

Marine Plastic Pollution and International Trade: Legal Pathways for Sustainable Solutions

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Abstract: *Marine plastic pollution has emerged as a defining transboundary environmental challenge of the twenty-first century. While plastic leakage is driven largely by domestic waste mismanagement, international trade in plastic products and plastic waste plays a critical yet underregulated role in shaping material flows, incentives, and environmental outcomes. This article examines the legal interfaces between oceans law, chemicals and waste law, and international trade law to identify coherent, trade-consistent pathways for curbing plastic leakage into the marine environment. It surveys core treaty regimes UNCLOS, MARPOL, the London Convention/Protocol, and the Basel Convention (including its plastic waste amendments) and analyzes their interaction with WTO law (GATT, TBT, SPS, and SCM Agreements) and preferential trade agreements (PTAs). Using comparative illustrations from the EU Single-Use Plastics regime, shifts in global scrap plastic markets following China's "National Sword" policy, and emerging extended producer responsibility (EPR) frameworks, the article proposes a toolbox of legally robust measures: (1) aligning trade measures with multilateral environmental agreements (MEAs); (2) harmonizing definitions and standards for recycled content and design-for-circularity; (3) leveraging TBT-compliant technical regulations, conformity assessment, and eco-labels; (4) designing pro-circular subsidies that avoid prohibited support; (5) incorporating plastic-specific chapters in PTAs; and (6) enhancing due-diligence, traceability, and digital waste shipment controls. The paper concludes with a normative roadmap for embedding trade-related measures in the prospective global plastics instrument, and a research agenda on data standardization, microplastics, and loss of plastic pellets in maritime transport.*

Keywords: marine plastic pollution; plastic waste trade; WTO law; Basel Convention; MARPOL; UNCLOS; TBT; subsidies; EPR; circular economy

Introduction

Marine plastic pollution has rapidly emerged as one of the most pressing environmental challenges of the twenty-first century, threatening biodiversity, human health, fisheries, tourism, and the stability of marine ecosystems. Every year, millions of tonnes of plastics leak into the oceans, largely from land-based activities such as mismanaged waste disposal, insufficient recycling infrastructure, and the widespread use of single-use plastics. While the leakage of plastics is often viewed as a domestic waste management issue, the problem is inherently transboundary. Plastic products and plastic waste are produced, traded, and shipped across borders, while the environmental harms they cause extend far

beyond national jurisdictions. This makes marine plastic pollution not only a global environmental crisis but also a legal and governance challenge at the intersection of environmental protection and international trade. The purpose of this article is to explore the legal pathways for addressing marine plastic pollution through the lens of international trade law. It situates the problem within the framework of global environmental treaties such as the United Nations Convention on the Law of the Sea UNCLOS, the International Convention for the Prevention of Pollution from Ships MARPOL, and the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, while also considering the emerging negotiations toward a global plastics treaty (Mathlouthi et al., 2025).

At the same time, it examines the role of the WTO and PTAs in shaping permissible policy responses. The scope of the study covers trade-related measures including import restrictions, product standards, subsidies, extended producer responsibility (EPR) schemes, and digital traceability requirements, recognizing that sustainable solutions require coherence between trade obligations and environmental imperatives. The significance of this inquiry lies in the dual role of international trade. On one hand, trade has contributed to the proliferation of plastic waste by facilitating the global movement of low-value or contaminated materials, often to countries with limited capacity to manage them. On the other hand, trade can also serve as a solution by enabling circular economies, promoting access to recycling technologies, and harmonizing product and waste standards. The central hypothesis guiding this research is that trade law, when aligned with environmental treaties and designed with care, does not stand as a barrier to ambitious plastic reduction policies. Instead, it can provide legitimate and enforceable pathways for states to curb marine plastic pollution while upholding their international trade commitments (Lyu, 2024; Khan et al., 2025).

