Chapter 4

Some Remarks on the 14th Sustainable Development Goal in Türkiye

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Abstract

Marine and oceans are important resources that provide numerous services such as sustaining life, food supply, clean energy, and transportation. However, these valuable resources, along with the habitats they support, are subjected to various anthropogenic pressures, including climate change, population growth, and industrial intensity. In order to create social, economic, and ecological value, sustainable utilization of the sea and its resources can only be achieved through the development and implementation of management strategies based on marine sciences. Recognizing the significance of marine and ocean conservation, the United Nations adopted a framework consisting of 17 Sustainable Development Goals (SDGs) in 2015, which includes the enhancement of sustainable use and conservation of seas and oceans as a priority goal. Effective strategies to combat overfishing, ocean acidification and worsening coastal eutrophication have been emphasized. Türkiye, being a country surrounded by three seas and rich in water resources, is also highly affected by water pollution. Industrial activities, agricultural use, urbanization, population growth, and hydrological conditions contribute to water pollution, making it a significant environmental issue in the country. In this context, the aim of this study is to examine the issues related to seas and marine resources in Türkiye in line with the 2030 Sustainable Development Goals and provide a fresh perspective on what has been done and what needs to be done in the context of Goal 14. The objective is to develop science-based strategies, intensify research capacity, and provide information on the necessary actions to be taken.

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https://doi.org/10.58830/ozgur.pub252.c1215

1. Introduction

The emergence of contemporary environmental movements in the 1960s and 1970s necessitated the examination of the concepts of development and environment together (Scoones, 2007). This situation was further advanced in the report known as the Brundtland Report, also referred to as "Our Common Future" (Brundtland, 1987), which introduced the concept of sustainable development to a new level. In this report, sustainable development, defined as meeting the needs of the present without compromising the ability of future generations to meet their own needs, emerged as a concept that encompasses various disciplines in today's world (Thiele, 2016). Today, sustainability and sustainable development have become indispensable concepts for modern societies, and they have become the guiding principles in the actions and decisions of governments, communities, organizations, and individuals in the modern world (Caradonna, 2014).

Sustainable development is an approach to development that aims to achieve social and economic progress in harmony with environmental sustainability. This approach involves using resources efficiently and effectively to meet the needs of current generations while considering the needs of future generations. Sustainable development is addressed in three fundamental dimensions: economic, social, and environmental. In the economic dimension, sustainable development seeks to promote economic growth while reducing inequalities, eradicating poverty, and ensuring the equitable distribution of resources. In the social dimension, the focus is on improving human well-being and safeguarding basic human rights such as education, health, equality, and gender justice. In the environmental dimension, the objectives include sustainable management of natural resources, conservation of biodiversity, combating climate change, and reducing environmental impacts. What sets sustainable development apart from traditional environmental conservation approaches is its proactive and holistic focus on long-term evolving dynamic processes (Portney, 2015; Bozoğlu and Ciğerim, 2022). It considers the interconnections between economic, social, and environmental aspects and seeks to promote a balanced and integrated approach for a sustainable future.

After sustainable development came to the agenda of countries, the question of how countries would achieve this development emerged. How countries will make a plan and program, how they will organize their investments and what should be done for sustainability has become an important topic of discussion. At this point, various targets have emerged and it has been stated that countries can achieve sustainable development

by realizing these goals (Yıldırım and Yıldırım, 2020). The latest goals for the countries of the world to reach sustainable development are in the form of "2030 Sustainable Development Goals". The "2030 Sustainable Development Goals", which contain 17 basic goals and were adopted in 2015, are seen as a historical global achievement.

Oceans and seas, which hold a significant place in our daily lives, serve as the locomotive of the blue economy and blue growth, encompassing global climate regulation, maritime transportation, marine tourism, health, and fisheries. Therefore, the oceans, seas, and underwater life should be on the agenda of all countries aiming for sustainable world goals. This priority is particularly crucial for countries with coastlines. This priority has led to the inclusion of the oceans and seas in the "2030 Sustainable Development Goals" and their identification with Goal 14 (Global Sustainable Development Report, 2023). SDG 14 focuses on the sustainable use and conservation of oceans and seas, addressing issues such as overfishing, ocean acidification, and coastal eutrophication. It aims to protect marine and ocean biodiversity and encourages countries to support research financing in this field. It is a crucial goal within the Sustainable Development Goals framework, aiming to combat the negative impacts of overfishing, ocean acidification, and coastal eutrophication, and to promote the preservation of marine and ocean biodiversity.

Türkiye is a country surrounded by seas on three sides and connected to oceans through straits. It has four different sea systems: the Sea of Marmara, the Mediterranean Sea, the Black Sea, and the Aegean Sea. The diverse ecological characteristics of its seas and inland waters have resulted in high biodiversity. This situation highlights the importance of preserving, developing, and sustainably managing water resources, especially marine resources, for the country. Türkiye's rich marine and inland water resources play a vital role in various aspects of the country's economy and society. They support sectors such as fisheries, maritime transportation, tourism, energy, and provide important ecological services. However, the sustainable use and effective management of these resources are essential to ensure their long-term viability and to avoid overexploitation or degradation. Efforts are made to protect and conserve marine and inland water ecosystems in Türkiye, including the establishment of marine protected areas, the implementation of sustainable fishing practices, and the promotion of responsible tourism. Furthermore, water resource management plans and regulations are developed to ensure the sustainable utilization of these valuable resources while considering ecological, economic, and social factors. The sustainable management of marine and inland water resources in Türkiye is not only

important for the country's own well-being but also contributes to the global efforts for the conservation and sustainable use of these vital ecosystems.

The aim of this study is to project the current situation in Türkiye's seas, as well as provide information on the progress made so far and the necessary actions and recommendations to be taken in line with the Sustainable Development Goals (SDGs). It focuses on the development of strategies, planning, and regulations in pursuit of sustainable development.

2. Physical Structure of the Country's Seas

Türkiye, surrounded by the Mediterranean, Black, and Aegean Seas, has a coastline of 8,333 kilometers (including islands), making it one of the countries with the longest coastal strip in Europe. The distribution of this coastline is approximately 33.66% in the Aegean Sea, 20.34% in the Black Sea, 20.07% in the Mediterranean, and 11.20% in the Sea of Marmara. Approximately 65% of the country's population is settled along the coast (Dölgen et al., 2006).

