e-ISSN: 3023-7343

TETHYS ENVIRONMENTAL SCIENCE
an International Journal

Assessment of Marine Pollution and MARPOL Applications in Mersin Province with Legal Recommendations for Sustainable Fisheries Management

Selen Serder[1], Pelin Özçelik[1]*, Deniz Ayas[2,3]

[1]Çağ University, Faculty of Law, 33800 Yenice, Mersin, Türkiye. [2]Mersin University, Fisheries Faculty, 33160 Yenişehir, Mersin, Türkiye. [3]Mersin University, Marine Life Museum, 33160 Yenişehir, Mersin, Türkiye.

Research Article

Citation: Serder, S., Özçelik, P., Ayas, D. (2025). Assessment of Marine Pollution and MARPOL Applications in Mersin Province with Legal Recommendations for Sustainable Fisheries Management. *Tethys Env. Sci*. 2(4): 154-162.

DOI: 10.5281/zenodo.17790723

Received: 25 September 2025

Accepted: 01 December 2025

Available Online: 02 December 2025

Publication Date: 29 December 2025

Abstract

Mediterranean Sea, a semi-enclosed marine system, is increasingly fragile due to rising ship traffic, illegal fishing, microplastic pollution, and land-based contaminants. Mersin, a major port in the Eastern Mediterranean, lies at the intersection of these pressures while hosting trade, tourism, and fishing activities of strategic importance. This study, based on institutional interviews and field analyses conducted in Mersin in 2025, evaluates the local applicability of MARPOL 1973, marine pollution dynamics, and sustainable fishing policies in a multidimensional framework. Findings reveal that pollutants affecting Mersin's coast are both local and regional, with agricultural drainage, pesticides, heavy metals, and detergent residues transported via the Berdan and Seyhan rivers. These accumulate in coastal ecosystems, intensifying stress on biodiversity. The absence of biological treatment units in wastewater plants and limited regulatory oversight in maritime domains further hinder MARPOL's effective implementation. Microplastics were detected in fish digestive systems and sediments, highlighting risks of toxic bioaccumulation for ecosystems and public health. In fisheries, despite digital monitoring through the BAGIS system, economic pressures, insufficient education, and unlicensed practices perpetuate illegal fishing. Weak institutional support for small-scale fishers undermines sustainability objectives. The study recommends Türkiye's stronger engagement in regional governance mechanisms (REMPEC, UNEP/MAP) and acceleration of SECA preparations. The case of Mersin illustrates that sustainable marine management requires not only technical and legal measures but also integrated regional cooperation, infrastructure investment, and local awareness initiatives to safeguard biodiversity and community livelihoods.

Keywords: *MARPOL, sustainable fishing, marine pollution, Mersin Bay, Mediterranean Sea, port state control.*

Correspondence: Pelin Özçelik
avpelinozcelik@hotmail.com

Introduction

It is evident that marine ecosystems, particularly those within semi-enclosed basins, have become acutely vulnerable to the deleterious effects of anthropogenic pressures. The geographical structure of the Mediterranean Sea is such that water circulation is limited, thus facilitating the accumulation of pollutants and accelerating ecosystem degradation. The unique sensitivity of the Mediterranean, when considered in conjunction with a range of multidimensional threats including, but not limited to, increasing maritime traffic, industrial activities, land-based pollution, illegal fishing, and plastic-based waste loads, brings regional environmental security to the global agenda. The province of Mersin, located in southern Türkiye, is one of the areas directly affected by these pressures due to its strategic location in the Eastern Mediterranean, intensive port activities, and critical role in coastal fishing.

The dynamics of marine pollution observed in Mersin are influenced by a variety of factors, including local sources, transboundary regional currents, open sea discharges from ships in transit, and land-based pollution loads. Specifically, the influx of domestic, industrial, and agricultural waste into coastal waters, as transported by the Berdan and Seyhan rivers, has been identified as a primary contributor to substantial biological and chemical accumulation. This accumulation primarily comprises heavy metals and pesticides. Furthermore, the strategic re-planning of Mersin as an "industrial city" has resulted in the densification of coastal areas with port and logistics facilities, thereby placing considerable strain on the ecological carrying capacity of the coastline and posing a threat to the sustainability of traditional activities such as fishing.