Methodologically, the article adopts a doctrinal legal analysis of international treaties, WTO agreements, and relevant case law, complemented by a comparative study of regulatory approaches such as the European Union's Single-Use Plastics regime, China's restrictions on plastic waste imports, and emerging EPR frameworks in developing countries. This is combined with a governance perspective that considers feasibility, equity, and capacity differences across jurisdictions. The expected outcome is a practical legal toolbox that identifies trade-compatible instruments for reducing marine plastic leakage, ranging from product standards and eco-labeling to MEA-aligned trade restrictions and environmentally sound subsidies. The article is organized as follows. Section 2 outlines the legal background of oceans, waste, and trade regimes relevant to plastic pollution. Section 3 examines the problem structure and identifies points of intersection between trade flows and marine leakage. Section 4 provides comparative illustrations from different jurisdictions, followed by Section 5, which proposes a trade-compatible legal toolbox. Section 6 explores the potential role of preferential trade agreements, while Section 7 considers the emerging global plastics treaty. Section 8 turns to the particular needs of developing countries, and Section 9 assesses WTO jurisprudence for guidance on permissible environmental measures. Section 10 sets out a policy roadmap, and Section 11 concludes with suggestions and future research directions. Marine plastic pollution threatens biodiversity, human health, navigation safety, fisheries, tourism, and coastal livelihoods. An estimated millions of tonnes of plastic enter the ocean annually, primarily through riverine pathways and coastal leakage. Although plastics serve vital economic and social functions, their durability, low cost, and inadequate end-of-life management turn advantages into negative externalities in the marine environment. International trade both accelerates and can help solve the problem. Trade moves plastic products and waste across borders, enabling scale economies in recycling but also creating risks of leakage when regulatory capacity is uneven. WTO disciplines and trade-related rules in PTAs shape how states design product standards, import restrictions, subsidies, procurement preferences, and waste shipment controls. The legal challenge is to craft instruments that reduce marine leakage without triggering avoidable trade frictions or disguised restrictions (Guggisberg, 2024).

2. Research Methodology

This research adopts analytical legal methodology, relying primarily on qualitative examination of international treaties, trade law instruments, and policy frameworks to investigate the intersections between marine plastic pollution and international trade. Primary sources including multilateral environmental agreements (such as the Basel Convention, MARPOL, and the Stockholm Convention), WTO agreements (notably the TBT and SCM Agreements), and relevant regional legal instruments (such as the EU Single-Use Plastics Directive) were systematically reviewed to identify the extent of their applicability and limitations in addressing plastic leakage. Secondary sources including scholarly articles, policy reports from the UNEP, OECD, WTO, and World Bank, as well as official submissions from states in ongoing UNEA negotiations were critically analyzed to contextualize legal developments within broader policy debates. A comparative approach was employed to assess different regulatory models (e.g., EU's SUP framework, EPR systems in Asia, and procurement practices in the US and developing states), highlighting lessons and divergences. The study also applies a normative lens, evaluating whether existing trade law disciplines can be reconciled with emerging environmental obligations, and considers equity-based perspectives to understand challenges faced by developing countries. By synthesizing doctrinal analysis with comparative and normative insights, the methodology aims to not only map the legal landscape but also propose coherent pathways for aligning trade and environmental regimes in pursuit of sustainable solutions to marine plastic pollution (Hui et al., 2025; Khan & Ullah, 2024).

