

Navigating the Green Frontier: The Evolving Role of the WTO in Environmental Protection and Sustainable Development

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The accelerating convergence between global trade and environmental governance has placed the World Trade Organization at the center of a fundamental policy transformation. This study examines how the WTO's legal and institutional frameworks have responded to emerging environmental imperatives, focusing on dispute settlement jurisprudence, committee deliberations, and the evolution of sustainability-related rules. Through qualitative doctrinal analysis, the research evaluates landmark cases such as US–Shrimp, EC–Asbestos, and the EU–Indonesia biofuels dispute to trace the gradual expansion of interpretive space for environmental measures. The findings reveal that adjudicators have played a pivotal role in shaping environmental jurisprudence in the absence of negotiated consensus, while institutional debates within the Committee on Trade and Environment highlight the growing salience of climate-related regulations, eco-labeling, and supply-chain due diligence. The study also assesses the implications of the Fisheries Subsidies Agreement as the first environmental-centered multilateral rule adopted by the WTO, illustrating both the organization's potential for reform and the political constraints that continue to impede progress. Broader trends—including the proliferation of unilateral climate measures, rising sustainability notifications, and increasing linguistic references to environmental objectives within WTO texts—demonstrate a systemic shift toward integrating sustainability into trade governance. Yet persistent tensions remain, including concerns over green protectionism, developmental equity, and the compatibility of domestic environmental regulations with nondiscrimination disciplines. The analysis concludes that the WTO stands at a critical juncture: it must adapt to evolving environmental priorities or risk fragmentation as major economies pursue unilateral regulatory pathways. Strengthening interpretive frameworks, enhancing cooperation with environmental regimes, and restoring the dispute settlement mechanism are essential steps for ensuring the WTO's relevance in a sustainable global economy.

Keywords: *WTO; environmental protection; sustainable development; dispute settlement; CBAM; EUDR; fisheries subsidies; trade–environment interface; unilateral climate measures; green protectionism*

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1. Introduction

The establishment of the World Trade Organization marked a decisive shift toward rules-based multilateralism, built around the principles of non-discrimination, market access, and the progressive

reduction of trade barriers. Yet even at its founding, the organization acknowledged that trade liberalization could not be pursued in isolation from environmental and social objectives, a recognition reflected in the Preamble of the Marrakesh Agreement and echoed in early analyses that emphasized the need to bridge the



trade–environment divide (Esty, 2001). Despite this normative acknowledgement, the institutional practice that followed was shaped far more strongly by doctrines of economic efficiency and the legal architecture of market access commitments, creating an early perception that environmental measures were peripheral or potentially incompatible with WTO law. Scholars examining the foundational years of the organization noted that sustainable development, although explicitly referenced, functioned more as a rhetorical aspiration than a guiding operational principle (Barral, 2012). This tension between normative ambition and institutional practice continues to define contemporary debates on whether the WTO can respond effectively to accelerating global ecological challenges.

The escalation of environmental degradation places unprecedented pressure on the multilateral trading system to internalize sustainability considerations. Climate change, biodiversity loss, and pollution have intensified to levels that threaten ecological stability, economic development, and global security, prompting international bodies to call for integrated policy responses that recognize the interconnectedness of trade and environmental governance (United, 2015). The growing awareness that global value chains amplify resource extraction, carbon emissions, and ecosystem disruption underscores the need for regulatory coherence between trade disciplines and environmental protection efforts (Sands, 2000). Recent assessments by UNCTAD reinforce this shift by demonstrating how the expansion of global trade networks shapes environmental vulnerabilities and contributes to patterns of unsustainable production and consumption (United Nations Conference on & Development, 2023). The contemporary economy is thus embedded in a planetary context where cross-border flows of goods, services, and investment necessarily influence environmental outcomes, whether through direct ecological footprints or the regulatory incentives embedded in trade agreements.

As trade flows expanded rapidly in the early twenty-first century, concerns emerged regarding the environmental consequences of industrial growth triggered by market liberalization. Empirical evidence from major economies illustrates these dynamics. Studies of China's industrial sectors reveal how accelerated production in the aftermath of WTO accession contributed to rising

emissions across energy-intensive industries, linking trade openness with expanding carbon footprints (Song et al., 2025). Similar analyses of international carbon markets and emission trading frameworks highlight how the liberalization of global economic activity shapes environmental trajectories by influencing investment patterns and technological choices (Chen & Kim, 2024). These findings reinforce the broader academic consensus that trade and sustainability cannot be treated as separate policy spheres, as the environmental externalities associated with global value chains directly influence the capacity of states to meet their climate and biodiversity objectives.

The early jurisprudence of the WTO reflected significant skepticism toward environmental measures that imposed trade-restrictive effects. Disputes such as those concerning asbestos or shrimp products exposed the difficulties of reconciling domestic environmental regulations with core obligations under the General Agreement on Tariffs and Trade, particularly in relation to non-discrimination and the treatment of process-based distinctions (Palmer & Werksman, 2001; Perkins, 1999). Analysts observing this era argued that the dispute settlement system tended to frame environmental policies as exceptions rather than integral components of the trade regime, thereby reinforcing a structural bias toward liberalization (Marceau & Wyatt, 2009). Over time, however, jurisprudence began to evolve in a direction more receptive to environmental justifications, recognizing the legitimacy of certain kinds of public-interest regulations and acknowledging that sustainable development forms part of the interpretive context for WTO agreements (Lydgate, 2012). This gradual shift reflected an increased willingness to examine the environmental purpose of regulatory measures and to evaluate them through a broader lens than strict market access commitments alone.