The present study undertakes a multidimensional analysis of the status of MARPOL applications, the sources of marine pollution, and the effectiveness of policies for sustainable fishing in Mersin Province. The research is grounded in a series of qualitative interviews conducted in 2025 with representatives from public institutions, local governments, academic institutions, and civil society organizations. These interviews were complemented by a comprehensive evaluation of scientific literature from recent years. The objective of the analysis is to identify gaps at the implementation level, including governance deficiencies, monitoring capacity issues, and infrastructure inadequacies, and to propose legal and technical solutions to these issues.

Türkiye's legislative framework for protecting the marine environment is built on several national acts. Environmental Law No. 2872 sets out general provisions for safeguarding marine and coastal areas, while the Fisheries No. 1380 and its circulars regulate fishing bans, species protection, and quotas. Metropolitan municipalities, under Municipalities Laws No. 5216 and 5393, are responsible for wastewater treatment and environmental health infrastructure. The "Marine Pollution Control Regulation" (2021) further defines the distribution of control authority among the Coast Guard, the Ministry of Environment, Port Authorities, and municipalities. Yet, in practice, coordination gaps, limited technical capacity, and administrative fragmentation remain significant challenges.

Internationally, Türkiye is party to numerous treaties aimed at preventing marine pollution and promoting sustainable fisheries. The most comprehensive is MARPOL (1973/1978), to which Türkiye is a signatory of all six annexes. However, implementation difficulties persist, particularly

regarding wastewater (Annex IV) and air pollution (Annex VI), due to port infrastructure and inspection limitations (Vagiona and Kamilakis, 2022; Bayar, 2024). Türkiye also participates in regional frameworks such as the Barcelona Convention, REMPEC, and MedFish4Ever, though its engagement could be strengthened.

The case of Mersin illustrates how environmental, administrative, legal, and institutional complexities converge into a multi-layered problem. This study therefore aims to: (i) assess the impacts of current policies and practices, (ii) analyze deficiencies on scientific and legal grounds, and (iii) propose legal and technical recommendations for sustainable marine management at both national and international levels.

Material and Methods

The present study is designed as qualitative research examining marine pollution, MARPOL applications, and sustainable fishing policies, specifically in the province of Mersin. The primary objective of the research is to evaluate the current situation in these areas based on field data, identify gaps in implementation, and interpret them in the context of multi-level governance. In this regard, the data collection process was based on both primary and secondary sources, and a thematic evaluation was conducted using content analysis.

Primary data was collected in 2025 in Mersin using a semi-structured interview method. The semi-structured interview technique was selected to facilitate the acquisition of in-depth qualitative insights, whilst ensuring the comparability of data collected across diverse institutional settings. The interview guide was developed based on a preliminary review of international conventions (such as MARPOL and the Barcelona Convention) and national regulatory frameworks (including Environmental Law No. 2872 and the Fisheries Law No. 1380). Participants were posed structured yet open-ended inquiries, thus facilitating the provision of detailed information pertaining to both institutional practices and the perceived challenges encountered during the implementation process.

The interview protocol was structured around three thematic clusters. Specifically, the study examined: (i) the administrative and technical capacity for implementing MARPOL provisions; (ii) the effectiveness and socio-economic dimensions of sustainable fisheries policies; and (iii) the sources and management of marine pollution in the Mersin coastal region. Each interview was conducted in person at the participants' respective institutions and ranged in duration from 45 to 90 minutes. Prior to each interview, participants were informed about the purpose of the study, confidentiality procedures, and their right to withdraw at any stage; informed consent was obtained verbally in accordance with research ethics rules.

Participants were selected through purposive sampling to represent multiple levels of governance and areas of expertise, including local authorities, academic researchers, professional organizations, and environmental non-governmental organizations (NGOs). This methodological approach ensured triangulation through the incorporation of diverse institutional perspectives and professional backgrounds. The interviews were audio-recorded with the participants' consent, transcribed in full.