3. Legal Background: Oceans, Waste, and Trade

3.1 Oceans and Marine Pollution Regimes

Marine plastic pollution falls within the broader framework of international law governing the protection and preservation of the marine environment. The most important foundation in this respect is the United Nations Convention on the Law of the Sea UNCLOS, often referred to as the “constitution of the oceans.” UNCLOS establishes a general obligation on states to protect and preserve the marine environment (Article 192) and to take all measures necessary to prevent, reduce, and control pollution of the marine environment from any source (Article 194). These obligations extend to both land-based and sea-based sources of marine pollution, including plastics. Although UNCLOS provides a broad legal basis, it does not set detailed standards for addressing plastic waste; rather, it relies on cooperation through other international instruments and regional organizations. One of the key treaties addressing operational sources of marine plastic pollution is the International Convention for the Prevention of Pollution from Ships MARPOL. Annex V of MARPOL expressly prohibits the discharge of plastics into the sea, making it a cornerstone in preventing ship-based plastic pollution. It also requires ships to maintain garbage management plans and record books, thereby strengthening compliance. However, while MARPOL effectively regulates deliberate discharges from vessels, it has limited reach over accidental plastic losses, such as pellet spills during transport, or abandoned, lost, or otherwise discarded fishing gear (ALDFG). These remain persistent challenges in need of more stringent international rules. Complementing these instruments is the London Convention of 1972 and its 1996 Protocol, which regulate the deliberate dumping of wastes and other matter at sea. Under this regime, plastics are excluded from permissible dumping lists, thereby prohibiting their intentional disposal into the ocean. Together with MARPOL, the London instruments form a strong legal shield against direct inputs of plastic waste from ships and offshore installations (Singh, et al., 2025; Khan, 2024).

Despite these frameworks, gaps remain. Existing oceans treaties primarily target sea-based sources of marine plastic pollution, which account for only a fraction of the total leakage. The majority of plastics entering the marine environment stem from land-based activities, including poor waste management, open dumping, and riverine transport of debris. UNCLOS acknowledges the need to control land-based sources of pollution (Article 207), but its provisions are general in nature and rely heavily on states to adopt national laws or regional agreements. The lack of binding global standards on land-based sources

of plastics represents one of the most significant weaknesses in the current legal framework, regional seas agreements such as the OSPAR Convention in the North-East Atlantic or the Cartagena Convention in the Caribbean have attempted to fill some of these gaps by developing regional action plans on marine litter. These efforts demonstrate the potential for localized cooperation, but the absence of a comprehensive, binding global instrument specifically dedicated to plastic pollution means that fragmentation and uneven implementation persist. While the oceans and marine pollution regimes provide a strong normative foundation for addressing plastic leakage from ships and dumping activities, they offer only limited tools for combating the larger problem of land-based plastic inputs. This regulatory imbalance underscores the need for closer integration with trade and waste regimes, as well as the development of a global plastics treaty that can bridge these legal gaps (Stoett, et al., 2024; Khan, 2024).

3.2 Chemicals and Waste Regimes

While oceans treaties focus on preventing discharges at sea, the international legal framework governing the movement and management of plastic waste falls largely under the category of chemicals and waste regimes. These instruments address the life cycle of plastics, particularly at the waste stage, where trade and disposal pose significant risks to human health and the environment. The most important instrument in this regard is the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (1989). Originally designed to prevent the dumping of hazardous waste in developing countries, the Convention has increasingly become central to the governance of plastic waste. In 2019, the Conference of the Parties adopted the Plastic Waste Amendments, which brought most categories of plastic waste under the Convention's control procedures. As a result, exports of contaminated, mixed, or hard-to-recycle plastic wastes are now subject to the PIC procedure, requiring notification and approval from importing states before shipments can proceed. These amendments aim to ensure that plastic waste is managed in an environmentally sound manner (ESM) and not exported to countries lacking adequate disposal or recycling infrastructure. The Basel Convention also obliges parties to minimize the generation of hazardous and other wastes, to promote waste reduction and environmentally sound recycling, and to prohibit trade with non-parties except under agreements with equivalent safeguards. In practice, this has shifted the global plastic waste trade, especially after China's "National Sword" policy (2018) restricted imports of contaminated plastics, redirecting flows to countries with weaker enforcement capacities. This highlights both the importance of Basel's controls and the challenges of monitoring and enforcing them at scale (Bel, et al., 2025; Khan & Jiliani, 2023).