This juridical evolution coincides with profound transformations in global regulatory landscapes. As climate risks intensify, major economies have begun designing unilateral environmental trade measures aimed at reducing carbon leakage, promoting sustainable supply chains, and aligning domestic climate goals with trade policy. The European Union's Carbon Border Adjustment Mechanism represents a prominent example. Legal assessments of the measure highlight

ongoing debates regarding its compatibility with WTO rules, particularly concerning the interpretation of non-discrimination obligations, the structure of exemptions, and its potential developmental implications (Sambhav, 2024; Sharma, 2024). Analyses of the transitional phase of the CBAM reveal early impacts on trade patterns and offer insights into how border adjustments may reshape global value chains in energy-intensive and trade-exposed sectors (Cornago & Berg, 2024). Moreover, scholarly commentary suggests that the legal architecture of the CBAM draws heavily on evolving jurisprudence surrounding environmental exceptions, even as its design continues to generate complex questions about fairness and proportionality (Durel, 2024). In parallel, the EU's Deforestation Regulation introduces new obligations on operators and traders that go beyond carbon leakage concerns and into supply-chain governance, provoking examinations of its WTO compatibility and potential extraterritorial effects (Brack, 2024; Capuzzi, 2024). Together, CBAM and EUDR signal a decisive shift toward trade instruments that embed environmental objectives at their core, challenging the WTO to determine how such regulations can coexist with longstanding commitments to nondiscrimination and market access.

These developments have spurred renewed debates on whether the WTO's existing legal and institutional frameworks are sufficiently adaptable to address twenty-first-century environmental imperatives. Scholars examining the systemic implications of European Green Deal measures argue that the coherence between EU trade policy and WTO law is likely to depend on developing more explicit principles guiding the relationship between environmental protection and trade liberalization (Kalimo et al., 2024). Others contend that the fragmentation of global climate governance and the proliferation of unilateral environmental measures risk exacerbating tensions within the WTO unless the organization undertakes substantive reforms that integrate sustainability into its core mandate (Viñuales, 2024). Analyses of technical barriers to trade in contemporary regional agreements demonstrate how new regulatory models increasingly incorporate environmental considerations, suggesting a broader shift in international trade law that the WTO must eventually reconcile with its existing disciplines (Romanchyshyna, 2023). The growing body of literature

on the evolving trade–environment nexus thus underscores that policy coherence is no longer a theoretical aspiration but a practical necessity for the stability of the multilateral trading system.

The significance of this study emerges from the confluence of these developments. The expansion of global trade has undeniably contributed to economic growth, yet it has also generated environmental pressures that existing WTO rules were not originally designed to address. The rise of new environmental trade measures, from carbon adjustments to supply-chain due diligence regimes, presents both challenges and opportunities for the multilateral trading system. If the WTO can adapt by interpreting its rules in ways that reflect contemporary sustainability imperatives or by facilitating negotiated outcomes that integrate environmental objectives, it may reinforce its relevance in global governance. If it cannot, there is growing concern that unilateral or plurilateral initiatives may increasingly bypass the organization, fragmenting the global trading order.

Against this backdrop, the aim of this study is to examine how the WTO's role in environmental protection and sustainable development is evolving in response to these emerging regulatory and jurisprudential dynamics.

2. Conceptual and Theoretical Foundations: The Trade–Environment Interface

The conceptual foundations of the trade–environment interface have long been shaped by a fundamental tension between the normative commitments of the multilateral trading system and the ecological imperatives embedded in modern environmental governance. At the heart of this tension lies a clash between the free-trade orthodoxy that animated the early development of the General Agreement on Tariffs and Trade and the broader need to protect the planet's ecological systems. Analysts argue that the traditional trade paradigm prioritizes allocative efficiency, market access, and nondiscrimination, often viewing regulatory measures that restrict trade as distortions requiring justification under narrowly drafted exceptions (Mavroidis, 2022). This orientation sits uneasily alongside contemporary environmental obligations, which frequently demand proactive interventions, differentiated responsibilities, and precautionary responses to ecological risk. Early work in this field

emphasized how the separation of trade and environmental regimes generated jurisdictional fragmentation and conceptual misunderstandings, ultimately limiting the capacity of the global trading system to respond to environmental degradation (Esty, 2001). The evolution of sustainable development as an organizing principle attempted to bridge these paradigms by asserting that economic development, environmental protection, and social welfare must be integrated, yet debates on how to operationalize this integration within WTO law remain contentious and unresolved (Barral, 2012).

