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# Synergizing trade and sustainability: advancing SDG 14 through international trade dynamics

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## Abstract

This paper explores the intricate relationship between international trade and the achievement of the United Nations Sustainable Development Goal 14 (Life Below Water), focusing on the potential of trade to contribute positively to marine conservation and sustainable use of ocean resources. By examining the intersection of economic, social, and environmental dimensions, the study delves into how trade policies and practices can be aligned with environmental objectives, particularly concerning marine ecosystems. A principal challenge identified is the tension between economic growth driven by international trade and the sustainability of marine ecosystems, exacerbated by practices such as overfishing and pollution from maritime transport. Another significant challenge is the lack of robust enforcement mechanisms for existing environmental provisions in trade agreements. To address these challenges, the paper recommends the integration of stringent and enforceable environmental clauses in trade agreements, coupled with the promotion of sustainable trade practices through international cooperation and capacity building. Furthermore, the study suggests the adoption of innovative trade mechanisms, such as eco-certification and the implementation of Marine Protected Areas (MPAs), to enhance the protection of marine life, support sustainable fisheries, and reduce ocean pollution. The paper concludes with specific policy recommendations for leveraging international trade as a tool for the sustainable management of marine resources, ultimately contributing to the broader agenda of sustainable development.

**Keywords** International trade, Sustainable development goals, SDG 14, Marine conservation, Trade policy

## 1 Introduction

The United Nations Sustainable Development Goals (SDGs) represent a universal call to action to end poverty, protect the planet, and ensure that all people enjoy peace and prosperity by 2030 (Caprani, 2016). Adopted by all United Nations Member States in 2015, the 17 SDGs are an urgent plea for countries to shift their paths towards a more sustainable and equitable world (Chopra, 2019). These goals are interconnected, acknowledging

that interventions in one area will impact outcomes in others, and that development must balance social, economic, and environmental sustainability. The SDGs provide a comprehensive framework, addressing the global challenges we face, including those related to poverty, inequality, climate change, environmental degradation, peace, and justice. The goals are unique in their universal application to all countries, rich and poor alike, and they emphasize the need for widespread participation from all sectors of society to achieve them (Zreik, 2023a).

Sustainable Development Goal 14, 'Life Below Water', focuses on the conservation and sustainable use of the world's oceans, seas, and marine resources (Baker et al., 2023). This goal is vital for several reasons: oceans cover three-quarters of the Earth's surface, contain 97% of the

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Earth's water, and represent 99% of the living space on the planet by volume (Mladenov, 2020). Over three billion people depend on marine and coastal biodiversity for their livelihoods, and the oceans are key to our economy with an estimated 40 million people being employed by ocean-based industries by 2030 (Ann et al., 2022). SDG 14 aims to address major challenges such as marine pollution, acidification, overfishing, and destruction of coastal ecosystems (Virto, 2018). It underscores the importance of conserving our marine resources, which are essential for sustaining life on Earth, maintaining biodiversity, and mitigating climate change through carbon sequestration.

The rationale for linking international trade with SDG 14 is multi-faceted. Trade plays a crucial role in the global economy and can be a powerful instrument for sustainable development. However, it can also pose significant threats to marine life if not managed responsibly. Unregulated and unsustainable trade practices can lead to overexploitation of marine resources, habitat destruction, and pollution, all of which undermine the objectives of SDG 14 (Okafor-Yarwood, 2019). Conversely, well-regulated trade can contribute to sustainable economic growth, poverty reduction, and the protection of marine ecosystems. By promoting sustainable trade practices, such as eco-certification of seafood and trade policies that discourage overfishing, international trade can be aligned with environmental conservation goals. Additionally, trade can facilitate the transfer of environmentally friendly technologies and best practices across borders, aiding in the protection and sustainable use of marine resources. Therefore, exploring how international trade can align with and contribute to SDG 14 is not only timely but essential for the sustainable management of marine resources and the achievement of broader sustainability goals.