The Black Sea, with a surface area of 496,064 km², has an average depth of 1,197 meters and its deepest point reaches 2,245 meters. The continental shelf along the Turkish coastline of the Black Sea is narrow, with a coastal length of 1,795 kilometers. The salinity of the Black Sea is 18 parts per thousand, and it is known for having the world's largest hydrogen sulfide reserves. Therefore, there is no life below depths ranging from 150 to 200 meters. More than half of the fish caught in Türkiye come from this sea, making it economically significant for the country. The Black Sea also holds importance in terms of maritime transportation due to its coastal ports (Akengin et al., 2016).

The Sea of Marmara, with a surface area of 11,350 km², is the smallest sea in Türkiye. It separates the Asian and European parts of Türkiye and has the characteristic of being an inland sea. The deepest point of the Sea of Marmara is 1,238 meters. It has a wide continental shelf. It is connected to the Black Sea through the Istanbul Strait and to the Aegean Sea through the Çanakkale Strait. The coastline of the Sea of Marmara is 1,275 kilometers long. It holds importance due to fishing and port activities. The Turkish Straits System (Bosphorus and Çanakkale) are significant in terms of upper and lower currents. The Black Sea, which receives heavy rainfall and is the outlet for numerous rivers, is 40 cm higher in elevation compared to the Sea of Marmara. The excess water flows from the Istanbul Strait to the Sea of Marmara and then through the Çanakkale Strait to the Aegean Sea. The salinity of the Aegean Sea is higher compared to the Marmara and Black

Seas. The denser waters flow as bottom currents through the straits towards the Black Sea.

The Istanbul Strait, which connects the Sea of Marmara to the Black Sea, is the narrowest and one of the busiest waterways in the world. The widest part of the Istanbul Strait is 3,600 meters, located in the north between the Anadolu Lighthouse and Turkeli Lighthouse. The narrowest part is 698 meters, between the Anadolu Fortress and the Rumeli Fortress. The depth of the Istanbul Strait varies between 30 and 110 meters. This strait holds significant strategic importance and enhances Türkiye's geopolitical position. Istanbul Port serves as a gateway for Türkiye's exports and imports, connecting it to the rest of the world.

The Çanakkale Strait, which connects the Sea of Marmara to the Aegean Sea, has its widest point at the southern boundary, measuring 3,600 meters, and its narrowest point is between Çanakkale and Kilitbahir, with a width of 1,200 meters. The depth of the strait varies between 50 and 140 meters. The Çanakkale Strait holds strategic importance as it connects the Marmara and Aegean seas. Similar to the Istanbul Strait, it is also a busy waterway. Both the Istanbul and Çanakkale straits are significant for fishing activities as well (Taşlıgil, 2004).

The Mediterranean, which is the largest sea surrounding Türkiye, covers an area of 2,500,000 km^2. It is connected to the Atlantic Ocean through the Strait of Gibraltar and to the Indian Ocean through the Suez Canal. The average depth of the Mediterranean is 1,400 meters, with the deepest point reaching 4,400 meters. Apart from the İskenderun and Mersin Gulfs, the continental shelf of the Mediterranean is quite narrow. The salinity level is 36 parts per thousand. Along the Turkish coastline, temperatures in the Mediterranean range from 14°C to 34°C. The length of the Turkish coastline along the Mediterranean is approximately 1,577 km. The Mediterranean Sea holds significant importance, particularly in terms of marine tourism. It also plays a crucial role in port activities and maritime transportation (Atalay, 2011).

The Aegean Sea, located between Türkiye and Greece, has a total area of 214,000 km^2 including the islands. There are approximately 3,000 islands in the Aegean Sea. It is the sea with the longest coastline for Türkiye. The length of the Turkish coastline along the Aegean Sea is 2,805 km, accounting for approximately one-third of the total length of our coasts. The Aegean region has numerous bays, gulfs, and peninsulas due to its indented coastline. The salinity level in the Aegean Sea is 25 parts per thousand. It holds significant importance in terms of fishing and port activities. It also contributes significantly to the Turkish economy through marine tourism (Başeren, 2006).

Our seas, besides their impact on our country's climate and strategic importance, are also significant economic resources. They hold great potential in terms of harvested seafood, maritime transportation, and natural resources on the seabed. This potential carries significant importance for the future of our country.

3. Sustainable Blue Economy for Marine Ecosystems

The concept of blue economy was first introduced by Pauli (2010), emphasizing that the blue economy creates wealth in terms of sustainability and therefore, the balance between environmental and economic goals needs to be achieved.

The blue economy conceptualizes the oceans as "development areas" that integrate conservation, sustainable use, oil and mineral extraction, bio-research, sustainable energy production, and marine transportation (United Nations, 2019). The blue economy is seen as a comprehensive development approach that promotes growth by emphasizing the efficient and optimal use of marine resources without compromising sustainability elements (Mohanty, 2019). At the core of the global blue economy concept lies the provision of healthy oceans to serve future generations while ensuring economic growth derived from the oceans (Atakpa, 2018). Table 1 further elucidates the concept of the blue economy and provides a detailed overview of its components (World Bank, 2016; Toplu-Yılmaz, 2021).

Table 1. The scope of the blue economy (abbreviated from Toplu-Yılmaz, 2021)

Type of activity (nature of business)	**Activities within Subcategories**
Collection and trade of marine resources	Seafood harvesting
	Utilization of marine organisms for pharmaceutical and chemical applications
Extraction and utilization of non-renewable resources from the sea	Mining of minerals
	Energy resource extraction
	Freshwater production
The use of renewable natural resources (wave, wind, tidal energy)	Renewable energy generation offshore
Trade within and across oceans	Transportation and trade
	Coastal development
	Tourism and recreation
Indirect impact on the economy and the environment	Carbon capture
	Coastal protection
	Waste management and industrial infrastructure
	Presence of biodiversity

As can be seen in the table, the blue economy encompasses numerous activities such as tourism in the seas and coastal regions, fishing, extraction of marine resources for cosmetics and medicines, maritime transport, production of shipbuilding and maritime equipment, extraction of oil and minerals, carbon sequestration and coastal recreation (Toplu-Yılmaz, 2021).

The evaluation of our seas in terms of the blue economy involves the sustainable and efficient utilization and management of marine resources. The blue economy is an approach that aims to maximize the economic potential of marine and ocean resources while also targeting environmental sustainability and the conservation of ecosystems. Türkiye has significant potential for a thriving blue economy due to its surrounding seas and extensive coastline. Various sectors such as fisheries, marine tourism, maritime transportation, energy resources, marine mining, water sports, and underwater resources form the key components of the blue economy in our seas.

