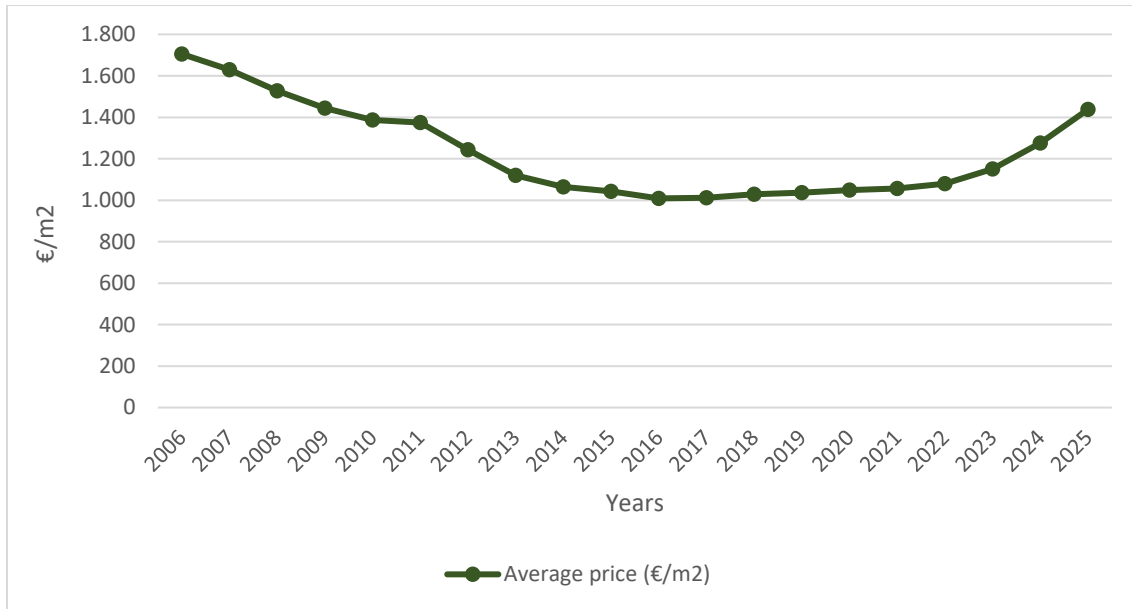


Figure 7. Evolution of house prices in the Region of Murcia (€/m²). Idealista, 2025.

Figure 7 presents the long-term trajectory of housing prices in the Murcia region from 2006 to 2025, clearly illustrating the impact of economic cycles and environmental crises. The data shows that average housing prices peaked in 2006 at 1.705 € per square meter, just before the global financial crisis. Prices then declined steadily, reaching their lowest point in 2016 at 1.009 €/m². Prices remained relatively stagnant between 2016 and 2019 (1.009 €/m² - 1.036 €/m²), coinciding precisely with the period of the most severe Mar Menor environmental crises and fish mortality events. The recovery began slowly in 2020, with prices gradually increasing to 1.080 €/m² by 2022. However, the most significant recovery occurred in the recent period, with prices surging to 1.150 €/m² in 2023, 1.276 €/m² in 2024, and reaching 1.438 €/m² by 2025, suggesting that despite environmental concerns, broader market forces and post-pandemic demand have ultimately driven significant price appreciation.

### Agricultural sector

The agricultural sector has emerged as the primary driver of environmental degradation in the Mar Menor lagoon over the past two decades, fundamentally transforming one of Europe's most important coastal ecosystems. Research by Mate-Sanchez-Val and Aparicio-Serrano (2023)



demonstrates that intensive irrigation agriculture, which began expanding around the lagoon in 1980, has been the primary source of nutrient pollution through nitrate and phosphate runoff, leading to devastating eutrophication episodes.

The period from 2005 to 2015 marked a critical transformation phase in the Campo de Cartagena region surrounding the Mar Menor. According to several studies, the area witnessed an expansion of intensive irrigation agriculture, with officially declared irrigated land covering approximately 474 km<sup>2</sup> by 2016, representing more than 80% of the total agricultural area. This dramatic shift from traditional dry-farming to irrigated agriculture was facilitated by the Tajo-Segura water transfer scheme, established in 1979, which provided an average of 122 million cubic meters annually. However, the European Parliament's 2022 investigation revealed that more than 10.000 hectares of farmland lacked proper irrigation rights, with at least 8.500 hectares operating without legal authorisation (Álvarez-Rogel et al. 2020; European Parliament, 2022; López-Ballesteros et al. 2023).