The doctrine of sustainable development emerged as a potential reconciling framework precisely because it challenges a rigid dichotomy between economic growth and environmental protection. Work within international environmental law and global economic governance has emphasized that trade rules must be interpreted in light of broader developmental and ecological objectives articulated through international instruments such as the Rio Declaration and the 2030 Agenda for Sustainable Development (United, 2015). However, integrating sustainable development into WTO law requires more than rhetorical commitment—it demands interpretive, procedural, and institutional adjustments. Scholars observing the operation of WTO adjudication note that while panels and the Appellate Body reference sustainable development as part of the context for treaty interpretation, these references rarely produce concrete doctrinal shifts capable of aligning trade obligations with environmental goals (Lydgate, 2012). This gap between symbolic recognition and substantive implementation remains a central conceptual challenge in the trade–environment interface.

Competing academic perspectives provide important insight into why trade and environmental obligations continue to collide in practice. Legal scholars assessing the WTO's dispute settlement system argue that doctrinal constraints, particularly the structure of Articles I, III, and XX of the GATT, limit the ability of adjudicators to accommodate environmental measures without stretching interpretive boundaries (Marceau & Wyatt, 2009). Others highlight how the technical design of trade rules privileges product-based distinctions and disfavors non-product-related process and production methods (PPMs), even though many environmental

harms arise from production processes rather than physical product characteristics (Pavoni, 2010). The difficulty of integrating PPM-based measures into WTO law without violating nondiscrimination obligations has become one of the central theoretical disputes in this field, prompting extensive debate on whether WTO jurisprudence can evolve sufficiently to accommodate environmental concerns without generating legal uncertainty. Additional perspectives from scholars examining the governance of the WTO's Committee on Trade and Environment show how political sensitivities surrounding environmental regulations, particularly those adopted by developed economies, shape institutional reluctance to embed firm sustainability obligations within the multilateral trading system (Teehankee, 2020).

Institutional perspectives from global bodies such as UNEP, the World Bank, and UNCTAD reinforce the argument that trade and environmental policymaking must be mutually supportive to achieve long-term sustainability. UNCTAD's recent assessments demonstrate how global value chains create environmental externalities that transcend national borders, requiring governance models that integrate trade policy with environmental management (United Nations Conference on & Development, 2023). UNEP similarly emphasizes that the global transition to a low-carbon economy depends on trade disciplines that encourage the dissemination of green technologies, sustainable supply-chain practices, and low-emission production patterns. The World Bank's analyses underscore the importance of aligning trade incentives with climate commitments in order to prevent carbon leakage and ensure that environmental standards do not exacerbate inequality between developing and developed countries. Collectively, these institutional insights highlight the structural limitations of a trade regime that was designed before climate change, biodiversity decline, and planetary boundaries became defining features of international policy.

A key conceptual tension emerging from contemporary scholarship concerns the distinction between environmental necessity and green protectionism. On one hand, measures such as carbon border adjustments, supply-chain due diligence obligations, and deforestation-related import restrictions may be justified as essential tools for preventing environmental

harm, reducing leakage, and supporting global climate objectives (Sharma, 2024). On the other hand, critics warn that such measures risk functioning as disguised restrictions on trade, creating asymmetrical burdens on developing countries whose export competitiveness depends on cost structures shaped by historical inequities in global production systems (Sabyrbekov & Overland, 2024). Analyses of the EU's CBAM illustrate this tension vividly, as commentators point out that while its design aims to advance climate objectives, it may also reinforce discriminatory treatment depending on how benchmarks, exemptions, and transitional mechanisms are applied (Lunenborg & Naidu, 2024). Similar concerns arise in relation to the European Union's Deforestation Regulation, whose extraterritorial reach has prompted debates on whether supply-chain due diligence systems can coexist with the non-discrimination principles at the core of WTO law (Brack, 2024; Capuzzi, 2024). These debates illuminate a broader theoretical dilemma: measures that are environmentally necessary from a climate governance perspective may appear protectionist when viewed through the doctrinal lens of trade law.

The principle of mutual supportiveness has become one of the most influential conceptual tools for addressing the trade–environment relationship. This principle suggests that trade and environmental regimes should be interpreted in a manner that allows them to reinforce rather than undermine one another, offering a pathway for integrating environmental objectives into trade governance without displacing the foundational norms of the WTO (Pavoni, 2010). Scholars evaluating the operation of mutual supportiveness argue that it provides a normative basis for reading trade agreements in harmony with multilateral environmental agreements and emerging climate policies. Yet despite its theoretical appeal, mutual supportiveness has rarely translated into concrete legal rules or institutional mechanisms, leaving its operational relevance largely aspirational.

A related analytical approach centers on balancing—the idea that adjudicators should weigh competing economic and environmental interests when interpreting WTO provisions. Work in this field demonstrates that while balancing has appeared implicitly in some dispute settlement decisions, it remains constrained by textual limitations and the reluctance of adjudicators to introduce methodologies that could be perceived as

judicial lawmaking (Marceau & Morosini, 2013). The balancing approach thus occupies a conceptual space within scholarly discourse but lacks systematic implementation within the WTO's legal structure.

Another conceptual tool employed by both scholars and adjudicators is evolutionary interpretation, the method by which treaty terms are interpreted in light of changing circumstances, new scientific knowledge, and contemporary policy priorities. Evolutionary interpretation has appeared in environmental disputes such as those concerning species protection and health-related risks, offering a mechanism for updating the meaning of treaty language without formal amendment. Analysts of WTO jurisprudence observe that evolutionary interpretation holds significant promise for strengthening the environmental dimensions of trade law, yet its use remains inconsistent and often contested by member states concerned about the expansion of judicial authority (Kalimo et al., 2024).