Fisheries and aquaculture sectors are significant sources of income derived from the rich fish and seafood resources in Türkiye's seas. They provide employment opportunities and contribute to exports.

Marine tourism also holds great economic value for Türkiye. Our beautiful beaches, bays, and islands attract tourists who prefer sea, sun, and beach vacations. These tourism activities contribute to increased tourism revenue and the development of local economies.

Maritime transportation plays an important role due to Türkiye's strategic location. Waterways such as the Istanbul and Çanakkale Strait serve as vital transit points for maritime trade and heavy ship traffic. Our ports are the lifelines of foreign trade and the logistics sector.

Furthermore, our seas also hold potential for energy resources, particularly wind and solar energy. Projects related to offshore wind and solar energy contribute to clean energy production and energy security.

Marine mining also plays a significant role within the blue economy of our seas. Resources such as minerals, oil, and natural gas found in the seabed can be economically evaluated and contribute to the country's economy.

The evaluation of Türkiye's seas in terms of the blue economy requires the sustainable utilization of this potential and the preservation of marine resources. Measures such as sustainable fishing practices, conservation of marine ecosystems, management of environmental impacts, and marine spatial planning can ensure the successful management of the blue economy.

Goal 14 of the Sustainable Development Agenda 2030 aims to promote sustainable blue economy and its objectives include (TCCSBB, 2019);

14.1 By 2025, prevent and significantly reduce all forms of marine pollution, including marine debris and nutrient pollution, particularly from land-based activities.

14.2 By 2020, sustainably manage and protect marine and coastal ecosystems, taking actions to restore and enhance their resilience, in order to achieve healthy and productive oceans, addressing the adverse impacts on these ecosystems.

14.3 By 2030, minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels.

14.4 By 2020, effectively regulate harvesting and end overfishing, illegal, unreported, and unregulated (IUU) fishing, and destructive fishing practices, and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics.

14.a Enhance the conservation and sustainable use of oceans and their resources by implementing international law as reflected in the United Nations Convention on the Law of the Sea (UNCLOS), which provides the legal framework for the conservation and sustainable use of oceans and their resources, in accordance with the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to increase scientific knowledge, develop research capacity, and transfer marine technology to developing countries, particularly Small Island Developing States (SIDS) and Least Developed Countries (LDCs), and promote the contribution of marine biodiversity to their development.

14.b Provide access for small-scale artisanal fishers to marine resources and markets.

14.c Enhance the conservation and sustainable use of oceans and their resources, as reflected in UNCLOS, which sets out the legal framework for the conservation and sustainable use of oceans and their resources, as stated in paragraph 158 of the document "The Future We Want."

In our country, the most important and highest revenue-generating component of the blue economy is fishing activities, which fall under the category of harvesting and trade of marine resources. According to the Turkish Statistical Institute (TÜİK) data for 2022, the production of aquatic products increased by 6.2% compared to the previous year, reaching

849,808 tons. Of this production, 30% consists of marine fish obtained through fishing, 5.6% consists of other marine products obtained through fishing, 3.9% consists of inland fish obtained through fishing, and 60.6% consists of aquaculture products (Figure 1).

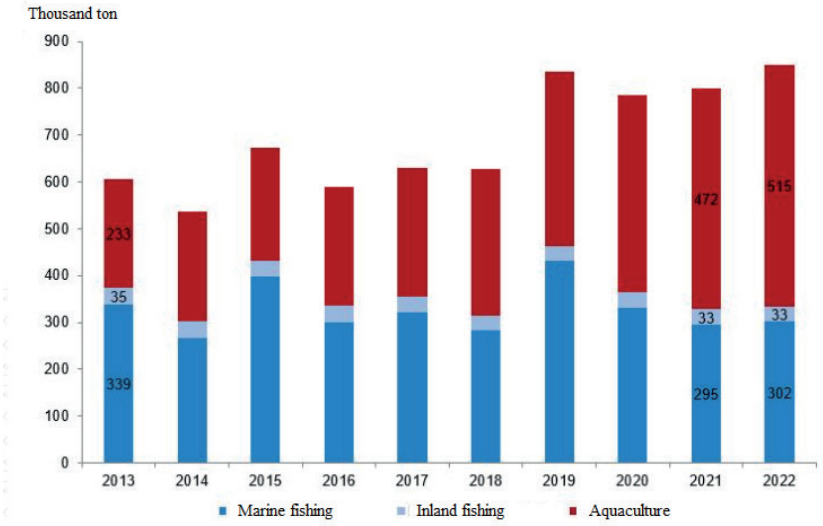

Figure 1: Aquaculture production, 2013-2022 (TÜİK, 2022)

In 2022, the production of fishery products increased by 2.1%, with a total production of 335,003 tons through fishing activities. Aquaculture production reached 514,805 tons, while marine fisheries increased by 2.3% compared to the previous year, and inland fisheries increased by 0.4%. The quantity of harvested marine fish reached 254,535 tons, with the most commonly caught species being anchovy (125,980 tons), bonito (49,892 tons), and sardine (16,729 tons). Aquaculture production increased by 9.1% in 2022 compared to the previous year. Of the total aquaculture production, 368,742 tons were from marine aquaculture, and 146,063 tons were from inland aquaculture. The most important fish species cultivated were trout with 145,649 tons in inland aquaculture, and sea bass with 156,602 tons and sea bream with 152,469 tons in marine aquaculture (TÜİK, 2022).

In addition to fishing activities, there is a need for the development of all the activity areas mentioned in Table 1 in our country's seas. However, we believe that special emphasis should be placed on marine biotechnology. Marine biotechnology is undergoing rapid development worldwide and

has reached an exciting stage in areas such as aquaculture, biochemistry, genetics, genomics, health, cosmetics, environment, bioenergy, and more. Genomic and proteomic methods provide valuable information for the sustainability of marine ecosystems and the exploration and utilization of marine biodiversity. Although marine biotechnology has a wide range of applications, from biomedical to environmental fields, its importance is just starting to be recognized in our country (TÜDAV, 2017).

In order to successfully implement the blue economy and make significant contributions to the country's economy, it is important to pay attention to issues such as food security, marine pollution, and overfishing in fishing activities. To achieve this, the following measures can be taken:

Food security: Emphasis should be placed on the production of healthy and reliable food in fishing activities. Good agricultural practices, hygiene standards, and traceability measures should be implemented. Fishermen should handle and store their catch properly.