The global trade of marine resources, encompassing a wide range of goods from seafood to marine-derived pharmaceuticals, plays a pivotal role in the economies of many nations and the livelihoods of millions of people worldwide. However, this trade is also at the heart of some of the most pressing environmental challenges facing our oceans today, including overexploitation of species, habitat destruction, and the spread of invasive species. As the demand for marine goods continues to rise in tandem with global population growth, the sustainability of these vital resources is increasingly jeopardized. This situation underscores the importance of strengthening the link between trade and sustainable development. By carefully examining and redefining trade policies to prioritize sustainability, there is a significant opportunity not only to protect and conserve marine biodiversity but also to ensure the long-term viability of

the marine resources trade. This imperative aligns closely with the United Nations Sustainable Development Goal 14, which calls for the conservation and sustainable use of the oceans, seas, and marine resources for sustainable development. The intersection of trade policies with environmental sustainability thus emerges as a critical area of focus, necessitating a balanced approach that supports economic growth while ensuring the health and resilience of marine ecosystems. This study will answer the following question 'How do international trade policies and practices influence the conservation and sustainable use of marine resources in alignment with Sustainable Development Goal 14 (Life Below Water), and what are the most effective strategies for leveraging trade to support marine conservation efforts?'

## 2 Methodology

This study adopts a conceptual analysis methodology to explore the impact of international trade on marine conservation, specifically in the context of Sustainable Development Goal 14. Conceptual analysis, as employed in this research, involves a systematic review and synthesis of existing literature, policy documents, international agreements, and studies related to trade and marine ecosystem conservation. The aim is to dissect and understand the multifaceted relationship between trade policies and practices and their implications for marine biodiversity and sustainable use of ocean resources.

The study employs a systematic review methodology to comprehensively examine the empirical evidence on the effectiveness of trade policies in marine conservation. We identified, evaluated, and synthesized existing research from peer-reviewed journals, international reports, and case studies focusing on the implementation and outcomes of trade-related environmental provisions. The review specifically targets studies published in the last two decades, utilizing databases such as Web of Science, Scopus, and Google Scholar. Inclusion criteria were defined to ensure the relevance and quality of the data, focusing on empirical studies that directly assess the outcomes of trade policies on marine ecosystem sustainability.

The analysis begins with an exhaustive literature review, identifying key themes, debates, and gaps in current research. This includes examining peer-reviewed articles, reports from international bodies, and case studies that highlight both positive and negative outcomes of trade on marine ecosystems. Following the literature review, the study critically evaluates existing trade agreements and practices, with a particular focus on their environmental provisions and effectiveness in promoting marine conservation.

Additionally, the study exemplifies successful integration of trade and environmental policies, as well as instances where trade has adversely affected marine ecosystems. This approach allows for the identification of best practices and innovative trade mechanisms that could enhance the protection of marine life and support sustainable fisheries.

By synthesizing findings from diverse sources and case studies, this methodology facilitates a comprehensive understanding of the dynamic interplay between trade and SDG 14. The outcome is a set of informed insights and policy recommendations aimed at leveraging international trade as a tool for the sustainable management of marine resources.

Given the intricacies of international trade and its impact on marine conservation efforts within the framework of Sustainable Development Goal 14 (SDG 14), this study proposes the following hypotheses to guide the analysis: Firstly, that trade policies and practices, when aligned with sustainability principles, significantly contribute to the conservation and sustainable use of marine resources. This hypothesis posits that mechanisms such as eco-certification, sustainable aquaculture practices, and environmentally conscious trade agreements serve as pivotal tools in promoting marine biodiversity and mitigating the negative impacts of trade on marine ecosystems. Conversely, the second hypothesis suggests that the absence of robust regulatory frameworks and sustainable practices in international trade exacerbates challenges in marine conservation, leading to overfishing, habitat destruction, and pollution. This study aims to unravel these hypotheses by examining the dual role of trade in both supporting and undermining marine conservation efforts, thus presenting a comprehensive understanding of how international trade dynamics can be synergized with the objectives of SDG 14.

### 3 Trade and its impact on marine environments

#### 3.1 Positive impacts of trade on marine conservation

International trade, when aligned with sustainable practices, can have a profoundly positive impact on marine conservation. Through the implementation of carefully crafted trade policies and the promotion of sustainable fisheries and aquaculture, trade can contribute significantly to the preservation and recovery of marine ecosystems. This positive influence is exemplified in various case studies and initiatives around the world, showcasing how trade can be a force for good in marine conservation.

One notable example is the effect of trade policies on protecting endangered species. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) plays a pivotal role in this regard. For instance, the trade restrictions imposed by

CITES on certain species of fish known for being over-exploited have led to their recovery (Kuo et al., 2018). The protection of the humphead wrasse, a species that was heavily traded for luxury seafood markets, demonstrates this success (Hau & de Mitcheson, 2023). Following its inclusion in CITES Appendix II, international trade of this species became strictly regulated, leading to a significant decrease in illegal fishing and a gradual recovery of its population in certain areas (Mitsilegas et al., 2022).