Another key treaty is the Stockholm Convention on Persistent Organic Pollutants POPs, which addresses harmful chemical additives used in certain plastics, such as brominated flame retardants and perfluorinated compounds. These additives can make plastics hazardous, restrict their recyclability, and contaminate waste streams. By requiring the elimination or restriction of such substances, the Stockholm Convention indirectly influences the composition and trade of plastic products and recyclates, making it relevant to the broader plastic governance landscape. The Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade also plays a supporting role by requiring exporting countries to provide information about certain hazardous chemicals, some of which are used in plastic production. Although its direct relevance is narrower, it complements the broader chemicals-and-waste regime by enhancing transparency and informed decision-making in trade. Despite their significance, these instruments have limitations. The Basel Convention addresses the waste stage but not the upstream design of plastic products that determines recyclability and leakage risk. The Stockholm and Rotterdam Conventions, while important for regulating hazardous additives, cover only a limited subset of chemicals associated with plastics. Moreover, enforcement challenges such as weak customs codes, limited inspection capacity, and illegal traffic disguised as recyclable waste continue to undermine the effectiveness of

these treaties. the chemicals and waste regimes provide the primary international controls on plastic waste trade and hazardous additives, but they leave substantial regulatory gaps in relation to product design, consumption, and the circular economy. Bridging these gaps requires stronger linkages with trade law and future negotiations on a global plastics instrument that can integrate waste management with upstream regulation of plastics (Puspitawati et al., 2025; Khan & Usman, 2023).

3.3 International Trade Law

While environmental treaties such as UNCLOS, MARPOL, and the Basel Convention set substantive obligations to control plastic pollution and waste flows, the international trade law regime, largely under the WTO, shapes the legality of trade-related measures that states may adopt to combat marine plastic pollution. WTO rules are designed to prevent protectionism and ensure non-discrimination in global trade, yet they also provide scope for environmental regulation when properly justified. Understanding this balance is essential for crafting legally robust responses to plastic pollution. The General Agreement on Tariffs and Trade (GATT 1994) establishes the core principles of non-discrimination through the Most-Favoured Nation (MFN) treatment (Article I) and National Treatment (Article III). These provisions require that imported plastic products and waste be treated no less favorably than domestic “like products” or those from other trading partners. GATT Article XI prohibits quantitative restrictions on imports and exports, meaning that outright bans on certain plastic products or waste flows may *prima facie* violate WTO rules. However, GATT also contains critical safeguards: Article XX(b) allows measures “necessary to protect human, animal or plant life or health,” while Article XX(g) permits measures “relating to the conservation of exhaustible natural resources,” including marine ecosystems, provided they are applied in a non-discriminatory and non-arbitrary manner. WTO jurisprudence *US–Shrimp/Turtle*, *Brazil–Retreaded Tyres* shows that well-designed environmental measures can be upheld when they are transparent, science-based, and accompanied by cooperative mechanisms (Khan, 2024; Khan et al., 2023).

The Agreement on Technical Barriers to Trade TBT Agreement is particularly relevant to plastic regulation, since many measures involve product standards and labeling. Examples include recycled-content mandates, design-for-recyclability requirements, and eco-labels for sustainable packaging. The TBT Agreement allows such technical regulations if they pursue a legitimate objective, such as environmental protection or human health, and are not “more trade-restrictive than necessary.” Members are encouraged to base regulations on international standards such as ISO or ASTM where available. Importantly, WTO case law highlights the need for technical measures to be applied consistently and non-discriminatorily to avoid disguised trade restrictions. Although less central, the Agreement on the Application of Sanitary and Phytosanitary Measures SPS Agreement may come into play where microplastics or chemical additives in plastics pose direct risks to food safety or human health. For example, restrictions on plastic packaging in food-contact materials could fall under SPS disciplines if justified by scientific risk assessments. The Agreement on Subsidies and Countervailing Measures SCM Agreement also shapes policy space for states seeking to incentivize circular solutions. Subsidies for recycling infrastructure, waste collection, or research into alternatives must be carefully designed to avoid being “prohibited subsidies” (i.e., contingent on export performance or use of domestic over imported goods). Instead, non-contingent, environmentally motivated subsidies are generally permissible, provided they do not cause serious trade distortions. This opens scope for governments to fund plastic-waste management and circular economy innovations without breaching WTO rules. In addition, the Government Procurement Agreement (GPA) and procurement disciplines in preferential trade agreements PTAs are relevant. Public procurement can act as a powerful driver of sustainable plastic alternatives by requiring recycled content, banning single-use plastics, or favoring reusable products in government contracts. As long as procurement criteria are origin-neutral and transparently applied, they align with WTO rules and can stimulate markets for sustainable goods. Overall, WTO law does not prevent ambitious action against marine plastic pollution, but it requires