Marine pollution: Environmental protection measures should be implemented to prevent marine pollution. Discharge of industrial waste into the sea should be controlled, and wastewater treatment facilities should be used to keep our seas clean. Additionally, recycling and awareness campaigns are important for reducing plastic and other waste in the oceans.

Overfishing: Preventing overfishing is essential for the sustainability of fish stocks. Fishing activities should be carried out using sustainable fishing methods that allow for the reproduction of fish populations. Regulations such as laws, quotas, and fishing seasons can help control overfishing.

In this field, plans and strategies focused on blue growth should be developed by following the incentives provided by the European Union and similar institutions.

Priority should be given to marine biotechnology studies, and various institutions should be supported through universities to promote research and development in this area.

These measures will ensure the sound management of the blue economy and the sustainable use of marine resources. This will lead to both economic development and the preservation of the ecosystems in our seas.

4. Pollution Problem in Turkish Seas

Marine systems, whose economic and ecological importance is increasingly due to their high nutrient, mineral and energy content, are threatened by a

variety of pollutants that reach through the atmosphere, coastlines, lakes and rivers (Doğan-Sağlamtimur and Subaşı, 2018). In particular, maritime transport, accidents, industrial activities, tourism, urbanization and high waste discharge cause a decrease in the amount of oxygen in sea water and have become an important threat to the life of marine organisms (İncaz et al., 2005; Ecel, 2007). Marine pollution occurs when the capacity to dispose of pollutants accumulated in water is exceeded (Artüz, 1992; Nauke and Holland, 1992; Aras, 2001; Clark, 2001; Güven and Öztürk, 2005; İncaz et al., 2005; Butt, 2007; Zuin et al., 2009).

4.1. Marine pollution from ships

Ship-source pollution is a significant source of marine pollution. The waste, spills, and emissions generated during ship operations can pollute the oceans. This pollution can occur in various forms:

Oil pollution: It occurs when oil contaminates the seas due to fuel transfers, maritime accidents, or leaks from oil tankers. Oil pollution can cause serious harm to marine life and disrupt ecosystems.

Chemical pollution: During the transportation of chemicals on ships, leaks or the discharge of chemical waste into the sea can result in chemical pollution. This type of pollution can directly impact marine life and cause damage to aquatic ecosystems.

Wastewater pollution: Discharging wastewater from ships, including waste from toilets, sinks, and kitchens, can lead to wastewater pollution. The pollutants contained in this waste can degrade water quality and affect marine life.

Air pollution: Ship engines emit harmful gases and particles into the atmosphere. These emissions can contribute to air pollution and environmental impacts in coastal areas near the seas.

In Türkiye, as well as globally, marine pollution and issues related to coastlines are prominent concerns. The Black Sea, Aegean Sea, and Mediterranean Sea are heavily polluted. Maritime transportation, accidents, the widespread production and use of oil and its derivatives, and discharges play a significant role in the industrial pollution of the seas (Doğan-Sağlamtimur and Subaşı, 2018).

According to data from the Turkish Statistical Institute (DİE), more than 20,000 ships visit ports in Türkiye each year, including multiple visits by the same ship within a year (Environmental Inspection Report, 2002). Hazardous substances carried by ships consist of approximately 70% (94.8

million tons) crude oil, 26% (34.2 million tons) petroleum products, and the remaining 4% (6 million tons) liquefied gases and chemical products (Orhon et al., 2008).

Pollution caused by ships is a comprehensive and complex issue. Initially, maritime pollution is not limited to oil alone. Apart from oil, wastewater, garbage, and other types of waste discharged or discarded from ships can also contribute to marine pollution. The cargo responsible for pollution resulting from maritime accidents is not solely limited to oil or petroleum derivatives. However, when we mention pollution caused by ships, the first thing that comes to mind is typically oil pollution caused by ships. There are two main reasons for oil pollution caused by ships. The first reason is the operation of tankers carrying oil cargo as well as other ships, and the second reason is oil pollution resulting from maritime accidents involving both oil tankers and occasionally non-tanker ships.

Intentional or operational oil pollution, resulting from the deliberate discharge of oil by ships during their operations, constitutes a major component of oil pollution in the seas. Intentional oil pollution, arising primarily from the normal activities of non-tanker ships and especially oil tankers, is based on two main causes. The first cause is the discharge of oil pollution resulting from the emptying of ballast water in tankers, and the second cause is oil pollution arising from the washing of cargo and sometimes fuel tanks. Accidental oil pollution, on the other hand, is actually the type of pollution that attracts the most attention from the international community. In today's world, where tanker capacities have reached unimaginable sizes, maritime accidents resulting from navigation errors, mistakes made by individuals responsible for ship management, and occasionally force majeure events have caused and continue to cause major disasters to the marine environment. The scale of marine pollution in general and, specifically, oil pollution caused by ships has reached alarming levels in recent times, making it a matter of great concern for both coastal states and the international community in terms of pollution prevention (Abdullahzade, 2009).

In the Mediterranean, the increase in the amount of domestic waste based on seasonal population growth due to tourism, industry, and agricultural activities, as well as waste from yacht tourism and petroleum derivatives resulting from maritime transportation, are significant causes of pollution. The Mediterranean accounts for 28% of global oil transportation, and around 20,000 tons of oil per year seep into the Mediterranean due to accidents or negligence from the 60 oil refineries located in its vicinity (Doğan-Sağlamtimur and Subaşı, 2018).

In the Aegean Sea, pollutants primarily reach through residential and industrial waste, wastewater discharges, runoff from precipitation, agricultural and port activities, maritime traffic, and rivers flowing into the sea. With the addition of wastewater discharges from the Turkish coast to the Aegean Sea and the influence of the Çanakkale Strait, the sea is exposed to a pollution load equivalent to a population of nearly 20 million (Doğan-Sağlamtimur and Subaşı, 2018).

The Sea of Marmara is an inland sea that connects the Black Sea to the Aegean and Mediterranean Seas through the Istanbul and Çanakkale Straits, respectively (Dölgen et al., 2006). In terms of size and capacity as a recipient environment for waste materials, the Sea of Marmara has about 100 times less capacity compared to the Mediterranean Sea and 1,000 times less compared to the Black Sea (Akkaya, 2004). The increasing maritime traffic in the Sea of Marmara, along with pollution triggered by the bilge and ballast waters of marine vessels, results in a significant pollution load spreading over a wide area (Doğan-Sağlamtimur and Subaşı, 2018).