The environmental consequences of agricultural intensification became measurably catastrophic during the 2015-2025 period. Research indicates that agricultural activities are responsible for approximately 85% of total nutrient input into the Mar Menor lagoon, with nitrates and phosphates from agricultural irrigation serving as the primary pollutants (European Parliament, 2022).



Figure 8. Evolution of the total farmland (hectare) in the Region of Murcia, divided between dryland and irrigated land. Centro Regional de Estadística de Murcia (CREM, 2025).



Figure 8 only shows data between 2013 and 2023 because there wasn't official data available in the Regional Statistical Centre of Murcia (CREM). During this period, the Region of Murcia experienced a marked contraction of total farmland, driven primarily by a massive abandonment of dryland farming, while irrigated land declined more moderately. This intensification of irrigated agriculture, often illegal in the Campo de Cartagena, where irrigation peaked at nearly 190,000 ha, has coincided with the Mar Menor's most severe eutrophication and anoxia crises. Nutrient-rich runoff from concentrated irrigation zones, especially during 2016, 2019 and 2021 algal blooms, has overwhelmed the lagoon's limited flushing capacity, underscoring how shifts toward irrigation in Murcia's watershed are fundamentally linked to the environmental collapse of the Mar Menor.

## Employment

Based on the data from the Regional Statistical Centre of Murcia (CREM), the progressive degradation of the Mar Menor lagoon has modified the employment landscape of the Region of Murcia, especially in the coastal municipalities of Los Alcázares, San Pedro del Pinatar, San Javier and Torre-Pacheco. Figure 9 demonstrates a clear reshaping of unemployment patterns across economic sectors. The most noticeable is the construction sector's collapse from 28.285 unemployed workers in 2010 to just 5.731 in 2025, which represents a 79.7% decline that reflects both the broader Spanish housing crisis and the specific impact on coastal developments around the Mar Menor. This construction downturn coincided with the lagoon's first major environmental crises, as deteriorating water quality made waterfront properties less attractive to investors and buyers.

In contrast, services sector unemployment has almost remained constant. While services unemployment declined from its 2020 peak of 74.392 to 51.912 in 2025, it still represents 67.1% of total regional unemployment. This services-heavy unemployment structure is particularly significant for Mar Menor municipalities, where tourism, hospitality, and recreation-dependent jobs face repeated disruption from environmental crises including the 2016 eutrophication, 2019 mass fish die-offs, and ongoing water quality problems that continue to dissuade visitors.

The structural transformation becomes even clearer when examining unemployment composition over time. The economy has shifted from construction-dominated joblessness (25.0% of total unemployment in 2009) to services-dominated unemployment (67.1% in 2025). This situation creates particular vulnerabilities for Mar Menor communities, as service sector jobs in tourism, hospitality, and marine recreation are directly exposed to the environmental status of the area.