The persistence of the implementation gap—the disconnect between theoretical compatibility and practical inaction—remains one of the most significant conceptual obstacles in the trade–environment interface. Despite abundant scholarship demonstrating that WTO law can accommodate environmental protection through interpretive tools such as mutual supportiveness and evolutionary reasoning, the institution has struggled to transform these ideas into operational norms. Commentators attribute this gap to structural features of the WTO, including its member-driven nature, the political sensitivities surrounding environmental regulations, and the rigid doctrinal architecture governing nondiscrimination and exceptions (Mavroidis & Neven, 2019). Others point to the absence of clear procedural channels for integrating environmental expertise into trade negotiations and dispute settlement, which limits the organization's ability to respond effectively to environmental concerns raised by scientific bodies and international environmental agreements (Cooreman, 2016). The implementation gap is further exacerbated by the growing role of unilateral environmental trade measures, which test the capacity of WTO law to distinguish between legitimate environmental policies and disguised restrictions on trade (Marín Durán, 2023). As these measures proliferate, the conceptual inadequacies of the existing system become more

pronounced, revealing the need for a theoretical framework that moves beyond the binary of trade liberalization versus environmental protection.

Theoretical contributions from scholars studying the interactional evolution of trade and climate measures suggest that the WTO must develop more explicit methodologies for assessing the environmental purpose and proportionality of regulatory measures (Durel, 2024). Analyses of structured sustainability discussions within the organization show that members increasingly recognize the necessity of updating trade principles to reflect environmental priorities, even though consensus remains elusive (del Álamo, 2024). Others argue that the future of the trade–environment nexus depends on strengthening institutional linkages between the WTO and climate-oriented legal regimes, particularly as environmental disputes grow more complex and technologically driven (Chien et al., 2024; Cima & Esty, 2024). These perspectives contribute to a broader theoretical understanding that the evolution of trade law must be dynamic, interdisciplinary, and responsive to the ecological realities of the twenty-first century.

Taken together, these conceptual debates illustrate that the trade–environment interface is not defined by a single theoretical conflict but by a constellation of overlapping tensions that shape how trade rules interact with environmental obligations. The competing paradigms of free trade and ecological protection, the ambiguous operationalization of sustainable development, the doctrinal challenges of integrating PPM-based measures, the risk of green protectionism, and the limitations of existing interpretive tools collectively form the intellectual foundation for analyzing the WTO's evolving role in environmental governance. These theoretical perspectives provide the necessary scaffolding for examining the doctrinal, jurisprudential, and institutional developments that underpin contemporary efforts to reconcile global trade with sustainable development in the sections that follow.

3. Empirical and Doctrinal Analysis: The WTO's Emerging Environmental Jurisprudence

The evolution of the WTO's environmental jurisprudence can be understood most clearly through the cumulative impact of key disputes that have shaped the legal contours of the trade–environment relationship. Among the earliest and most influential

cases is United States–Import Prohibition of Certain Shrimp and Shrimp Products, which marked a turning point in how the organization evaluated environmental measures with extraterritorial implications. The dispute forced adjudicators to consider whether a trade restriction grounded in environmental conservation could be justified under Article XX, and whether the application of this restriction satisfied the Chapeau's requirements of non-arbitrariness and non-discrimination. By recognizing that environmental measures aimed at protecting endangered species might satisfy the conditions of Article XX(g), the Appellate Body departed from earlier interpretations that had been far more skeptical of PPM-based distinctions (Perkins, 1999). The decision also signaled an emerging willingness to integrate environmental considerations into the legal analysis, provided that the measure's design and application met procedural fairness standards such as transparency and flexibility. Scholars analyzing the implications of the Shrimp–Turtle decision have emphasized how it introduced the possibility of reconciling environmental protection with trade obligations without fundamentally disrupting the architecture of the GATT (Sands, 2000).

A similar expansion of normative space occurred in European Communities–Asbestos, where the WTO adjudicatory bodies confronted a measure designed to protect public health and the environment from carcinogenic materials. A central issue in the case concerned the interpretation of “likeness” under Article III:4 and whether products could be deemed unlike on the basis of health risks rather than physical characteristics alone. The Appellate Body ultimately recognized that health and environmental risks could influence consumer preferences and thus factor into the likeness assessment, thereby legitimizing regulatory distinctions grounded in non-economic values (Palmer & Werksman, 2001). This decision reinforced the notion that WTO law can accommodate protective measures aimed at non-commercial objectives and that the rigid application of market-based tests must be tempered by consideration of broader societal concerns. For many analysts, EC–Asbestos demonstrated the system's capacity for doctrinal flexibility and its ability to integrate scientific evidence into legal reasoning in a manner supportive of environmental protection (Marceau & Morosini, 2013). Together, these early

disputes established legal pathways through which environmental considerations could be recognized, even if such pathways required careful navigation to avoid conflict with core nondiscrimination rules.