The Black Sea in our country receives pollutant loads from various rivers, primarily including the Sakarya, Yeşilırmak, and Kızılırmak, as well as the Danube River, which carries the pollutant load of almost all of Europe. The pollution of the Black Sea is not limited to the sea and rivers; the region is also threatened by environmental pollution (Talınlı & Sarıöz, 2002). Annually, 548 km3 of water flows from the Black Sea to the Sea of Marmara, while only 249 km3 of water flows from the Sea of Marmara to the Black Sea through the bottom current. This indicates that pollution occurring in the Black Sea will have approximately twice the impact on the Sea of Marmara compared to the influence of the Sea of Marmara on the Black Sea (Doğan-Sağlamtimur & Subaşı, 2018).

Marine pollution in the Turkish Straits, which connect the Black Sea and the Mediterranean Sea, is primarily caused by maritime transportation through the Çanakkale and Istanbul Straits. The contribution of pollution from maritime traffic in the Istanbul Strait to the total pollution has been determined to be approximately 10% (Orhon et al., 2008). Records show that a total of 162 significant marine accidents have occurred in Türkiye until today. Out of these accidents, 105 took place in the Istanbul Strait, 35 in the Çanakkale Strait, and 22 in the Sea of Marmara. Among these incidents, 4% were fires, 30% were groundings, 52% were collisions between two vessels, 72% were collisions with docks or waterfront mansions, and 10% occurred due to other reasons. It has been noted that there are six accidents per 1 million miles of passage through the Istanbul Strait, which is twice the

number of accidents that occur in the Suez Canal (Doğan-Sağlamtimur and Subaşı, 2018).

To prevent and reduce ship-source pollution, various measures have been implemented. International maritime organizations have established standards and guidelines to control ship emissions, regulate waste management, and prevent marine pollution. These measures include the proper management of ship waste, promotion of recycling, use of wastewater treatment systems, and monitoring of ship operations.

International cooperation is crucial in combating ship-source pollution. Collaboration and awareness-raising activities should be conducted among the maritime sector, shipowners, port operators, governments, and non-governmental organizations. Additionally, innovations such as the development of ship technologies and the use of eco-friendly fuels can be effective in addressing marine pollution.

4.2. Domestic Waste and Land-Based Marine Pollution

Domestic waste and land-based marine pollution occur when waste from land areas and coastal settlements reaches the sea. This type of pollution can result from various factors and can cause significant harm to marine ecosystems. Here are some examples of domestic waste and land-based marine pollution:

Sewage discharge: Urban areas have sewage systems that collect domestic waste and used water and discharge it into the sea. However, in cases where sewage systems are inadequate or faulty, waste can directly reach the sea or coastlines. This can lead to water pollution and harm to aquatic life.

Beach and coastal pollution: Touristic areas or coastal settlements can experience pollution due to litter, plastic waste, and other land-based debris left by visitors or the local population. Beach and coastal pollution disrupts marine ecosystems, damages the food sources of marine organisms, and leads to the degradation of coastal ecosystems.

Agricultural pollution: During agricultural activities, fertilizers, agricultural chemicals, and irrigation water can reach the sea through rivers. Agricultural pollution can result in the excessive accumulation of nutrients like nitrates and phosphates in aquatic ecosystems. This impairs water quality, reduces oxygen levels in the seawater, and negatively affects marine life.

Industrial pollution: Wastewater from industrial facilities, factory discharges, and industrial waste can reach the sea. These wastes may contain chemicals, heavy metals, toxic compounds, and other pollutants. Industrial

pollution can lead to water pollution, harm to aquatic life, and disrupt the balance of ecosystems.

To combat domestic waste and land-based marine pollution, measures such as the establishment of wastewater treatment plants, improvement of sewage systems, implementation of environmental conservation policies, and public awareness campaigns are taken. Additionally, there are various international agreements and regulations in place to control marine pollution on a global scale.

Land-based pollution is particularly evident in the Sea of Marmara. As a relatively small sea, it is essential for all coastal municipalities to invest in wastewater treatment to minimize the impact of pollution on the Sea of Marmara. Additionally, monitoring the pollution in the Sea of Marmara from a public health perspective and providing transparent and easily accessible information to the public entering the sea is important.

Since the Sea of Marmara is replenished with oxygenated waters from the North Aegean and the Çanakkale, special attention should be given to preventing pollution in the Northern Aegean and the Çanakkale. Monitoring the pollutants carried by the surface currents from the Black Sea is also of great importance. This way, the pollution budgets of the Marmara and Black Seas can be updated.

4.3. Eutrophication and Heavy Metal Pollution

Eutrophication is a type of pollution that occurs in water systems due to the accumulation of excessive nutrients. It is often caused by sources such as agricultural activities, sewage discharge, and industrial waste, which introduce high levels of nitrogen and phosphorus compounds into water systems. These nutrients promote rapid algae growth in aquatic ecosystems, leading to excessive proliferation of aquatic plants and a decrease in oxygen levels in the water. As a result, the balance of aquatic life is disrupted, leading to fish deaths and a decline in water quality.

Heavy metal pollution, on the other hand, occurs when heavy metals are released into water systems. Industrial activities, mining, energy production, and waste disposal are common sources of heavy metal contamination in water. Metals such as lead, mercury, cadmium, and arsenic can accumulate in aquatic environments, posing a serious threat to aquatic organisms and ecosystems. The long-term accumulation of these metals can impact the health and reproductive abilities of aquatic organisms and affect population dynamics. Furthermore, heavy metals can have significant effects on human

health and can be transmitted to humans through contaminated water sources.

Several measures are taken to combat these types of pollution. To control eutrophication, it is important to regulate fertilizer use in agricultural areas, treat sewage water, and improve industrial waste management. Preventing heavy metal pollution involves using wastewater treatment systems in industrial facilities, ensuring safe waste disposal practices, and being cautious with products containing heavy metals.

Regular monitoring of aquatic ecosystems, determination of pollution levels, and the development of effective conservation strategies are also crucial. These efforts are vital for the protection of water resources, the sustainability of aquatic life, and the preservation of human health.

There is limited data available on eutrophication-related pollution in Turkish seas. However, in recent times, the use of phosphate-free cleaning products has helped reduce the ecological damage caused by their release into the marine environment. It is important to comply with the standards set by EU countries in this regard and promote the use of phosphate-free cleaning products. The use of phosphate compounds increases the phosphate content in water, leading to a process known as eutrophication, which results in decreased oxygen levels and negatively affects marine organisms. The increased phosphate levels lead to rapid algae growth, organic matter accumulation at the bottom, insufficient oxygen levels, and fish deaths. Changes in parameters such as odor, taste, and color can be observed in seawater. The choice of raw materials used is important not only for the preservation of our seas and the environment but also for water conservation. Protecting our seas from pollution is crucial. Particularly along the Mediterranean coasts, there have been observed retreats in endemic seagrass meadows known as Posidonia oceanica due to pollution from domestic sources. These seagrass meadows are considered the lungs of the Mediterranean due to their oxygen production, and although they are under protection, they are still threatened by various factors.