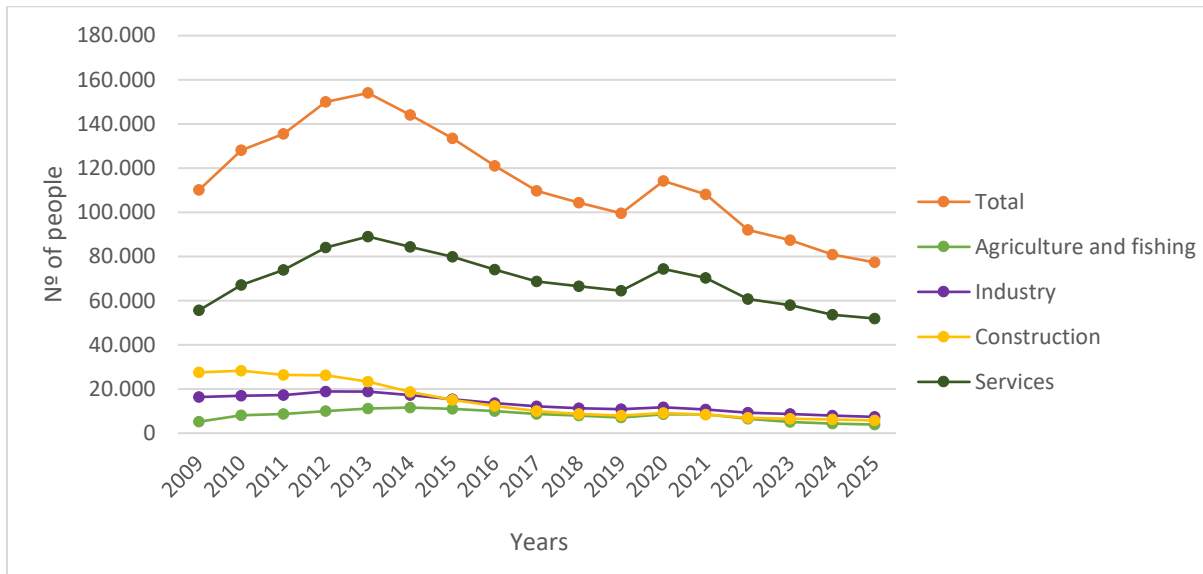


Figure 9. Evolution of unemployed people in the Region of Murcia detailing the different sectors potentially affected by the deterioration of Mar Menor. Centro Regional de Estadística de Murcia (CREM, 2025).

The unemployment data reveals a paradox: while agriculture and fishing unemployment has declined 65.0% since 2013 (from 11.149 to 3.898 unemployed), this sector remains the primary responsible of Mar Menor pollution through nutrient runoff. The sector's continued employment stability, even as it degrades the very ecosystem that supports tourism and fishing livelihoods, illustrates the fundamental market failure affecting the region.

The timing of major unemployment shifts aligns closely with Mar Menor environmental milestones. The services sector's vulnerability became particularly evident during 2016-2019, when repeated ecological crises coincided with persistent high unemployment in tourism-dependent activities. As the regional economy has become increasingly dependent on services, the Mar Menor's environmental health has become critically important for regional employment stability, creating a direct linkage between ecological degradation and economic distress in coastal communities.

Figure 10 below reveals the unemployment trajectory of the four key Mar Menor municipalities from 2013 to 2025, showing how the lagoon's environmental degradation has coincided with dramatic shifts in local labour markets. The data presents a compelling narrative of economic recovery interrupted by both the COVID-19 pandemic and ongoing environmental pressures.

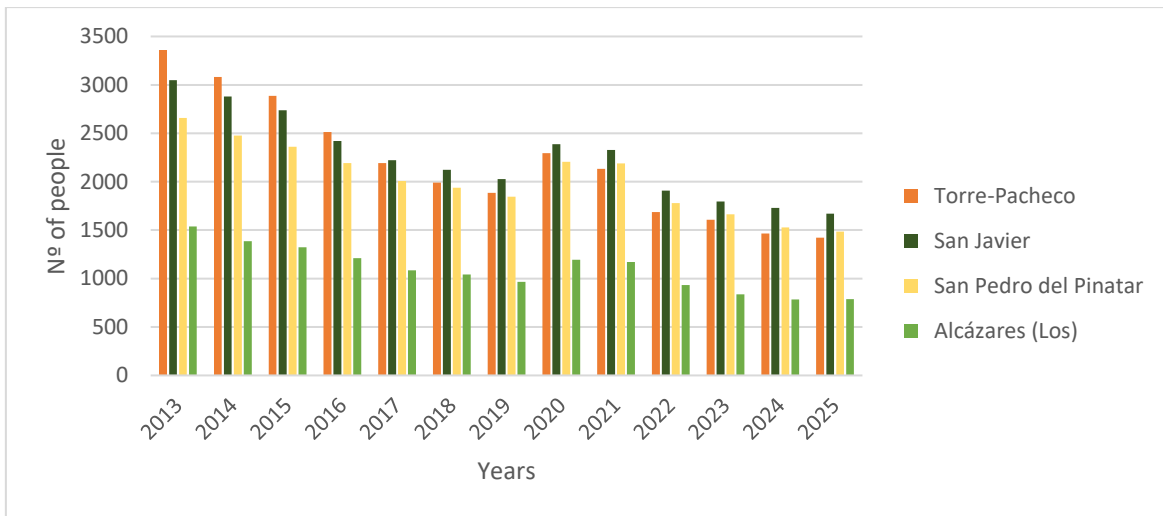


Figure 10. Evolution of unemployed people detailing the different municipalities potentially affected by the deterioration of Mar Menor. Centro Regional de Estadística de Murcia (CREM, 2025).

## IMPACT OF THE LIFE TRANSFER PROJECT

### LIFE Transfer results

The LIFE Transfer project, focused on the transplantation of seagrass meadows (*Cymodocea nodosa* and *Ruppia cirrhosa*) in the Mar Menor and other Natura 2000 coastal lagoons across Spain, Italy, and Greece, has demonstrated significant ecological benefits by promoting ecosystem recovery in degraded transitional habitats.