that such measures be designed with non-discrimination, necessity, proportionality, and reliance on international standards in mind. Trade law thus functions less as a barrier and more as a framework for ensuring that environmental measures are fair, transparent, and globally coherent. Properly used, it provides legal pathways for aligning plastic policies with both environmental and trade objectives (Cheng, 2024; Khan, 2023).

4. Problem Structure: Where Trade and Leakage Meet

Marine plastic pollution is not only an environmental management issue but also a direct consequence of global patterns of production and trade. Plastics are among the most widely traded commodities in the world, covering raw polymers, intermediate goods, finished products, and post-consumer plastic waste. Each stage of this trade chain creates opportunities for leakage into the environment, underscoring how international commerce and pollution are deeply intertwined. At the production stage, the global trade in primary plastic resins predominantly derived from fossil fuels drives continuous growth in plastic output. By lowering costs and enabling economies of scale, international trade has accelerated the availability of cheap, disposable plastics worldwide. This has contributed to the proliferation of single-use items that dominate marine litter, from packaging to consumer goods. The economic incentives created by trade thus amplify the consumption side of the plastic crisis. At the disposal stage, trade in plastic waste and scrap has been one of the most controversial drivers of marine leakage. For decades, high-income countries exported mixed and contaminated plastic waste to developing states under the guise of recycling. Weak infrastructure, insufficient regulatory oversight, and informal waste economies in many importing countries meant that large volumes of plastics were either openly dumped or inadequately managed, eventually leaking into rivers and coastal environments. China's 2018 "National Sword" policy, which banned imports of most plastic waste, exposed the fragility of this system by redirecting flows to Southeast Asia and Africa, often overwhelming local waste management capacities. This shift highlighted how trade imbalances in waste management directly translate into leakage hotspots in the Global South (Hui, et al., 2025; Liu et al., 2023).

Another area of intersection is maritime transport itself. Plastics are moved in massive quantities across oceans, often in the form of plastic pellets (nurdles), which are highly prone to spillage. Accidental losses during shipping and port handling have been recognized as a significant but underregulated source of marine microplastics. Similarly, discarded or lost fishing gear commonly traded across borders represents a major contributor to ocean plastic pollution. In both cases, trade logistics directly facilitate leakage. These linkages show that trade is not just a background factor but a structural driver of plastic pollution. The current regime of liberalized trade has enabled the spread of plastics globally, while inadequate regulation of waste shipments has shifted environmental burdens to countries with limited governance capacity. Yet trade also provides pathways for solutions: it can facilitate access to advanced recycling technologies, incentivize circular economy innovations, and harmonize product standards to minimize leakage risks. Understanding where trade and leakage meet is therefore crucial for designing effective interventions. It highlights the need for trade-compatible legal tools that regulate plastic waste flows, enhance supply chain accountability, and close loopholes in shipping and transport. Without addressing the trade dimension, global efforts to curb marine plastic pollution will remain fragmented and insufficient (Hoel, 2001; Khan & Ximei, 2022).