More recent disputes reflect the increasing complexity of environmental measures and the sophistication of legal arguments surrounding them. The panel report in *European Union–Certain Measures Concerning Palm Oil and Oil Palm Crop-Based Biofuels* (DS593) offers significant insight into how environmental justifications intersect with concerns regarding discrimination and regulatory design. The dispute examined whether the EU's renewable energy criteria, which imposed restrictions on palm-oil-based biofuels due to deforestation concerns, violated WTO obligations. The panel's analysis highlighted the difficulty of balancing environmental objectives with the principle of equal competitive conditions, particularly when regulatory distinctions target production processes rather than product characteristics (World Trade, 2025). Observers note that DS593 reflects a growing judicial willingness to scrutinize the proportionality and coherence of environmental measures, assessing whether they genuinely advance ecological objectives or risk functioning as disguised forms of discrimination (Brack, 2024). This case illustrates how environmental jurisprudence continues to evolve in response to contemporary regulatory practices centered on climate mitigation and sustainable supply chains.

The cumulative trajectory of these disputes demonstrates that WTO adjudicators have become central actors in defining the boundaries of legitimate environmental regulation. Scholars examining the history of WTO negotiations emphasize that the organization has struggled to produce new rules addressing sustainability due to deep political divisions among members (Fergusson, 2008). As a result, dispute settlement has functioned as a *de facto* lawmaking mechanism, gradually shaping the contours of permissible environmental policy in the absence of negotiated consensus (Mavroidis & Neven, 2019). The prominence of climate-related and sustainability-oriented disputes in recent years further reinforces the idea that judicial interpretation, rather than new treaty-making, has been the primary driver of environmental evolution within the WTO system.

Beyond adjudication, institutional dynamics within WTO committees also reveal significant shifts in how environmental concerns are framed and discussed. The Committee on Trade and Environment (CTE) has become a focal point for debates on eco-labeling, sustainable production systems, and the compatibility of emerging climate policies—such as the EU's CBAM—with WTO rules. Committee minutes show that developed countries frequently emphasize the need for transparent, science-based environmental measures aligned with climate commitments, while many developing members express concern that these measures may constitute new forms of green protectionism or impose costs inconsistent with their development needs (Sharma, 2024). Discussions surrounding deforestation-related regulations provide a clear example of this divide. Developed economies tend to frame such regulations as essential tools for halting ecosystem degradation, whereas exporting countries argue that supply-chain due diligence requirements impose disproportionate burdens and may function as *de facto* market barriers (Capuzzi, 2024). The Committee on Trade and Development (CTD) further highlights these tensions by documenting concerns related to special and differential treatment and the need for capacity building to support compliance efforts among developing members (Gnintedem, 2024). Together, the deliberations of the CTE and CTD reveal a persistent but evolving discourse that increasingly integrates sustainability into trade-related decision-making.

Legislative developments within the WTO underscore the organization's growing willingness to address environmental issues, even if incremental. The 2022 Fisheries Subsidies Agreement represents a landmark achievement as the first WTO agreement primarily motivated by environmental objectives. The agreement aims to curb harmful subsidies that contribute to overfishing and marine ecosystem depletion, reflecting global recognition that unsustainable fishing practices threaten both environmental integrity and economic resilience (Young, 2023). Analysts note that the agreement's adoption demonstrates the WTO's capacity to advance environmental protection when members converge around a shared problem, even though the negotiations required years of compromise and remain subject to ongoing challenges related to implementation and special and differential treatment (Hoekman et al., 2021). Current discussions on a second phase of

negotiations, often referred to as Fish 2, reveal continued disagreements regarding how to operationalize developmental considerations within environmental disciplines, highlighting enduring tensions between sustainability and equity in WTO rulemaking. These negotiations illustrate that environmental norm-setting within the WTO is possible but often constrained by political sensitivities and divergent economic interests. Quantitative and qualitative trends in WTO documentation further demonstrate the institution's evolving engagement with environmental matters. A noticeable increase in sustainability-related notifications under various WTO agreements reflects the proliferation of national policies aimed at reducing carbon emissions, enhancing supply-chain transparency, and promoting environmental protection. Many of these notifications arise from climate-related regulations, including carbon pricing schemes, renewable energy policies, and environmental certification systems, indicating that member states are increasingly using trade-related instruments to achieve sustainability goals (Chien et al., 2024). At the same time, linguistic analysis of WTO texts reveals a growing presence of environmental terminology, with expressions such as "sustainable development," "climate mitigation," and "environmental protection" appearing with increasing frequency in reports, committee minutes, and negotiation documents (United Nations Conference on & Development, 2023). This discursive shift aligns with broader global trends emphasizing the need for integrated governance approaches that link economic activity to planetary boundaries.

The rise in disputes concerning unilateral environmental measures marks another empirical indicator of transformation. As major economies implement carbon border adjustments, deforestation regulations, and other climate-related trade instruments, the WTO has become a key site for contestation over how environmental values should be balanced against trade obligations. Legal analyses of the EU's CBAM highlight how its design and implementation raise new questions regarding non-discrimination and development equity, prompting increased scrutiny within the multilateral framework (Lunenburg & Naidu, 2024; Sambhav, 2024). Similarly, the European Union's Deforestation Regulation has triggered concerns over the extraterritorial reach of environmental governance and the potential for

inconsistency with WTO rules governing technical barriers to trade (Brack, 2024). The proliferation of these measures suggests that environmental disputes will become increasingly prominent in WTO adjudication as countries adopt more ambitious climate policies and integrate sustainability into their trade strategies.