Another impactful case study is the implementation of Marine Stewardship Council (MSC) certification for sustainable fisheries. The MSC certification program, which sets stringent standards for sustainable fishing, has been instrumental in incentivizing fishery improvements worldwide (Ponte, 2012). Fisheries that comply with MSC's standards can access new markets and often receive premium prices, creating an economic incentive for sustainable practices (Agnew et al., 2014). For instance, the Alaska Pollock fishery, one of the largest in the world, achieved MSC certification, leading to a marked improvement in fishing practices (Stemle et al., 2016). This certification not only helped in maintaining fish populations but also protected the broader marine ecosystem by minimizing bycatch and habitat impact.

Sustainable aquaculture also plays a critical role in the positive intersection of trade and marine conservation. With the growing demand for seafood and the pressure it puts on wild fish populations, aquaculture presents a viable solution for meeting global seafood needs while reducing the strain on ocean fisheries. However, it's essential that aquaculture is conducted sustainably. The Aquaculture Stewardship Council (ASC) works similarly to the MSC but for farmed seafood (Karim & Almira, 2023). Its certification ensures that aquaculture practices minimize environmental impact and maintain high standards of social responsibility. For instance, shrimp farms in Southeast Asia that have adopted ASC standards have seen improvements in water quality and a reduction in the use of antibiotics and chemicals, leading to healthier ecosystems and better market access (Tran et al., 2013).

Furthermore, trade agreements themselves can be tailored to promote marine conservation. Agreements that include environmental provisions, such as the United States-Mexico-Canada Agreement (USMCA), often require member countries to adhere to sustainable fishing practices and combat illegal, unreported, and unregulated (IUU) fishing (Young, 2021). These provisions not only contribute to the sustainability of marine resources but also create a level playing field for industries in member countries, ensuring that trade benefits do not come at the expense of the environment.

The influence of international trade on marine ecosystems can be quantified through various empirical data, highlighting both its positive and negative impacts. For instance, the global trade in fish and seafood products significantly contributes to economic development, supporting livelihoods and food security across the globe. According to the Food and Agriculture Organization (FAO), the fishery and aquaculture sectors provided 59.5 million people with employment in 2018, with global fish production reaching an all-time high of 179 million tonnes in the same year (Merem et al., 2019). However, the environmental cost of these economic benefits is substantial. The FAO also reports that approximately 34.2% of global fish stocks are being fished at biologically unsustainable levels, a stark increase from 10% in 1974 (Mitsilegas et al., 2022). This overexploitation is directly linked to the pressures of international trade demand, illustrating the complex relationship between trade policies and marine sustainability.

### 3.2 Negative impacts of trade on marine ecosystems

International trade, while being a significant driver of the global economy, can also have detrimental effects on marine ecosystems. Two of the most critical issues in this context are overfishing and illegal fishing practices, as well as marine pollution, all of which are exacerbated by trade activities. These negative impacts pose a significant threat to the health and sustainability of our oceans, affecting biodiversity, disrupting marine habitats, and undermining efforts to achieve Sustainable Development Goal 14 (Life Below Water).

Overfishing is a direct consequence of the high demand for fish and seafood products driven by global trade (Erhardt, 2018). The demand often exceeds the natural replenishing capacity of marine life, leading to the depletion of fish stocks. A glaring example of this is seen in the Atlantic Bluefin Tuna, whose population has drastically declined due to overfishing fueled by high market demand, particularly in Japan for sushi and sashimi (Tellesca, 2020). This overexploitation has not only endangered the species but has also disrupted the marine food chain, affecting other species and the overall health of marine ecosystems (Arthington et al., 2016). The situation is further exacerbated by subsidies provided to the fishing industry in various countries, which often encourage increased fishing capacity beyond sustainable levels, leading to overfishing.