The ecological achievements are described below:

- High survival rates of transplanted seagrass have been recorded, with an average survival of around 80% across monitored sites, particularly successful in areas deeper than one meter.
- Transplanted meadows not only maintained physiological stability but also exhibited expansion and natural colonization abilities, aiding in the restoration of the habitat.
- By 2025, the area covered by *Cymodocea nodosa* in transplanted zones grew exponentially, reaching approximately 88% of the initially transplanted surface, amounting to over 900 m<sup>2</sup>. *Ruppia cirrhosa* showed a more variable but positive expansion, covering about 35% of its transplant area.
- Improvements were also observed in the physical-chemical conditions of sediments and water within transplant zones, matching those of natural seagrass meadows, which



supported the recolonization of diverse flora and fauna species typical of well-conserved ecosystems.

- The project positively impacted biodiversity, with increased density and richness of benthic species associated with success in seagrass growth.
- Ecological quality indices rose to high levels by the project's end, indicating enhanced ecosystem functionality and resilience against anthropogenic pressures and climate change.

The strategic outlook of the LIFE Transfer project demonstrates that active seagrass transplantation is an effective tool for stopping and reversing the degradation of coastal habitats caused by eutrophication and sedimentation, thereby supporting the ecological recovery of sensitive Mediterranean lagoons. Continued intervention will be necessary to address ongoing environmental threats and sustain seagrass resilience, including the management of invasive species like *Caulerpa prolifera*. The long-term success of the restoration depends heavily on institutional cooperation, the standardisation of restoration protocols, and robust community engagement. These factors help to ensure that conservation gains are maintained and expanded across other threatened sites.

By integrating ecological restoration with socio-economic considerations and establishing adaptive management practices, the project not only advances regional conservation objectives but also provides a replicable model for harmonising ecosystem health with economic and social benefits in coastal areas.

## SWOT Analysis

The LIFE Transfer project's seagrass transplantation initiative represents a critical intervention at the intersection of environmental restoration and economic revitalisation for the Mar Menor lagoon and the broader Region of Murcia. This SWOT analysis reveals how ecosystem recovery through the restoration of marine phanerogams could address the fundamental environmental degradation that has constrained regional economic development and employment stability since 2016.



Table 1. SWOT analysis of the impact of the LIFE Transfer project on the main economic sector in the Mar Menor.

Strengths	Weaknesses
<p>Water quality improvement. Seagrasses act as natural filtration system reducing Mar Menor eutrophication.</p>	<p>Variable success in shallow areas: some shallow stations showed declining survival or lower expansion compared to deeper sites.</p>
<p>The improvement of seagrass meadows will potentially act as a nursery habitat for commercially important fish species.</p>	<p>Scarce growth of phanerogams sods transplant.</p>
<p>Seagrass meadows will counteract the erosion and the deepening of coastal lagoons caused by the synergy of climate change and anthropogenic activities.</p>	<p>Small scale impact.</p>
<p>There are studies which suggest high survival rates achieved in similar Mediterranean seagrass transplants</p>	<p>No or low availability of species in the donor site, the donor site should not be damaged by sod/rhizome explant.</p>
<p>Decreased sediment resuspension, water turbidity and settling.</p>	<p>Tourism correlation uncertainty: direct relationship between seagrass recovery and visitor numbers unclear.</p>
<p><i>C. nodosa</i> meadows can play a key role as a sink for dissolved inorganic nitrogen, being an important mechanism of resistance to eutrophication.</p>	<p>Maintenance needs: Continuous monitoring and potential re-transplantation required.</p>
<p>Restoration of angiosperm grasslands is key to countering climate change through CO<sub>2</sub> sequestration.</p>	<p>High initial costs with limited immediate returns.</p>
<p>Collaboration between Italy, Greece, and Spain with knowledge transfer.</p>	<p>Some species, especially <i>Ruppia cirrhosa</i>, required repeated reinforcements to maintain presence, showing vulnerability to local stressors.</p>
<p>Improved ecosystem may support sustainable Mar Menor prawn fishery.</p>	<p>Transplants are highly dependent on sediment conditions, turbidity, and water quality, making them fragile if these parameters fluctuate.</p>
<p>Restored ecosystems provide better conditions for sustainable fish farming.</p>	<p>The duration of the project is short relative to the decades required for stable meadow establishment and ecosystem recovery.</p>
<p>Clear water and healthy marine environments attract visitors and boost local economy.</p>	
<p>Increase the biodiversity of the marine ecosystems of the Mar Menor and its surroundings.</p>	
<p>Improve the quality of services offered to citizens like ecotourism and sport fishing.</p>	
<p>Create transplantation protocols that can be exported to other Mediterranean or European lagoons.</p>	



### Opportunities

Development of environmental education programs to protect seagrass meadows in Mar Menor.