Taken together, these doctrinal, institutional, and empirical developments reflect a gradual but unmistakable evolution in the WTO's engagement with environmental protection. Dispute settlement has played a crucial role in expanding the interpretive space available for environmental measures, committees have become arenas for negotiating the boundaries of permissible regulation, and legislative achievements such as the Fisheries Subsidies Agreement demonstrate that multilateral consensus on environmental issues is possible under certain conditions. The increasing volume of sustainability-related notifications and the prominence of environmental issues in WTO discourse further underscore the organization's shifting priorities. Although significant challenges remain—particularly concerning equity, policy coherence, and institutional reform—the trajectory of WTO practice reveals an expanding capacity to accommodate environmental imperatives within the global trading system.

4. Critical Discussion: WTO at a Crossroads — Fragmentation or Green Reform?

The evolving relationship between trade and environmental governance has brought the WTO to a decisive crossroads, where its ability to remain a central institution of global economic order increasingly depends on how it responds to the proliferation of unilateral climate and sustainability measures. The rise of instruments such as the European Union's Carbon Border Adjustment Mechanism and the Deforestation Regulation reflects an emerging reality in which major economies seek to align trade flows with climate objectives, yet these measures challenge foundational principles of WTO law. Analytical assessments of CBAM, for instance, highlight potential violations of core non-discrimination rules under Articles I and III, as differential treatment of imported products based on embedded emissions may run counter to the most-favoured-nation obligation or the national-treatment requirement (Sharma, 2024). Additional concerns arise under Article XI when trade restrictions effectively

function as prohibitions on products originating from countries with less stringent climate policies, raising questions about whether such measures impermissibly restrict market access (Sambhav, 2024). These doctrinal tensions underscore the legal fragility of unilateral environmental measures under existing WTO disciplines and reveal the difficulty of reconciling domestic climate ambitions with the multilateral rulebook.

Beyond these apparent inconsistencies with primary obligations, unilateral climate regulations face significant challenges when evaluated under the general exceptions of Article XX. Although environmental objectives fall within the scope of paragraphs (b) and (g), the justification process remains complex. The necessity test requires that the measure contribute materially to its stated environmental objective, be no more trade restrictive than necessary, and be supported by scientific or empirical evidence. Observers note that CBAM's effectiveness in reducing global emissions may be difficult to demonstrate, as its impact depends heavily on how trading partners adjust their production methods and whether alternative policy designs could achieve similar goals with fewer trade distortions (Cornago & Berg, 2024). Similarly, the EUDR's requirement for actionable due diligence on deforestation risks may be challenged for imposing compliance burdens that far exceed what is necessary to achieve environmental protection, especially for small producers lacking institutional capacity (Capuzzi, 2024). These concerns reveal the doctrinal complexities of using trade restrictions to advance environmental protection, even when the underlying objectives align with global climate commitments.

A further layer of conflict arises when unilateral climate measures are evaluated through the lens of international environmental law, particularly the principle of common but differentiated responsibilities and respective capabilities. CBDRRC, a central norm within the UN climate regime, recognizes historical responsibility and unequal technological and financial capacity among states. By contrast, WTO law is built on the premise of strict non-discrimination, applying uniform obligations without regard to developmental or historical differences. Legal analyses highlight that this normative mismatch creates friction when evaluating measures like CBAM, which may disproportionately burden developing countries with fewer resources to decarbonize their

economies (Sabyrbekov & Overland, 2024). The absence of CBDRRC within WTO jurisprudence means panels are not empowered to account for developmental equity when assessing whether an environmental measure is justified under Article XX. This structural asymmetry amplifies concerns that WTO adjudication may be ill-suited to evaluate climate measures that inherently rely on differentiated obligations under environmental treaties.

The risk of failing the Chapeau test adds yet another layer of vulnerability for unilateral environmental measures. The Chapeau requires that exceptions not be applied in a manner that constitutes arbitrary or unjustifiable discrimination or disguised restrictions on trade. As scholars have noted, the risk of arbitrary discrimination is particularly acute for CBAM, where the methodology for calculating embedded emissions, determining equivalence of foreign climate policies, and granting exemptions could result in disparate treatment of similarly situated trading partners (Lunenborg & Naidu, 2024). The dynamic nature of climate policy and the technical complexity of carbon accounting further increase the likelihood of inconsistent or opaque application, thereby heightening the risk that panels may find violations under the Chapeau. The EUDR raises similar concerns because its due diligence requirements extend deep into foreign supply chains, potentially imposing compliance burdens that vary across exporting countries in ways that are difficult to justify under WTO law (Brack, 2024). These doctrinal vulnerabilities demonstrate the precarious position of unilateral climate instruments within the multilateral legal framework.