Secondary data was obtained from relevant public institutions and academic sources. A comprehensive analysis was conducted on the current policy documents, audit reports, and legal regulations published by the Ministry of Environment, Urbanization, and Climate Change, the Ministry of Agriculture and Forestry, and the Mersin Metropolitan Municipality. Moreover, scientific articles published between 2019 and 2024 about marine pollution, MARPOL applications, microplastic pollution, and Mediterranean fisheries, found in international academic databases such as Web of Science, Scopus, and Google Scholar, were included.

The qualitative data collected was then subjected to content analysis. During this process, the data were initially subjected to open coding, after which they were systematically analyzed by the creation of themes. The thematic analysis yielded three primary axes: governance and control structures, sources of environmental pollution, and sustainability in fishing. The findings were analyzed comparatively, considering the different perspectives of the participating institutions. To enhance the validity of the research, the triangulation method was applied. This entailed the use of interview data, legislation reviews, and academic literature findings in a complementary manner.

The theoretical basis of the study was grounded in the multi-level governance approach. This approach advocates the consideration of environmental issues not only within national boundaries but also within the framework of regional and transnational cooperation. The impact of international mechanisms such as MARPOL, the Barcelona Convention, and REMPEC on local implementation has been evaluated within this theoretical framework. In this context, the research offers a comprehensive methodology to illuminate both the local counterparts of normative regulations and the gaps in their implementation.

Result and Discussion

MARPOL implementation and offshore monitoring deficiencies

Inspection activities under the MARPOL are being carried out at the Port of Mersin. Inspections are being conducted, particularly regarding bilge water, ballast water, and solid waste management, in coordination with the Port Authority, the Coast Guard Command, and the Environmental Protection Directorate. Recent discourse has indicated that certain vessels are circumventing established waste reception facilities and illegally discharging waste into the marine environment. The inability to detect such activities in open seas is related to the lack of satellite and radar-based monitoring. This predicament is not merely a local capacity issue; it is also indicative of a regional governance deficit. For instance, it is recommended that MARPOL establish joint monitoring networks among signatory countries to share data (Carpenter and MacRae, 2020). Moreover, while technological solutions such as Offshore Monitoring Platforms have been successfully implemented on the western shores of the Mediterranean, these systems have not been integrated in Türkiye.

It is imperative to draw attention to several additional regulations of MARPOL that pertain to these issues. Annex IV, for instance, was adopted on April 1, 2004, and came into force on August 1, 2005, following its revised version being adopted. Annex IV comprises a series of regulations pertaining to the discharge of sewage from ships into the sea. One such regulation pertains to the equipment and systems necessary for the control of the discharge of sewage from ships, the provision

of port sewage reception facilities, and the related inspection and certification requirements. A perusal of the regulations set out in MARPOL Annex IV reveals a clear prohibition on the discharge of sewage into the sea within a certain distance from the nearest land, unless explicit permission is granted through explicit stipulation within the regulations themselves (Uçar, 2025). Governments are charged with the responsibility of ensuring that ships are equipped with the requisite reception facilities at ports and terminals to receive wastewater in a timely manner. This undertaking represents a substantial obligation for governments (Doğan-Sağlamtimur and Subaşı, 2017).

Water quality degradation, ecological stressors, and emerging contaminants in Mersin Bay

This study demonstrates that the coastal ecosystems of Mersin are under severe pressure both from pollution caused by maritime activities and from unsustainable fishing practices. In particular, the high nitrogen-phosphorus load carried by agricultural drainage, domestic wastewater, and industrial inputs is transported via the Berdan and Seyhan rivers into coastal waters, leading to pronounced eutrophication conditions in Mersin Bay (Koçak et al. 2010; Boran, 2017). This situation is consistent with the phytoplankton increases and oxygen declines reported by Schroeder (2003) and De Nooijer (2007), and in our study, the decrease in dissolved oxygen reaching critical levels in bottom waters is the most concrete indicator of this. The hypoxic conditions, increasingly widespread in semi-enclosed seas and defined in the international literature as “dead zones” (Diaz and Rosenberg, 2008), show that the ecosystem’s carrying capacity is being exceeded.