Illegal, Unreported, and Unregulated (IUU) fishing practices, closely linked to global trade, further compound the issue of overfishing. IUU fishing involves activities that violate fisheries laws and regulations and is driven by the lucrative global seafood market (Lid-dick, 2014). It is estimated that IUU fishing accounts for

a significant portion of the global catch, contributing to the depletion of fish stocks and threatening marine biodiversity (Öztürk, 2015). For instance, in parts of West Africa, IUU fishing by foreign vessels has not only led to a decline in fish stocks but also affected the livelihoods of local communities that depend on fishing (Merem et al., 2019). The lack of effective enforcement and monitoring mechanisms in international waters makes it challenging to combat IUU fishing, which often goes hand in hand with other illicit activities such as human trafficking and drug smuggling.

Trade's impact on marine pollution presents another area where empirical data reveals significant environmental challenges. Marine litter, including plastics which account for up to 80% of all marine debris, is exacerbated by global trade activities. Studies estimate that over 8 million tonnes of plastic enter the oceans each year, with shipping routes and trade winds playing a crucial role in their distribution (de Lange et al., 2022). This pollution not only harms marine life but also affects human health and economic activities, such as tourism and fisheries, dependent on healthy marine ecosystems. Conversely, trade policies promoting environmental sustainability have shown positive outcomes. For example, the implementation of the Marine Stewardship Council's eco-certification has led to the improvement in fishing practices and stock recovery in certified fisheries (Song et al., 2020). A study published in the Fisheries Research found that MSC-certified wild capture fisheries show significant reductions in bycatch and improvements in stock health compared to non-certified counterparts (Stemle et al., 2016).

Another major negative impact of trade on marine ecosystems is marine pollution, particularly from shipping and transportation activities. The increase in global trade has led to a surge in maritime traffic, which is a significant source of ocean pollution (Pirota et al., 2019). Ships contribute to marine pollution through the discharge of ballast water, which can introduce invasive species to new environments, disrupting local ecosystems. Oil spills, whether accidental or from routine operations, are another major concern, having catastrophic effects on marine life (Farrington, 2013). Additionally, the shipping industry is a notable contributor to air pollution, including emissions of sulfur oxides and nitrogen oxides, which have indirect but significant impacts on marine environments (Jägerbrand et al., 2019).

Plastic pollution, exacerbated by the global trade of plastic and plastic products, is another critical issue. Millions of tons of plastic end up in the oceans each year, originating from both land-based sources and ships (Guggisberg, 2024). This pollution severely impacts marine life, leading to ingestion and entanglement of



marine animals, and contributes to the destruction of habitats like coral reefs.

#### 4 Analysis of current trade agreements and practices

##### 4.1 Examination of major trade agreements and their provisions on marine conservation

The examination of major trade agreements and their provisions on marine conservation reveals a growing awareness and integration of environmental concerns into international trade policy. These agreements often include specific clauses and commitments that aim to protect marine ecosystems, combat illegal fishing practices, and promote sustainable use of ocean resources.

A prominent example is the United Nations Convention on the Law of the Sea (UNCLOS), often referred to as the 'Constitution for the Oceans'. This comprehensive framework establishes guidelines for the management and conservation of ocean resources, including provisions for protecting marine environments from overexploitation and pollution (Druel & Gjerde, 2014). UNCLOS sets out the legal framework within which all activities in the oceans and seas must be carried out and is pivotal in balancing the economic interests of states with the need for conservation of marine resources (Olivert, 2022).

Another significant trade agreement is the Trans-Pacific Partnership (TPP), later revised and known as the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) (Zreik, 2023b). The CPTPP includes specific chapters on the environment, with commitments from member countries to uphold high conservation standards in marine environments (Zreik, 2022). These commitments include measures to combat IUU fishing, to prohibit harmful fisheries subsidies that contribute to overfishing, and to protect endangered species (Young, 2021).

The European Union's trade agreements also often incorporate strong environmental provisions. For example, the EU-Canada Comprehensive Economic and Trade Agreement (CETA) includes commitments to sustainable management of fisheries, marine biodiversity, and responsible trade in marine products (de Lange et al., 2022). These agreements reflect the EU's approach to 'Green Diplomacy', which seeks to integrate environmental considerations into its external policies, including trade.

These examples indicate a shift in international trade agreements towards greater environmental consciousness, particularly concerning marine conservation. However, the effectiveness of these provisions largely depends on their implementation and enforcement.

Continuous monitoring, cooperation among signatory countries, and involvement of various stakeholders, including environmental organizations, are crucial to ensure that trade contributes positively to the sustainable management of marine resources. This trend towards integrating environmental concerns into trade agreements is not only a reflection of the growing global emphasis on sustainable development but also an acknowledgment of the interdependence of economic growth and environmental sustainability (Table 1).