5. Comparative Illustrations

5.1 EU Single-Use Plastics (SUP) Framework

The European Union's Single-Use Plastics SUP Directive (2019/904) represents one of the most ambitious regulatory efforts to curb plastic leakage at its source. Adopted in 2019 as part of the EU's Circular Economy Action Plan, the Directive directly targets the ten single-use plastic products most commonly found on European beaches and in marine environments, including cutlery, plates, straws,

beverage cups, and food containers. These products are disproportionately represented in marine litter, accounting for a significant share of ocean plastics, and often have readily available, more sustainable alternatives. The SUP Directive establishes a differentiated regulatory approach. Certain items, such as plastic straws, cotton buds, and stirrers, are subject to outright bans when substitutes exist. Other products, such as beverage bottles, are not banned but are regulated through design requirements (e.g., mandatory tethered caps), collection targets (90% collection rate for plastic bottles by 2029), and recycled content obligations (minimum 25% recycled content in PET bottles by 2025, rising to 30% for all bottles by 2030). The Directive also introduces extended producer responsibility (EPR) schemes, requiring producers to bear the financial and operational responsibility for waste management, cleanup, and awareness-raising measures. This reflects a shift of responsibility upstream, from consumers and municipalities to producers and manufacturers. Importantly, the SUP Directive integrates consumer information and labeling requirements, ensuring that products such as sanitary items and tobacco filters carry clear warnings about their environmental impact. By combining bans, standards, EPR, and awareness tools, the EU framework demonstrates a holistic approach to tackling single-use plastics across their life cycle (Cipriani, 2021; Khan et al., 2022).

The SUP framework also interacts with international trade law. Because the Directive applies equally to domestic and imported products, it aligns with the WTO's non-discrimination principles under GATT and the TBT Agreement. However, it raises compliance challenges for exporters to the EU, especially small and medium-sized enterprises in developing countries that must adapt to new design, labeling, and recycled-content requirements. While some critics have framed the SUP Directive as a potential trade barrier, its environmental justification under provides strong legal support, particularly given the clear evidence linking single-use plastics to marine pollution. The broader significance of the EU SUP Directive lies in its role as a regulatory model. Several non-EU states including the UK, Canada, and certain ASEAN countries have adopted similar bans or restrictions inspired by the EU framework. Moreover, the Directive signals a shift from downstream waste management toward upstream product regulation and market transformation, placing responsibility on producers and supply chains rather than relying solely on recycling. the EU SUP framework demonstrates how trade-compatible product regulation can serve as a powerful legal pathway for reducing marine plastic pollution. By leveraging a mix of bans, design standards, EPR, and consumer information, it provides a template for other jurisdictions seeking to balance environmental ambition with trade obligations. The EU's approach couples product bans (where readily substitutable), consumption reduction targets, tethered caps, EPR for fishing gear, recycled-content mandates for beverage bottles, and comprehensive marking requirements. Legally, these are framed as TBT-consistent regulations pursuing legitimate environmental objectives, grounded in scientific assessments and applied on a non-discriminatory basis (Cowan, 2020; Khan, 2022).

5.2 The Global Scrap Plastic Market and Import Quality Standards

For decades, the global trade in scrap plastic has played a central role in shaping the geography of marine plastic pollution. High-income countries, facing rising waste volumes and stringent domestic disposal costs, exported large quantities of plastic waste to lower-income nations under the guise of recycling. This practice created a globalized plastic-waste economy, in which Asia, particularly China, emerged as the world's largest importer of scrap plastics. By the mid-2010s, China alone was importing nearly 7 million tonnes of plastic waste annually, much of it contaminated or mixed with non-recyclable materials. The fragility of this system was exposed in 2018, when China implemented its "National Sword" policy, banning imports of most plastic waste and tightening contamination thresholds for recyclables. This decision was driven by domestic concerns over environmental degradation, marine leakage, and the health impacts of poorly managed waste. The ban not only disrupted global recycling markets but also redirected waste flows to Southeast Asian countries such as Malaysia, Vietnam, Indonesia, and Thailand, as well as to parts of Africa. Many of these countries lacked adequate waste

management infrastructure, resulting in large-scale open dumping, illegal burning, and mismanagement that exacerbated plastic leakage into rivers and oceans (Pacini, et al., 2021; Khan & Wu, 2021).