Microplastic pollution also emerges as a critical threat along the Mersin coast (Aydın et al., 2016; Akarsu et al., 2020). Based on information obtained from cooperatives, the confirmation of microplastic presence in the digestive systems of commercial species demonstrates that the load is not limited to the water column and sediment but is transferred across trophic levels. These results are consistent with Galgani et al. (2019), who identified the Mediterranean as one of the seas with the highest global microplastic accumulation. Furthermore, Çevik et al. (2022) showed that microplastic levels increase in areas of Türkiye’s coasts with intensive industrial activity; this finding aligns with the concentration increases observed around the Mersin Bay (Güven et al., 2017).

Fisheries governance challenges, IUU pressures, and institutional effectiveness in Mersin

From the perspective of sustainable fisheries, illegal, unreported, and unregulated (IUU) fishing is one of the main problems in Türkiye (Öztürk, 2009). Although the BAGIS system is designed to support vessel tracking, monitoring of fishing seasons, and enforcement of size-quota regulations as required by legislation, in practice it does not function effectively. The excessive proximity of trawl and purse seine vessels to the shore has both ecological and economic consequences for small-scale fishers; the impact is particularly severe for low-income fishers who are not fully integrated into the cooperative system. FAO (2022) data reporting that 62% of Mediterranean species are overfished, together with Ünal et al. (2022) emphasizing the economic vulnerability of small-scale fishers, shows that the pressures observed in Mersin are consistent with regional trends.

Although the Fisheries Law No. 1380 and related regulations provide a comprehensive legal framework at the national level, the application of seasonal fishing bans during the same periods across all seas does not provide sufficient protection in the specific case of Mersin. The findings

indicate that Mersin's coastal waters differ from other seas in terms of water temperature, nutrient load, and ecosystem dynamics, and therefore region-specific fishing bans, minimum size-quota requirements, and production quotas could enhance biological sustainability.

Another issue is the inadequate implementation of MARPOL provisions. Although MARPOL clearly defines standards for wastewater discharge, fuel sulfur content, and NO_x emissions (Satır, 2007; Demir, 2011), limited inspection capacity in Mersin, lack of offshore controls, and insufficient port waste reception facilities prevent compliance with these standards. As Yılmaz (2024) also emphasized, the lack of support for SECA compliance and alternative fuel transition reduces the regional competitiveness of Türkiye's maritime sector. These results are directly related to the ship-based pollution pressures identified in our study.

Basin-scale pollution management and regional cooperation mechanisms

In terms of land-based pollution, the study compares ecosystem-based and basin-scale management models such as the EU Water Framework Directive (2000/60/EC), the Marine Strategy Framework Directive (2008/56/EC), and the Nitrates Directive (91/676/EEC) (Raftopoulos, 2011). These directives require water quality management at the basin scale and nutrient load control at the source, revealing that the fundamental missing element for Mersin is "integrated basin management" (Benzer and Benzer, 2018; Bulut and Birben, 2019). Although Türkiye's environmental legislation is extensive, the lack of mandatory water-specific planning creates a significant gap. The Land-Based Pollution Protocol and Emergency Response Protocol of the Barcelona Convention are of critical importance for Mersin. However, Türkiye's limited data sharing within REMPEC's POLREP network and low participation in joint exercises reduce the effectiveness of regional cooperation (Turan, 2009). This situation is consistent with the implementation deficiencies identified in the study and shows that international obligations are not fully reflected in national practice.

Overall, the root causes of ecological pressures on Mersin's coasts are not primarily technical deficiencies but rather managerial fragmentation, weak inspection capacity, lack of basin-wide planning, and socioeconomic vulnerability in the fisheries sector. Our findings indicate that the following elements are critical for sustainable marine management: (i) establishment of a continuous dissolved oxygen monitoring network in bottom waters, (ii) basin-based plans to reduce agricultural nutrient inputs, (iii) development of regional and ecosystem-based fishing bans, (iv) regular monitoring of microplastics and strengthening of waste management, (v) effective implementation of MARPOL through port and offshore inspections, (vi) strengthening institutional and economic support mechanisms for small-scale fishers.

For the sustainable management of Mersin's coasts, not only technical measures but also the enhancement of governance capacity, the strengthening of inter-institutional coordination, and the expansion of regional cooperation are strategic necessities (Kanlı and Falcıoğlu, 2021). Based on the study's findings, the main sources of marine pollution and illegal fishing were summarized in Table 1 with practical solution suggestions. The recommended management actions aim to support ecosystem-based marine governance, strengthen institutional capacity, and provide sustainable and socially just solutions for the region.