The proliferation of unilateral measures also fuels broader concerns about green protectionism, particularly among developing countries. Many exporters have argued that regulations such as CBAM and EUDR function as disguised trade restrictions that privilege advanced economies with superior regulatory and technological capacity while undermining the competitiveness of countries still industrializing. Scholars analyzing the political economy of these measures note that power asymmetries allow large markets to project their environmental standards globally, effectively shaping production practices in third countries without engaging in multilateral negotiations (Chen & Kim, 2024). This dynamic has been described as

a form of regulatory imperialism, whereby environmental norms become instruments of economic influence. Developing countries further contend that such measures rarely include adequate financial, technical, or institutional support to facilitate compliance, thereby exacerbating inequality and undermining the principle of fairness in international trade. These concerns echo long-standing tensions within the WTO, where developing members have frequently cautioned that environmental regulations could become tools for disguised protectionism rather than genuine sustainability efforts (Gnintedem, 2024). These criticisms also intersect with ongoing debates over special and differential treatment. While environmental protection is a shared global priority, the capacity to implement sustainability measures varies widely across states. Negotiations on fisheries subsidies illustrate this challenge vividly. Although the agreement aims to curb harmful practices that degrade marine ecosystems, disagreements persist over how to operationalize special and differential treatment without undermining environmental effectiveness (Young, 2023). The deadlock in the “Fish 2” negotiations exemplifies the broader challenge of designing environmental rules that accommodate developmental needs without permitting environmentally harmful practices to continue unchecked. This tension reinforces developing-country concerns that environmental measures introduced by powerful economies may neglect equity considerations that are central to sustainable development.

The rise of unilateral climate policies also contributes to the erosion of multilateralism, as states increasingly rely on domestic regulations rather than negotiated rules to achieve environmental objectives. This trend is occurring at a time when the WTO’s crisis of dispute settlement has dramatically reduced the organization’s ability to provide legal certainty. Since the paralysis of the Appellate Body, the WTO lacks a binding mechanism for final adjudication, leaving members without assurance that their environmental measures will be evaluated consistently across disputes (Mavroidis, 2022). Legal uncertainty weakens incentives for countries to invest in climate-aligned trade policies that might later be overturned, while also encouraging retaliatory measures or tit-for-tat regulatory escalation. Without a fully functioning dispute settlement system,

adjudication risks fragmenting into competing interpretations, further undermining the predictability needed for coherent global climate governance.

The weakening of the multilateral system also increases the likelihood of regulatory fragmentation across major economic blocs. Analysts note that tensions among the European Union, the United States, and China could result in divergent climate-related trade frameworks, each incorporating distinct standards for emissions accounting, supply-chain transparency, and environmental due diligence (Hoekman et al., 2021). Such fragmentation would complicate global supply-chain management and increase compliance burdens, particularly for developing countries with limited institutional capacity. In extreme scenarios, competing blocs may adopt incompatible regulatory systems, undermining the very function of the multilateral trading system as a harmonizing force. Some scholars warn that if the WTO fails to provide a platform for developing shared rules on sustainability, its relevance may diminish as states turn increasingly to plurilateral agreements or unilateral action (Kalimo et al., 2024).

These systemic vulnerabilities feed into a broader existential question: can the WTO remain central to global economic governance if it cannot accommodate sustainability as a core regulatory principle? The organization’s legal architecture was designed in an era when environmental concerns were peripheral to trade governance, and although dispute settlement has demonstrated interpretive flexibility, structural reform remains necessary to integrate environmental imperatives more fully. Analyses of the EU’s Green Deal and its interaction with WTO law suggest that the success of global sustainability transitions depends on the creation of trade rules that explicitly incorporate environmental objectives, moving beyond reliance on exceptions and narrow interpretive pathways (Directorate-General for, 2025). Scholars analyzing the coherence between trade policy and climate commitments argue that without explicit recognition of environmental priorities within WTO rulemaking, conflicts between unilateral measures and multilateral obligations will intensify (Kalimo et al., 2024). Others contend that the credibility of the WTO depends on its ability to reconcile the demands of climate governance with the foundational principles of the trading system, emphasizing that environmental challenges cannot be

addressed effectively through fragmented national initiatives alone (Cima & Esty, 2024).

The cumulative conclusion emerging from doctrinal, political, and institutional analysis is that the WTO now faces a choice between fragmentation and green reform. Fragmentation would result from continued reliance on unilateral climate measures, the persistence of doctrinal conflicts, and the deterioration of dispute settlement, ultimately weakening the organization's authority and global coherence. Green reform, by contrast, would require meaningful engagement with sustainability across both rulemaking and adjudicatory functions, ensuring that trade policy evolves in tandem with the imperatives of planetary protection. Whether the WTO embraces this transformation will determine not only its relevance in the twenty-first century but also the capacity of the global trading system to contribute constructively to the urgent environmental challenges confronting the world.

5. Conclusion

The evolving trajectory of the WTO's engagement with environmental protection reveals a system standing at a pivotal intersection. On one side lies the established trade regime, built on principles of nondiscrimination, market access, and predictability, and forged in an era when ecological considerations were largely peripheral to global economic policy. On the other side stand the mounting imperatives of climate change, biodiversity loss, pollution, and resource degradation—challenges that demand profound structural adjustments in how nations regulate production, consumption, and cross-border flows of goods. The conclusion emerging from this analysis is that the WTO can no longer avoid confronting the question of whether its legal and institutional frameworks are capable of supporting a global transition toward sustainability. The organization's experience to date demonstrates both a capacity for adaptation and significant structural limitations. Jurisprudence has evolved in ways that expand the interpretive space for environmental measures, institutional debates increasingly reflect the centrality of sustainability in contemporary policymaking, and recent agreements show that environmental negotiations are possible. Yet these developments remain uneven, incremental, and constrained by political divisions, doctrinal rigidity, and

an outdated architecture that was not designed to address the complexities of twenty-first-century ecological governance.