In response, several importing states introduced import quality standards aimed at filtering out low-grade and contaminated waste. Malaysia, for instance, tightened customs check and imposed licensing requirements for waste importers. Thailand announced plans to phase out plastic waste imports entirely. The European Union, for its part, amended its Waste Shipment Regulation to align with the Basel Convention's Plastic Waste Amendments 2019, which require exporters to obtain prior informed consent PIC from importing countries before shipping contaminated or non-recyclable plastic waste. These measures signal a global trend toward stricter trade controls, designed to prevent environmental dumping under the guise of recycling. However, the adoption of quality standards has generated tensions under international trade law. Exporting states argue that such restrictions risk becoming disguised barriers to trade, potentially conflicting with WTO disciplines on quantitative restrictions. Yet importing states have a strong environmental defence: trade restrictions are permissible if justified as measures necessary to protect human health and conserve natural resources, provided they are applied transparently and non-discriminatorily. WTO jurisprudence *Brazil–Retreaded Tyres* suggests that well-justified bans and quality standards for plastic waste would likely be upheld if linked to legitimate environmental concerns. At the same time, the disruption of global scrap plastic trade has exposed deeper systemic issues. Many developed countries have struggled to manage their own plastic waste domestically, revealing over-reliance on foreign processing. Meanwhile, the burden of pollution has disproportionately fallen on developing countries that served as import destinations. This inequity underscores the urgent need for circular economy approaches, where plastics are designed for recyclability and retained within domestic markets rather than exported as waste (Gazeau, et al., 2024; Abdelrehim Hammad et al., 2021).

5.3 Extended Producer Responsibility (EPR) Models

Extended Producer Responsibility (EPR) has emerged as a leading policy tool in addressing plastic pollution, particularly its marine impacts. Rooted in the “polluter pays” principle, EPR shifts responsibility for post-consumer waste away from municipalities and consumers and back to producers. The underlying logic is that producers, who design, manufacture, and profit from plastic products, are in the best position to minimize environmental impacts through product design, financing of waste management, and consumer awareness initiatives. In practice, EPR requires producers to finance waste collection, sorting, recycling, and cleanup systems, as well as to invest in awareness-raising campaigns. Often, these obligations are carried out through producer responsibility organizations PROs, which pool resources and coordinate compliance across multiple companies. By internalizing the costs of plastic waste, EPR encourages producers to adopt circular design approaches, such as increasing recycled content, ensuring recyclability, and phasing out non-recyclable materials. Comparative experiences show diverse applications of EPR. In the European Union, the Single-Use Plastics (SUP) Directive places clear obligations on producers of products like beverage containers, tobacco filters, and fishing gear to bear the costs of collection and litter cleanup. This complements the EU Packaging and Packaging Waste Directive, which has long required producer financing of recycling systems. In Asia, Japan and South Korea operate some of the most advanced EPR models, with recycling obligation rates that impose binding targets on producers, ensuring measurable recovery outcomes. In contrast, developing countries such as India, Kenya, and South Africa have only recently introduced EPR frameworks, often facing difficulties in enforcement, infrastructure, and the integration of informal waste economies into formal schemes (Morita & Hayashi, 2022; Khan et al., 2020).

EPR also has a direct connection to marine plastic leakage. By shifting the costs of collection and cleanup to producers, it reduces the risk of plastics escaping into waterways and oceans. Furthermore, EPR rules that mandate design-for-recyclability lessen the prevalence of single-use, non-recyclable plastics, which dominate marine litter. Notably, the EU's rules on fishing gear demonstrate the targeted