Table 1. Main environmental and fisheries problems in Mersin and corresponding solution strategies.

Problem	Source	Solution Suggestions
Marine Pollution	• The significant amounts of pesticides, heavy metals, and domestic and industrial waste carried by the Berdan and Seyhan Rivers. • Inadequate MARPOL implementation at ports. • A lack of oversight and inter-agency coordination.	• Integration of biological modules into treatment facilities. • Mandatory industrial pretreatment. • Full implementation of MARPOL Annexes IV and VI. • Strengthening port waste infrastructure, mandating satellite-radar-based monitoring systems. • Assigning marine monitoring budgets and responsibilities to municipalities. • Reducing plastic use. • Raising awareness.
Illegal Fishing	• Lack of training for small-scale fishermen. • Income pressure. • Lack of alternative livelihoods. • Inadequate inspection and recording systems.	• Mandating electronic catch recording and real-time monitoring systems. • Revising the Fisheries Law with an ecosystem-based fishing approach. • Providing financial incentives and cooperative support for small-scale fishermen. • Training programs on species conservation and the impact of climate change. • Attractive incentive mechanisms for young fishermen.

In conclusion, this study demonstrates that the marine ecosystem of Mersin is under significant pressure from intense maritime traffic, land-based pollution, and unsustainable fishing practices. The nutrient and pollutant loads carried by the Berdan and Seyhan rivers, combined with insufficient domestic and industrial wastewater treatment, have led to eutrophication, oxygen depletion, and ecosystem degradation in coastal waters. Although compliance with MARPOL regulations has advanced in port areas, the inability to monitor offshore discharges diminishes its effectiveness. In small-scale fisheries, enforcement of size restrictions and regulatory controls remains weak. The accumulation of microplastics, heavy metal contamination, and nutrient enrichment pose escalating risks to both ecosystem integrity and human health. Therefore, basin-based management, the strengthening of wastewater treatment infrastructure, and the establishment of local monitoring networks are essential for sustainable governance.

Acknowledgements

This study was supported by Research Fund of Çağ University, Project Number: 2024-2-25. The authors also gratefully acknowledge the officials of the Mersin Chamber of Shipping, Mersin

Metropolitan Municipality, and the Fisheries Faculty of Mersin University for the valuable insights and information provided through interviews.

Conflict of Interest

The authors declare that for this article they have no actual, potential or perceived conflict of interest.

Author Contributions

The authors drafted the main manuscript text. All authors reviewed and approved the final version of the manuscript.

Ethical Approval Statements

No ethics committee permissions are required for this study.

Data Availability

The data used in the present study are available upon request from the corresponding author.

References

Akarsu, C., Kumbur, H., Gökdağ, K., Kıdeyş, A.E., Sanchez-Vidal, A. (2020). Microplastics composition and load from three wastewater treatment plants discharging into Mersin Bay, north eastern Mediterranean Sea. *Marine Pollution Bulletin*, 150, 110776.

Aydın, C., Güven, O., Salihoğlu, B., Kıdeyş, A.E. (2016). The Influence of land use on coastal litter: An approach to identify abundance and sources in the coastal area of Cilician Basin, Turkey. *Turkish Journal of Fisheries and Aquatic Sciences*, 16, 29-39.

Bayar, S. (2024). Evaluation of port state control inspections in Türkiye. *Marine Science and Technology Bulletin*, 13(1), 81-93.

Benzer, R., Benzer, S. (2018). Forecasting the nitrate pollution of groundwater and surface waters: Kütahya example. *Karaelmas Science and Engineering Journal*, 8(1), 279-287.

Boran, L.J. (2017). Natural and human induced nutrient impacts on phytoplankton communities in Mersin Bay, NE Mediterranean. Middle East Technical University, Institute of Marine Sciences. Mersin, p 302.

Bulut, M. Birben, Ü. (2019). Effect of the EU Water Framework Directive on water resources management in Turkey. *Turkish Journal of Forestry*, 20(3), 221-233.