There are numerous studies on heavy metals in Turkish waters. It is known that heavy metals can also transfer to humans through marine organisms. However, so far, specific fish species that are harmful to human health have not been identified. Nevertheless, monitoring studies need to continue in order to assess the situation. (TÜDAV, 2017).

Excessive plankton growth, particularly during the spring months, is a common manifestation of eutrophication and can be observed in widespread

areas. Many seas in Türkiye, especially the Sea of Marmara, experience excessive plankton growth, also known as plankton blooms. This phenomenon typically begins in the spring season and ends around June. However, in the past decade, the frequency of these blooms has increased fivefold, primarily due to the excessive input of nutrient salts. This nutrient input leads to the overgrowth of single-celled organisms called phytoplankton, which can be seen on the water surface as red or sometimes white patches. These blooms, which primarily contribute to oxygen depletion in seawater, can also result in fish mortality if they persist for a long time. It is recommended to regularly monitor the dynamics of the phytoplankton and coccolithophores responsible for these occurrences, particularly in the Turkish Straits System. Furthermore, the occurrence frequency of phenomena such as "mucilage" and "sea snot," which are indicators of pollution, has also increased in recent years, especially in the Marmara and Northern Aegean waters, particularly during the spring season.

Marine mucilage, also known as sea snot, is a dense and highly viscous substance composed of polymers derived from various marine organisms, including excretions and secretions of different sizes and species such as viruses, bacteria, phytoplankton, and even zooplankton. It consists of dissolved and polymeric organic matter, rich in extracellular polysaccharides, and exhibits hydrogel-like properties. The jelly-like and adhesive characteristics of marine mucilage enable it to encapsulate a wide range of marine organisms.

The mucilage problem has been frequently observed in the Adriatic Sea since the 1870s. In the Aegean Sea, it was documented between 1990 and 2010, while in the Sea of Marmara , it was first observed between 2007 and 2010, and most recently in June 2021, with severe intensity (Danovaro et al., 2009).

The recent intense mucilage formation in the Sea of Marmara, which has high human activity, is considered to be a result of environmental pollutants and pressures such as climate change affecting the Sea of Marmara ecosystem. The prominent presence of polysaccharides and carbohydrates in mucilage structure indicates that it originates from phytoplankton-derived materials. The transition from a mild winter to spring and hot summer months leads to calm sea currents and reduced wave activity, creating stagnant conditions in the water column. These conditions promote the development of anoxic conditions, delayed decomposition of humic compounds, and accelerated production of mucilage. Some studies have reported that a high N/P ratio and low levels of certain nutrient elements can accelerate mucilage production (Mecozzi et al., 2001).

The Marmara Basin is home to numerous Organized Industrial Zones and industrial establishments. Additionally, agricultural and livestock activities take place within the basin. Residential areas and industrial facilities within the Marmara Basin contribute pollutants to the air and water from areas where solid waste is disposed of. Agriculture and livestock activities result in the influx of significant amounts of N, P, and pesticides into the basin. Airborne pollutants such as polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and polybrominated diphenyl ethers (PBDEs) are released into the atmosphere from domestic and industrial activities. In addition to C, N, and P pollution in water, metals, PAHs, PCBs, PBDEs, pharmaceuticals, and microplastics are transported to the Sea of Marmara through discharges, rainfall, and dry and wet deposition from the atmosphere (Aydın, 2021).

4.4. Plastic Waste Pollution in Marine Systems

Plastic waste pollution in our seas is an environmental issue that occurs as a result of plastic materials being discarded or transported into marine environments. Plastic waste can enter the seas from various sources, such as the dumping of waste in coastal areas, garbage disposed of from marine vessels or ships, litter carried from coastlines, and plastics transported through rivers. The majority of plastic waste in the oceans remains in marine ecosystems for a long time, causing various negative effects. Plastics can take years to degrade, during which they can be ingested by marine organisms or entangle fish and marine mammals in fishing nets, leading to suffocation. Additionally, plastics that are fragmented by sunlight and wave action can become microplastics, which can be consumed by marine organisms. This situation can progress through the food chain, reaching organisms at the top trophic levels and ultimately impacting humans as well.

Plastic waste pollution not only harms marine ecosystems and biodiversity but also creates visual pollution and negatively affects the tourism sector. Furthermore, the release of chemical substances contained in plastics can have adverse effects on water quality and the health of marine ecosystems. Several measures are being taken to address this issue. Firstly, waste management and recycling systems need to be strengthened to prevent plastic waste from reaching the seas. Steps can be taken to reduce plastic consumption, ban or limit single-use plastics, and replace plastic packaging with recyclable materials. In addition, raising public awareness and conducting educational campaigns are crucial. It is important for individuals to understand the impact of plastic waste on nature and the oceans and to raise awareness about proper waste management practices.

Internationally, there are agreements and initiatives aimed at combating plastic waste pollution. For example, the "Marine Plastic Pollution" program led by the United Nations Environment Programme (UNEP) contributes to collaboration and the development of strategies among countries. Combating plastic waste pollution is an important step towards preserving marine ecosystems and achieving a sustainable environment. It requires the responsibility and adherence to proper waste management practices by every individual and institution.

More than 40% of plastic waste consists of single-use products, and over half of plastic items become waste within three years (Lebreton and Andrady, 2019; Tortell, 2020). If current plastic consumption and waste management systems continue, it is estimated that by 2025, the oceans will receive 6.4 million tons of plastic waste every day (Jambeck et al., 2015). An Australian study cited in WWF's report titled "No Plastic in Nature" revealed that humans ingest 5 grams of plastic per week, equivalent to consuming a credit card's worth of plastic. The ingestion of plastics into the human body occurs primarily through water consumption. According to WWF, the Mediterranean Sea receives 0.57 million tons of plastic waste annually, and this amount is expected to increase further (WWF, 2019). WWF's report titled "Out of the Plastic Trap: Saving the Mediterranean from Plastic Pollution" indicated that Türkiye is the third-highest contributor of plastic waste to the Mediterranean Sea, following Egypt and Italy (Boucher and Bilard, 2020).