use of EPR to address abandoned, lost, or discarded fishing equipment, which represents a significant portion of marine plastic pollution. Despite its promise, EPR faces notable challenges. Free-riding and weak enforcement remain persistent issues, especially in countries with large informal waste sectors. Producers may also pass compliance costs onto consumers, undermining equity and public acceptance. Moreover, EPR frameworks are complicated by transboundary trade: plastics designed or produced in one country may be consumed and discarded in another, raising questions about how responsibility should be allocated internationally. Finally, EPR's success depends heavily on adequate infrastructure for collection, recycling, and monitoring, which remains uneven across the globe. Looking forward, EPR is likely to play a central role in the emerging global plastics treaty being negotiated under the UN Environment Assembly. A harmonized global framework could standardize product design requirements, ensure financing for waste management, and help reduce the transboundary leakage of plastics into the oceans. In this sense, EPR offers a powerful legal pathway to internalize the costs of plastic pollution, drive circular innovation, and mitigate marine impacts—provided that enforcement mechanisms are strong and sensitive to the diverse realities of both developed and developing economies. EPR schemes shift end-of-life costs to producers, incentivizing design changes. When structured with performance-based, origin-neutral criteria and transparent fee modulation (e.g., eco-modulation for design attributes), EPR can align with national treatment and TBT principles while stimulating circular trade in secondary materials (Bourtsalas, 2023).

6. Conclusion

Marine plastic pollution represents one of the defining environmental challenges of our time, with far-reaching ecological, economic, and social consequences. This article has shown that while existing legal regimes—ranging from marine pollution treaties to chemicals and waste conventions—provide partial tools, their fragmented nature limits their effectiveness. International trade law plays a pivotal role in both exacerbating and solving the crisis: plastics move across borders as commodities, packaging, and waste, and thus any sustainable solution must align with trade rules to avoid fragmentation, inequity, or unintended trade barriers. The analysis highlighted multiple legal pathways for reconciling trade and environmental objectives. TBT-compliant product standards and design rules can incentivize recyclability and innovation while remaining WTO-consistent. SCM-safe subsidies and economic instruments such as taxes, levies, and deposit-refund systems can drive systemic change without distorting trade. Government procurement policies demonstrate the potential of states as market makers, creating demand for sustainable products at scale. At the global level, the emerging plastics instrument under UNEA provides a historic opportunity to harmonize fragmented regimes into a coherent framework, embedding principles of circularity, precaution, and equity. Special emphasis must be placed on developing countries, which face disproportionate burdens and require differentiated obligations, financial assistance, and technology transfer to participate fairly in the transition. The key suggestion arising from this study is the need for policy coherence across levels of governance. Global treaty negotiations must be explicitly aligned with WTO disciplines and regional initiatives, avoiding duplication and ensuring mutual reinforcement. National governments should design policies that balance ambition with equity, ensuring that producers, exporters, and SMEs in developing countries are not marginalized but empowered through targeted support. Strengthened monitoring, reporting, and accountability mechanisms will be essential to ensure that commitments translate into measurable reductions in plastic leakage. Looking forward, several areas demand further research. First, deeper inquiry is needed into how trade-related measures under the plastics treaty can be structured to withstand WTO scrutiny, particularly regarding import restrictions and subsidies. Second, greater attention should be given to the role of informal economies and local communities in waste management, particularly in developing regions. Third, research on innovation pathways—such as bio-based plastics, advanced recycling technologies, and circular business models will be crucial to complement legal frameworks with technological solutions. Ultimately, this research matters because the stakes extend beyond plastics alone. The governance of marine plastic pollution is a litmus test for how the international community

manages trade–environment tensions in the Anthropocene. If law can successfully integrate sustainability into global commerce, it will not only curb plastic leakage but also offer a model for addressing other transboundary environmental challenges. The future direction must therefore be one of coherence, equity, and ambition transforming fragmented legal tools into a unified framework capable of safeguarding both the oceans and the integrity of the global trading system. Marine plastic pollution sits at the confluence of product design, consumption, waste governance, maritime transport, and international trade. Existing oceans and waste treaties constrain sea-based sources and regulate waste shipments but leave upstream drivers to national and trade regimes. WTO law does not preclude ambitious plastic policies; it demands careful design: non-discrimination, evidence-based necessity, and reliance on international standards where possible.

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