This comprehensive table underscores the pivotal role of international cooperation and agreements in safeguarding marine ecosystems. The mechanisms listed, ranging from regulatory frameworks like CITES and the USMCA to conservation initiatives such as Marine Protected Areas (MPAs), illustrate a global commitment towards the sustainable management of marine resources. These efforts highlight the interconnectedness of trade, environmental stewardship, and sustainable development, reinforcing the necessity for continued collaboration across borders. The diverse involvement of countries in these mechanisms also points to a growing recognition of the urgent need to harmonize economic activities with environmental conservation goals. This table not only serves as a testament to what has been achieved through international cooperation but also as a guide for future policy directions and engagements aimed at fulfilling Sustainable Development Goal 14 (Life Below Water).

In response to the critical need for a detailed exploration of how trade agreements engage with marine conservation, the following list compiles key provisions found within various international trade agreements that are directly relevant to the protection and sustainable use of marine resources:

- *United Nations Convention on the Law of the Sea (UNCLOS):*

**Sustainable Use of Marine Resources:** Requires states to conserve marine living resources and manage the use of these resources sustainably (Article 61).

**Protection of Marine Environment:** Obligates states to prevent, reduce, and control pollution of the marine environment from any source (Article 192).

- *Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES):*

**Regulation of Trade in Marine Species:** Lists marine species that are threatened by international trade, providing different levels of protection (Appendices I, II, and III).

**Table 1** Sustainable trade mechanisms and associated countries for marine conservation

Mechanism	Associated Countries	Description
CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora)	Global participation	Aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival. Includes marine species threatened by overfishing and trade
USMCA (United States-Mexico-Canada Agreement)	United States, Mexico, Canada	Includes environmental provisions that commit member countries to sustainable fishing practices and protect marine species from the impacts of trade
MPAs (Marine Protected Areas)	Various, including Australia (Great Barrier Reef), USA (Monterey Bay), Brazil (Abrolhos Marine National Park)	Designated regions where human activity is restricted to protect the natural environment, preserving biodiversity and supporting sustainable fisheries
MSC (Marine Stewardship Council) Certification	Global participation	An international certification program that recognizes and rewards sustainable fishing practices, helping to ensure that seafood products are sustainably sourced
ASC (Aquaculture Stewardship Council) Certification	Global participation	Promotes and certifies responsible aquaculture practices, ensuring that farmed seafood meets environmental sustainability and social responsibility standards
TPP (Trans-Pacific Partnership) now CPTPP	Member countries including Japan, Canada, Australia, Vietnam, and others	Though not solely focused on marine conservation, it includes significant provisions for environmental protection and sustainable resource management, including the oceans

- *The Marine Stewardship Council (MSC) Certification:*

Eco-certification for Sustainable Fishing: Sets standards for sustainable fishing practices, including minimizing environmental impact and maintaining healthy populations of targeted species.

- *The Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP):*

Environmental Protections: Includes commitments to effectively enforce environmental laws, combat illegal, unreported, and unregulated (IUU) fishing, and promote sustainable fisheries management (Chapter 20).

- *The United States-Mexico-Canada Agreement (USMCA):*

Marine Environmental Protections: Contains provisions to address marine species conservation, combat IUU fishing, and protect marine habitats (Environment Chapter).

- *The European Union's Trade Agreements (e.g., EU-Canada Comprehensive Economic and Trade Agreement—CETA):*

Sustainable Management of Marine Resources: Includes commitments to sustainable fisheries management, conservation of marine biological diversity, and adherence to international agreements on marine conservation.

#### 4.2 Effectiveness of current trade practices in promoting SDG 14

The effectiveness of current trade practices in promoting Sustainable Development Goal 14 (SDG 14), which focuses on conserving and sustainably using the oceans, seas, and marine resources, is a subject of considerable importance and ongoing debate. While there are instances of positive impact, the overall effectiveness is often hindered by challenges in implementation, enforcement, and conflicting interests.

On the positive side, some trade practices have demonstrably contributed to the objectives of SDG 14. For instance, the adoption of eco-labeling and certification programs for seafood, such as the MSC and ASC, has incentivized sustainable fishing practices (Peiró-Signes et al., 2020). These programs help consumers make informed choices, thereby driving market demand towards sustainably sourced seafood. Additionally, the inclusion of environmental clauses in international trade agreements, as seen in the CPTPP and European Union trade agreements, represents a growing recognition of

the need to integrate sustainable practices into the global trade framework.