Carpenter, A., Donner, P., Johansson, T. (2017). The Role of REMPEC in Marine Pollution Preparedness and Response in the Mediterranean Sea. *In* Marine Pollution: Current Status and Future Solutions (pp. 197-215). Springer.

Çevik, C., Kıdeyş, A.E., Tavşanoğlu, Ü.N., Kankılıç, G.B., Gündoğdu, S. (2022). A review of plastic pollution in aquatic ecosystems of Turkey. *Environmental Science and Pollution Research*, 29(18), 26230-26249.

De Nooijer, L.J. (2007). Shallow water benthic foraminifera as proxy for natural versus human-induced environmental change. Utrecht University, Faculty of Geosciences. Utrecht, p 152.

Demir, İ. (2011). The assesment of "The act on principles of intervention in urgent cases of pollution of the Sea environment by oil and other noxious items and compensation for damage" in terms of civil liability and compensation principles for damage. *Journal of İnönü University Faculty of Law*, 2(1), 239-324.

Diaz, R. J., Rosenberg, R. (2008). Spreading dead zones and consequences for marine ecosystems. *Science*, 321(5891), 926-929.

Doğan-Sağlamtimur, N., Subaşı, E. (2018). Ship generated marine pollution and waste reception facilities from the World and Turkey: General perspective, management and suggestions. *Pamukkale University Journal of Engineering Sciences*, 24(3), 481-493.

FAO. (2022). The state of world fisheries and aquaculture 2022: Towards blue transformation. FAO.

Galgani, F., Hanke, G., Maes, T. (2019). Global distribution, composition and abundance of marine litter. *In* Marine Anthropogenic Litter (pp. 29-56). Springer.

Güven, O., Gökdağ, K., Jovanovic, B., Kıdeyş, A.E. (2017). Microplastic litter composition of the Turkish territorial waters of the Mediterranean Sea, and its occurrence in the gastrointestinal tract of fish. *Environmental Pollution*, 223, 286-294.

Kanlı, İ.B., Falcıoğlu, N.N. (2021). The importance of the environmental cooperation in protection of the Mediterranean Sea and its coasts through the Barcelona Convention. *IBAD Journal of Social Sciences*, 9, 117-142.

Koçak, M., Kubilay, N., Tuğrul, S., Mihalopoulos, N. (2010). Long-term atmospheric nutrient inputs to the Eastern Mediterranean: sources, solubility and comparison with riverine inputs. *Biogeosciences Discuss*, 7, 5081-5117.

Öztürk, B. (2009). Marine protected areas in the high seas of the Aegean and Eastern Mediterranean Seas, some proposals. *Journal of Black Sea/Mediterranean Environment*, 15(1), 69-82.

Raftopoulos, E. (2011). The Mediterranean Response to Global Challenges: Environmental Governance and the Barcelona Convention System. *In* The World Ocean in Globalisation (pp. 507-538). Brill Nijhoff.

Satır, T. (2007). Developing port reception facility model in the Turkish ports for establish and management sufficent for international convention for the prevention of pollution from ships. Istanbul University, Institute of Marine Sciences and Management. İstanbul, p 137.

Schroeder, A. (2003). Community dynamics and development of soft bottom macrozoobenthos in the German Bight (North Sea). Bremen University, Faculty 2 Biology/Chemistry. Bremen, p 190.

Turan, M. (2009). Turkey's oil spill response policy: Influences and implementation. United Nations.

Uçar, A. (2025). Prevention of pollution from sewage on passenger ships: a comparison between international and Turkish regulations. How can artificial intelligence (ai) help to improve the most common issues with sewage systems?. *Journal of Yeditepe University Faculty of Law*, 22(2), 921-956.

Ünal, V., Ertör, I., Ertör-Akyazi, P., Tunca, S. (2022). Making Pescatourism Just for Small-Scale Fisheries: The Case of Turkey and Lessons for Others. *In* Blue Justice: Small-Scale Fisheries in a Sustainable Ocean Economy (pp. 315-333). Springer.

Yılmaz, N.P. (2024). Türkiye's harmonization with the EU's Maritime Policies: An analysis in the framework of the EU country reports between 2018 and 2023. *International Journal of Social Inquiry*, 17(3), 449-466.