The disputes analyzed throughout the study illustrate that the WTO's adjudicatory bodies have played a central role in shaping environmental jurisprudence. However, reliance on dispute settlement as the primary mechanism of legal evolution is inherently limited. Panels and the Appellate Body were never intended to function as rule-makers, and without explicit guidance from negotiated agreements, their interpretations remain vulnerable to criticism and reversal. Furthermore, the paralysis of the Appellate Body undermines the stability of the very jurisprudence that has supported environmental integration. Without a functioning dispute settlement system, members cannot rely on consistent interpretation, nor can they be assured that their own environmental measures will be treated fairly and predictably. This uncertainty discourages ambition in climate policy, risks retaliation or unilateral escalation, and contributes to a gradual weakening of multilateral cohesion.

Equally important is the emergence of unilateral climate measures that test the boundaries of WTO law. The proliferation of carbon border adjustments, supply-chain due diligence regulations, and deforestation-related import restrictions reflects a pragmatic attempt by states to align trade policy with domestic environmental commitments. Yet these measures simultaneously expose the misalignment between contemporary ecological needs and the WTO's existing rulebook. When states perceive the multilateral system as incapable of addressing climate concerns, they increasingly resort to unilateral action. If the WTO cannot provide a coherent framework for evaluating and accommodating environmental measures, its relevance will continue to erode, and the global trading system may fragment into regulatory blocs with incompatible standards. Such fragmentation would deepen inequities, weaken global cooperation, and hinder the effectiveness of environmental policies that depend on cross-border coordination.

A related challenge concerns the divergences between developed and developing countries regarding how environmental measures should be designed and implemented. Developing states frequently argue that unilateral regulations impose disproportionate burdens

on producers with limited financial and institutional capacity, creating barriers that reinforce existing inequalities. They also emphasize the need for support, flexibility, and meaningful differentiation in implementing environmental policies. The WTO has struggled to balance environmental protection with development needs, in part because its legal framework lacks clear mechanisms for integrating equity considerations. Sustainable development requires a model of trade governance that recognizes both the ecological urgency of environmental protection and the developmental realities faced by different members. Without institutional pathways for reconciling these priorities, the WTO risks exacerbating tensions and diminishing legitimacy among large segments of its membership.

Given these systemic pressures, the central question becomes whether the WTO can undertake the reforms necessary to realign its mandate with global sustainability goals. The answer depends on the willingness of members to modernize the organization's rulemaking processes, strengthen institutional linkages with environmental regimes, and recognize that sustainability is not an external constraint but a foundational requirement for long-term economic stability. Trade policy cannot operate in isolation from climate governance; the environmental consequences of economic activity are too significant, too global, and too interconnected to be treated as peripheral concerns. If the WTO fails to adapt, alternative structures—plurilateral coalitions, regional agreements, and national regulatory frameworks—will increasingly shape global trade in ways that leave the multilateral system behind. To move toward a more coherent and future-ready system, several recommendations emerge from this analysis. First, WTO members should establish a formal interpretive framework clarifying the relationship between trade obligations and environmental objectives. Such a framework would reduce uncertainty, support consistent adjudication, and reinforce the principle that environmental protection is compatible with trade liberalization. Second, the organization should strengthen cooperation with multilateral environmental agreements, creating mechanisms for information-sharing, joint assessments, and coordinated policy approaches. These linkages would help ensure that trade

rules and environmental commitments evolve in harmony rather than in competition.

Third, members should revisit and revitalize negotiations on environmental issues, including the expansion of the Fisheries Subsidies Agreement and the development of rules addressing carbon pricing, sustainable goods, and supply-chain transparency. Multilateral negotiations offer the most legitimate and effective means of integrating sustainability into the global trading system, and renewed engagement is essential for preventing fragmentation. Fourth, capacity-building initiatives should be significantly enhanced to support developing countries in meeting environmental requirements. Adequate financing, technical assistance, and institutional support are necessary to ensure that environmental measures do not exacerbate global inequality.

Fifth, reforming the dispute settlement system is indispensable. Without a functioning appellate mechanism, members lack the legal certainty needed to innovate in environmental policy, and the WTO's credibility suffers. Restoring dispute settlement must be treated as a prerequisite for any meaningful environmental reform. Finally, the WTO should adopt a long-term institutional vision that places sustainability at the core of its mandate. This shift requires not only legal revisions but also cultural and institutional change—recognizing that trade governance in the twenty-first century must integrate ecological realities into every dimension of decision-making.

In sum, the WTO's future relevance will hinge on its ability to embrace sustainability as a fundamental organizing principle. The organization stands at a moment of institutional choice. It can remain anchored in a twentieth-century model of trade governance that fails to account for the ecological challenges now central to global policy, or it can evolve into a modern, adaptive institution capable of supporting the transition to a sustainable world economy. The direction it chooses will shape not only the future of the multilateral trading system but also the capacity of the international community to address the defining environmental challenges of our time.

Authors' Contributions

Authors contributed equally to this article.

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In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

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