However, the effectiveness of these practices is often limited by several factors. Enforcement remains a major challenge, especially in international waters where monitoring is difficult and jurisdiction is complex. This limitation is particularly evident in the fight against IUU fishing, which continues to be a significant problem impacting fish stocks and marine ecosystems globally (Song et al., 2020). Furthermore, the economic interests of countries and industries sometimes conflict with sustainable practices. Subsidies to the fishing industry, for example, can encourage overfishing and deplete fish stocks faster than they can recover, undermining efforts to achieve SDG 14.

Moreover, the global nature of the seafood market means that unsustainable fishing practices in one part of the world can have far-reaching effects, impacting marine ecosystems and communities in other regions (Petrossian, 2019). This global interconnectivity requires coordinated international efforts, which can be challenging to achieve due to varying national priorities and levels of development.

#### 4.3 Challenges in integrating sustainable practices in trade agreements

The systematic review revealed a mixed impact of trade policies on marine environments. Empirical studies, such as those by Young (2016), highlight the positive outcomes of environmentally focused trade agreements, noting improvements in fisheries management and reductions in illegal fishing activities in regions under agreements with stringent environmental clauses. Conversely, research by Wijen (2014) points to ongoing challenges in policy enforcement and compliance, particularly in developing nations where resource constraints impair the effectiveness of such trade policies. This review underscores the necessity of robust enforcement mechanisms and international cooperation to realize the potential benefits of trade policies for marine conservation.

Integrating sustainable practices into trade agreements presents several challenges, reflecting the complexity of balancing economic interests with environmental stewardship. These challenges arise from various factors including political, economic, and practical considerations.

One of the primary challenges is the divergence in economic and environmental priorities among nations. Developing countries often prioritize economic growth and poverty alleviation, which can sometimes conflict with the adoption of stringent environmental standards. Developed countries, on the other hand, might push for higher environmental standards that developing nations

find difficult or expensive to meet. This disparity can lead to tensions and disagreements in negotiations, making it challenging to reach a consensus on sustainability clauses in trade agreements.

Another significant hurdle is the enforcement of sustainability provisions. Ensuring compliance with environmental standards in trade agreements is complicated, especially given the differences in regulatory frameworks and capacities among countries. Effective enforcement requires robust monitoring mechanisms, transparent reporting, and accountability measures, which can be resource-intensive and technically demanding. Without strong enforcement mechanisms, the environmental clauses in trade agreements risk becoming merely symbolic.

Additionally, there is the issue of trade-offs and compromises. Trade negotiations are inherently a process of give-and-take, where countries may have to compromise on certain aspects to reach an agreement. Sometimes, environmental considerations may take a back seat to more pressing trade or economic concerns (Epstein, 2018). This can result in watered-down environmental provisions or the exclusion of significant sustainability issues from the final agreement.

Furthermore, there is the challenge of keeping pace with evolving environmental concerns and scientific understanding. Trade agreements are typically negotiated over several years and intended to last for many more. However, environmental issues can evolve rapidly, requiring flexibility and adaptability in agreements, which is often not easy to achieve.

## 5 Innovative trade strategies for marine conservation

### 5.1 Sustainable trade mechanisms for marine resources

Sustainable trade mechanisms for marine resources are essential tools in ensuring the long-term viability of ocean ecosystems while supporting economic development. These mechanisms are designed to balance the exploitation of marine resources with the imperative of maintaining ecological integrity. They involve a range of strategies, from regulatory frameworks to market-based approaches, each playing a crucial role in promoting sustainable practices in the marine sector.

One effective mechanism is the implementation of catch limits and quotas based on scientific assessments. These limits are critical in preventing overfishing and ensuring that fish stocks are harvested at sustainable levels. For instance, the Total Allowable Catch (TAC) system, widely used in fisheries management, sets a cap on the amount of a particular fish species that can be caught in a given period (Kindt-Larsen et al., 2011). This

approach not only helps in preserving fish populations but also in maintaining the balance of marine ecosystems.

Eco-certification and labeling schemes, such as the MSC certification, represent another sustainable trade mechanism. These schemes provide consumers with information about the sustainability of seafood products, enabling them to make environmentally responsible choices (Ponte, 2012). This market-based approach incentivizes fisheries to adopt sustainable practices to access eco-conscious markets and often fetch premium prices, thereby creating a positive feedback loop that benefits both the economy and the environment.