Modification of the current legislation to protect seagrass meadows by fining people who uproot them.

Strengthening environmental legislation, including more stringent protections for Natura 2000 sites, could enhance the legal and regulatory environment in which the project operate.

Adjustment of the current tourism model to one that is more respectful of the natural environment.

The growing availability of EU and national funding for nature-based solutions and habitat restoration, including LIFE Programme and Horizon Europe calls, creates opportunities for both financial sustainability and project scaling.

Advances in restoration science, remote sensing, and monitoring technologies can be utilised to improve transplantation efficiency, track progress, and demonstrate project outcomes to funding bodies and stakeholders.

Development and implementation of codes of good practice associated with fisheries, urban development, agriculture and tourism.

Shift to a new development model through the recovery of the lagoon and its ecosystem services.

### Threats

Sea level variation modifies the depth profile which can affect light penetration and growth conditions.

Rising water temperatures may exceed species tolerance thresholds.

People pull out the transplants during bathing season due to a lack of environmental education.

Storm episodes, such as a DANA, could damage the transplanted meadows.

Weak urban planning and tourism model, subject to different pressures and interests

Eutrophication of the coastal lagoon. Diffuse pollution by fertilisers and pesticides.

Human threat to the natural ecosystem: difficulty of the lagoon system to assimilate the pressures of human activities.

Increased tourist numbers could have repercussions on the exploitation of resources and affect restoration.

Deterioration of the biodiversity, the environmental conditions and landscape identity of the lagoon.

Conflicts of interest between farmers and those responsible for good water status.

The restoration of seagrass meadows offers multiple economic benefits through ecosystem services. As nursery habitats for commercially important fish species, restored meadows could revitalise the artisanal fishing sector while supporting the tourism industry through improved water clarity and marine biodiversity. The project's capacity to reduce sediment resuspension and water turbidity directly addresses the visual water quality problems that have deterred visitors during critical summer months. Furthermore, successful seagrass restoration could enable a transition toward higher-value ecotourism and sustainable aquaculture, potentially creating more stable employment than the cyclical tourism jobs that currently dominate unemployment statistics.



On the other hand, the analysis reveals critical limitations that could constrain the project's economic impact. The small-scale nature of transplantation efforts may be insufficient to generate measurable improvements in water quality at the ecosystem level, limiting immediate benefits for the tourism-dependent municipalities. Technical challenges in transplant execution and slow growth rates of transplanted sods suggest that visible improvements may take years to materialise, while the tourism industry needs immediate water quality improvements to sustain the employment recovery evident since 2020. The uncertainty regarding direct correlations between seagrass recovery and tourism numbers highlights a critical gap: while environmental improvement is necessary for sustainable tourism, it may not be sufficient without complementary destination marketing and infrastructure development.

At the same time, there are several external opportunities that could enhance the project's impact and facilitate its longer-term success. Environmental education programs aimed at protecting seagrass meadows could foster community engagement and environmental care. Strengthening and modifying legislation, such as introducing fines for uprooting seagrass and enhancing protections for Natura 2000 sites, would improve the regulatory framework supporting restoration efforts. A shift toward more sustainable tourism models that respect natural ecosystems offers a chance to align economic activity with environmental recovery. Additionally, growing EU and national funding opportunities for habitat restoration increase the project's potential for financial continuity and scalability. Finally, advances in restoration science and monitoring technologies also provide tools to improve transplantation effectiveness and facilitate more robust impact demonstration to stakeholders.

The threats analysis reveals the challenges that could ruin both restoration efforts and economic recovery. Continued eutrophication from diffuse agricultural pollution, weak urban planning, and climate change impacts (rising temperatures, storm episodes, sea level variation) threaten long-term restoration success. Particularly concerning for economic planning is the potential conflict between restoration success and tourism pressure. If seagrass restoration significantly improves water quality, increased visitor numbers could damage transplanted meadows and create new environmental pressures. In addition, the identified conflicts of interest between farmers and water quality managers highlight the political economy challenges that have prevented effective lagoon management. If these underlying governance issues are not being addressed, the restoration efforts might only show temporary results.