Türkiye is surrounded by various seas where economic activities such as industry, fishing, shipping, and tourism take place. The coastal areas of the Mediterranean and Aegean Seas are particularly important for tourism. The success of combating plastic pollution in these areas will not only affect the diversity of marine life and ecosystems but also tourism revenues and the quality of tourists' experiences. In the Black Sea, shipping, fishing activities, and tourism are both sources and sectors affected by plastic pollution. Food and packaging waste, plastic bottles, and cigarette butts are the most commonly found plastic waste in nature, accounting for 70% of plastic waste according to WWF Australia's report titled "Plastic Revolution to Reality." Unfortunately, these wastes are frequently observed along all coastlines of Türkiye. The prevalence of polystyrene and polyethylene plastics in marine environments supports this data, as these materials are commonly used in packaging (UNDP, 2021). As of 2018, the average plastic packaging recycling rate in the EU was 41.5%. In Türkiye, 9.6 million tons of plastic are produced annually, with 2.2 million tons of plastics being released into the market as packaging, and only half a million tons of this packaging being

recycled. According to a study conducted in 2015, Türkiye ranks 14th in the world in terms of mismanaged plastic waste. The low rates of waste collection and deficiencies in waste management further exacerbate the environmental impact of plastic waste. According to a WWF report published in 2018, 144 tons of plastic waste from Türkiye enters the Mediterranean Sea every day. Similar studies have identified significant amounts of plastics reaching the sea in other regions as well (Alessi et al., 2018; Baysal et al., 2020).

Plastics enter the seas through direct or indirect pathways. Direct input is caused by litter left on beaches or plastic products discarded into the sea during fishing or transportation activities. Indirect input, on the other hand, refers to the transportation of plastic waste to the seas through various pathways such as wind or river currents, originating from land-based activities and inadequately managed plastic waste (including littering, pesticide packaging, greenhouse covers, etc.). Research on plastic pollution has found that 80% of plastic waste in the seas is land-based, while only 20% is generated from marine activities (Akdoğan and Güven, 2019). One of the main sources of land-based plastic pollution in Türkiye is the deficiencies in waste management practices. There are still four municipalities in Türkiye that do not provide waste services. In municipalities where waste services are provided, the proportion of the population receiving waste services in those municipalities is 98.8% of the total population. Of the collected waste, 67.2% is subjected to controlled landfilling, 20.2% is disposed of in open dumpsites, and only 12.3% is sent to recycling facilities (TÜİK, 2018). Due to the lack of effective recycling and recovery infrastructure, plastic waste can easily end up in the environment, bypassing the waste management system. Although efforts are being made to prevent uncontrolled dumping and transform open dumpsites into controlled landfill sites, the disposal of waste in open dumpsites (in a manner not compliant with the EU Landfill Directive) continues. Coastal areas, river basins, and hillsides are used as open dumpsites. Some of the plastic waste disposed of in controlled landfill sites also mixes with the environment through rainfall, soil movements, and wind. To prevent this situation, land conditions and prevailing wind directions should be taken into account when selecting sites for controlled landfill areas. Additionally, storage cells opened in controlled landfill sites should be covered with soil daily to prevent potential leaks of plastic waste. Source separation of household waste will both reduce the amount of plastic entering the environment and promote resource and energy conservation. Dual collection systems are in place in EU countries, and steps in this direction are also regulated in Türkiye through the Zero Waste Regulation, Packaging Waste Regulation, and the Environment Agency Law related to

deposit systems. Municipalities need to establish infrastructure for separate waste collection through waste collection centers. However, the deficiencies of municipalities in the separate collection or sorting of packaging waste lead to the leakage of plastic waste into the environment. Moreover, delays in the implementation of the deposit system contribute to the increase in plastic pollution stemming from beverage packaging. Improper disposal of waste in terrestrial areas and coastal regions is one of the most significant factors in the release of plastic waste into the environment. Intentionally leaving, dropping, or wind-blown litter from open waste bins are among the causes of terrestrial pollution. The amount of plastic entering the environment in this way is not yet known in Türkiye, and national-scale studies should be conducted. The increase in plastic consumption along with the increase in consumption overall, combined with weaknesses in waste management system monitoring and implementation, leads to single-use plastic packaging and other disposable products becoming the most common sources of pollution in the seas. Plastic waste is the most commonly encountered waste in coastal areas and beaches in terms of volume (Gönülal et al., 2016; Ertaş, 2021).

This situation applies to both the Mediterranean and the Black Sea, although the sources and types of waste may vary. Along Türkiye's Mediterranean coast, packaging waste, small plastic particles, and single-use products are more prevalent compared to other types of plastic waste (Öztekin et al., 2019). In the Black Sea, packaging waste is predominantly observed, while cigarette butts tend to increase during the summer season. One important problem in our seas is ghost nets. Particularly in the Black Sea, there are large amounts of nets and plastics on the seabed. Globally, ghost nets account for 10% of plastic waste in the seas and are the most lethal type of plastic waste for marine organisms (WWF, 2020). Fishing nets and gear used in fishing and monitoring activities contain a significant amount of plastic, and after they reach the end of their lifespan, fishermen may discard them into the sea. These abandoned nets continue to capture fish and other marine organisms and, being made of plastic, persist in the marine environment for decades without decomposing. According to WWF data, 28% of the plastic waste entering the Mediterranean is derived from fishing (both capture and aquaculture) and shipping activities. Unmanaged plastics harm marine life, the predators that consume them, and ultimately humans. Additionally, plastics dumped into the seas also damage the fishing and tourism sectors. The estimated cost of the damage caused, including the cost of cleaning up such waste, is $13 billion for these industries. Microplastics, which are not visible to the naked eye (less than 5 mm in size), also infiltrate

the environment in large quantities, similar to macroplastics. This infiltration occurs through various pathways such as the use of cosmetic products, improper storage of raw materials, and the wear of vehicle tires and large plastics. These invisible particles harm marine life and smaller organisms that create the conditions necessary for the survival of larger organisms (Baysal et al., 2020). With China's ban on plastic waste imports in 2018, Türkiye's volume of plastic waste imports has been increasing (Tremblay, 2019).