The SWOT analysis reveals that the LIFE Transfer project's success depends not simply on ecological restoration but on facilitating a new regional development model that integrates environmental quality with economic sustainability. The project's international collaboration framework (Italy, Greece, Spain) offers opportunities for knowledge transfer and best practice



development that could position the Region of Murcia as a leader in sustainable coastal development.

Based on the regional economy's current structure, with services representing 67% of unemployment and agriculture maintaining employment despite environmental costs, the restoration project could help the transition toward a more sustainable and diversified economic base. In order to be successful, it would be necessary to seagrass restoration with complementary policies addressing agricultural runoff, tourism management, and employment diversification.

In this way, the project offers a possible pathway toward resolving the economic-environmental tensions that have constrained sustainable development in the Mar Menor region, and it could also potentially serve as a model for Mediterranean coastal areas facing similar challenges.

## FINAL CONSIDERATIONS

The degradation of the Mar Menor demonstrates the interconnection between ecosystem health and regional economic performance in the Region of Murcia. Over four decades of cumulative anthropogenic have transformed this ecosystem into a chronically unstable system prone to eutrophication, anoxia, and biodiversity loss. The resulting crises have had significant economic impacts on all major sectors of the regional economy, apart from agriculture, such as tourism, fishing, and real estate, as well as on employment.

The report demonstrates that the Mar Menor's decline is not an isolated environmental issue but a systemic economic one. Since the 1960s, economic expansion in the Campo de Cartagena basin has relied upon intensive irrigation agriculture and mass tourism. The 2016, 2019, and 2021 ecological crises exposed the fragility of this model, as the water quality deterioration immediately translated into economic losses, reputational damage, and reduced investor confidence. Regardless of the recent post-pandemic recovery in the tourism sector, the lagoon's degraded state continues presenting a threat to the long-term economic stability and social well-being in the region.

From a macroeconomic perspective, the Region of Murcia remains highly dependent on sectors that are environmentally vulnerable. Services account for 67% of total unemployment, concentrated in tourism and hospitality, these industries are directly tied to water quality and environmental perception. The fishing sector, once a symbol of local cultural identity, has decreased both in fleet size and economic relevance, while real estate values along the Mar Menor area have lost an estimated €4 billion compared to similar Mediterranean destinations. Meanwhile, the agricultural sector, which is responsible for around 85% of nutrient pollution,



maintains employment stability and export competitiveness, which demonstrates that there is not a balance between economic growth and environmental sustainability.

The LIFE Transfer project demonstrates that targeted ecological restoration can produce tangible environmental improvements and potential long-term economic benefits. With an average transplant survival rate of 80% and significant recolonization by associated fauna, the project has proven that seagrass transplantation is a viable tool for restoring degraded lagoon habitats. Beyond its ecological success, the project illustrates how restoring natural ecosystems can support economic diversification and resilience.

However, the implementation of the project on such a small scale limits its immediate socio-economic visibility. Large-scale ecosystem recovery, necessary for measurable economic returns, depends on integrated governance under frameworks like Spain's Marco de Actuaciones Prioritarias para Recuperar el Mar Menor (MAPMM). This approach can be applied to future interventions, where efforts must combine habitat restoration with structural reforms in agriculture, tourism, and land use to maximise economic impact. The potential lies not in isolated projects but in their coordination within a long-term strategy connecting environmental health to economic prosperity.

The analysis covered in this report reveals that the Mar Menor's crisis represents a larger Mediterranean challenge, which is the conflict between short-term economic gains and the sustainability of natural capital. The lagoon's degradation has exposed the economic costs of unsustainable development, like lost property value, reduced tourism income, and weakened community resilience. However, it has also created a window of opportunity for transformation.

By integrating restoration projects like LIFE Transfer, the Region of Murcia can position itself as a good model to follow in terms of sustainable coastal management. To achieve the latter, it is crucial to transition to a new regional development model based on ecosystem recovery, green innovation, and responsible tourism. Such a model requires strict nutrient control, transparent governance, and community participation, aligning environmental protection with economic opportunity.

In summary, the socio-economic impact of Mar Menor's degradation demonstrates that environmental collapse and economic instability are inseparable. The lagoon's recovery is not only an ecological necessity but an economic imperative. Without decisive intervention to reverse pollution, regulate agricultural practices, and consolidate restoration gains, the region risks perpetuating a cycle of crisis management rather than achieving sustainable development. On the contrary, investing in the recovery of the Mar Menor, through continued seagrass restoration and improved water governance, could transform this lagoon into a model of resilience and sustainability, ensuring long-term prosperity for both people and nature.



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