Türkiye is a country that imports a significant amount of plastic waste, especially from Europe. Despite restrictions on the import of unsorted plastics and a reduction in the import quota for packaging waste imposed by the European Union, Türkiye still remains a country that imports waste from abroad. One serious problem that arises is that a portion of the imported packaging waste is not recyclable and is illegally incinerated. According to a report by Greenpeace in 2019, Türkiye's monthly plastic waste imports increased from 4,000 tons in the first quarter of 2016 to 33,000 tons per month in the first quarter of 2018. A large portion of this import came from the United Kingdom (Greenpeace, 2019). According to data compiled from the UN Comtrade platform, this amount reached 225,376 tons in 2019. The Ministry of Environment and Urbanization decided that companies could meet 80% of their plastic waste processing capacity through imported waste from 2019 and the beginning of 2020, and then reduced this percentage to 50%. However, despite this decision, Türkiye's plastic waste imports continue. The Ministry of Environment and Urbanization banned the import of polyethylene, which constitutes a significant portion of plastic waste imports, as of July 2, 2021, with a regulation published in the Official Gazette numbered 31485 on May 18, 2021. However, another regulation published in the Official Gazette numbered 31537 on July 10, 2021, lifted the ban on the import of waste polyethylene.

4.5. Global Climate Change Effects on Marine Systems

Türkiye is a country with rich biodiversity and a strategic location, surrounded by seas such as the Aegean Sea, Mediterranean Sea, Black Sea, and Sea of Marmara . However, these seas are significantly affected by the impacts of climate change. Climate change has various negative effects on the seas. The increase in sea water temperatures has significant impacts on marine ecosystems. Warm water can disrupt food chains and habitats that are vital for marine organisms. Additionally, the increase in ocean acidification can harm coral reefs and weaken the calcium shells of marine organisms.

Climate change also leads to rising sea levels. Increased sea levels can result in coastal erosion, salinization, and flooding in coastal areas (Cheung et al., 2009). Coastal ecosystems are threatened as a result of the rising sea levels. The effects of climate change can be observed in various ways in Türkiye's seas. For example, the temperature rise and sea level increase in the Mediterranean Sea affect agriculture, tourism, and natural life in coastal regions. In the Black Sea, changes in sea water temperature have impacts on fishing and marine ecosystems. Türkiye is taking various steps to combat climate change and protect its seas. These steps include promoting the use of renewable energy sources, establishing marine protected areas, implementing measures to combat coastal erosion, and implementing programs to tackle marine pollution. However, more work and international cooperation are needed in the areas of climate change and the protection of seas. Ensuring the healthy preservation of seas and adapting to the impacts of climate change is of great importance for Türkiye's future sustainability and ecosystem health (TUDAV, 2017).

5. Conclusions and Recommendations

Türkiye, in its journey of development from the past to the future, prioritizes the protection and improvement of the environment in line with its global responsibilities while advancing its country economically and socially. In this context, our country emphasizes its readiness to contribute to a sustainable world since the adoption of the 2030 Agenda for Sustainable Development. Türkiye adopts the approach of integrating Sustainable Development Goals (SDGs) into its Development Plans and sectoral strategies, and implementing and monitoring them in a comprehensive manner. Türkiye, surrounded by seas on three sides, is a country with high biological diversity due to the influence of its diverse ecological characteristics in its seas and inland waters. Therefore, the conservation, development, sustainable use, and effective management of water resources, especially marine resources, are important. In addition to the strategic plans of public institutions related to Development Plans, key policy documents for Sustainable Development Goals (SDGs) include the National Climate Change Strategy Document, Climate Change Adaptation Strategy and Action Plan, Biodiversity Strategy and Action Plan, National Wetlands Strategy, and Türkiye National Marine Research Strategy Document SKA 14.

The components of the main policy framework that overlaps with SKA 14 are as follows:

- Conservation of water quality in coastal and transitional waters

• Expansion of marine and coastal protected areas, strengthening of the conservation system, and effective management

• Ensuring effective stock management through identification, monitoring, and control of fish stocks

• Support for sustainable aquaculture production

• Development of aquaculture practices

• Conservation of genetic resources in aquatic organisms and establishment of gene banks

• Support for research and technology development activities in the field of aquaculture

• Facilitation of market access for producer organizations

• Implementation of science-based and effective resource management in fisheries and strengthening of administrative capacity

• Enhancement of product diversity and branding in aquaculture, considering environmental sustainability, to increase competitiveness in international markets.

Our legislation includes regulations for the protection and prevention of pollution in coastal and marine ecosystems. The Environmental Law and relevant legislation establish principles for preventing the entry of waste originating from land-based and maritime activities into our seas. Principles for the discharge of wastewater and the prevention of water pollution, as well as the monitoring and control procedures for these purposes, are also regulated. In the event of pollution, regulations are in place to ensure maritime safety, protect the sea and its surroundings, and prevent harm to life and property. To conserve fish stocks and economically benefit from fishery resources, our legislation addresses matters related to their acquisition, trade, and utilization. Türkiye evaluates SKA 14 within two main thematic focuses:

i. Prevention of marine pollution and ecosystem conservation, and

ii. Sustainable production of aquatic products and stock management.

Based on the consideration of TÜİK (Turkish Statistical Institute) data, Türkiye's National Voluntary Reviews of the Sustainable Development Goals, and studies on marine pollution, the following activities are recommended:

• In the context of preventing marine pollution and conserving ecosystems, an ecosystem-based integrated management approach should

be adopted, considering both the quality and quantity of water resources. Important steps should be taken in pollution monitoring and prevention, as well as in the identification and conservation of biodiversity.

• In the context of sustainable production of aquatic products and stock management, activities should focus on monitoring stocks, protecting endangered species, and enhancing stocks through restocking efforts. Additionally, important steps such as utilizing information and communication technologies in the aquaculture sector, certifying and monitoring aquaculture facilities, should be taken.

• Maximizing the utilization of aquatic resources from our seas and inland waters, while ensuring a balance between conservation and use based on the principle of sustainability.

• Increasing the contribution of seafood consumption to meeting people's protein needs.

• Enhancing the effectiveness of producer organizations in seafood production and marketing.

• Establishing well-equipped fishing harbors and logistics centers for the benefit of fishermen and aquaculture farmers.

• Ensuring the recording of seafood products obtained from seas and inland waters at the points of landing to facilitate access to accurate, reliable, and up-to-date data.

• Improving the legal framework for the conservation of fish stocks and the development of aquaculture.

• Conducting research in various fields such as Pharmacology and Biomedical Sciences, Marine Bioproducts, Marine Bioenergy, Marine Microbiology, Algal Biotechnology, Biomaterials and Nanobiotechnology, Functionality/Sustainability of Marine Ecosystems, and similar topics in Türkiye's seas. In this regard, activities in marine biotechnology should be encouraged.

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