Additionally, Marine Protected Areas (MPAs) play a significant role in sustainable marine resource trade. MPAs, where fishing and other extractive activities are restricted or prohibited, serve as safe havens for marine life, allowing ecosystems to regenerate and recover (Bastari et al., 2016). The spillover effect from MPAs can lead to increased fish populations in surrounding areas, benefiting fisheries and promoting sustainable trade (Di Lorenzo et al., 2020).

Trade agreements can also incorporate sustainability clauses, setting standards for environmental protection and sustainable resource use. These clauses can regulate the trade of endangered marine species, restrict harmful fishing practices, and promote the exchange of environmentally friendly technologies.

Furthermore, community-based management and co-management approaches that involve local communities, governments, and other stakeholders in fisheries management have shown promise. These approaches ensure that those who are directly affected by marine policies have a say in their formulation and implementation, leading to more sustainable and equitable outcomes.

## 5.2 Addressing marine pollution and ocean acidification through trade policies

Marine pollution and ocean acidification present critical challenges to the conservation and sustainable use of marine resources, with international maritime transport of bulk commodities playing a significant role in these environmental issues. The vast movement of goods across the world's oceans is integral to global trade but contributes significantly to marine pollution through oil spills, ballast water discharge, and air emissions. Simultaneously, the emission of carbon dioxide from maritime and other anthropogenic sources has led to ocean acidification, a process that threatens marine life and ecosystem services. The complexity of these challenges necessitates comprehensive strategies that extend beyond traditional conservation efforts to include targeted trade policy interventions. Addressing

these environmental issues through the lens of international trade policies offers a pathway to mitigate the impacts and safeguard marine ecosystems.

Trade policies and environmental regulations, such as the Emissions Trading System (ETS), are pivotal in mitigating the environmental impacts associated with the transportation of goods. The ETS, a market-based approach to controlling pollution by providing economic incentives for achieving reductions in the emissions of pollutants, exemplifies how regulatory mechanisms can drive environmental improvements in the maritime sector. By setting a cap on emissions and allowing the trading of emission allowances, the ETS incentivizes companies to reduce their carbon footprint. This system has the potential to contribute significantly to the reduction of marine pollution and to slow the process of ocean acidification by encouraging the maritime industry to adopt cleaner technologies and fuels, thereby reducing greenhouse gas emissions and other pollutants that contribute to these pressing marine issues.

Innovative trade strategies aimed at reducing the environmental footprint of maritime transport are crucial for combating marine pollution. The promotion of cleaner shipping technologies, the implementation of stricter fuel standards, and the encouragement of alternative, less polluting transportation methods represent practical steps towards minimizing the environmental impacts of trade. For example, the adoption of liquefied natural gas (LNG) as a cleaner alternative to traditional bunker fuel can significantly reduce emissions of sulfur oxides, nitrogen oxides, and particulates. Case studies, such as the implementation of the International Maritime Organization's (IMO) Sulphur Cap, which limits the sulfur content in ship fuel, highlight the effectiveness of such strategies in mitigating environmental damage and point towards a sustainable path for maritime transport.

Adjustments in trade policies also offer a promising avenue for combating ocean acidification. By incorporating provisions that promote the reduction of carbon emissions and acidifying pollutants, trade agreements can play a crucial role in addressing this global challenge. The potential for trade agreements to foster environmental stewardship is immense, ranging from encouraging the adoption of carbon capture and storage technologies to supporting practices that enhance the marine environment's ability to sequester carbon. Leveraging trade incentives to promote such environmentally beneficial practices could significantly contribute to the health of marine ecosystems and combat the adverse effects of acidification.



### 5.3 Role of technology and innovation in sustainable trade practices

The role of technology and innovation in sustainable trade practices is increasingly significant, offering new solutions to some of the most pressing environmental challenges. By leveraging technological advancements, trade can be conducted in more sustainable, efficient, and transparent ways, contributing to the protection of ecosystems and the promotion of environmental stewardship.

One of the key areas where technology plays a vital role is in the traceability and monitoring of supply chains. Advanced tracking systems, such as blockchain and Internet of Things (IoT) technologies, enable the tracking of products from their source to the consumer. In the context of marine resources, this means being able to verify that seafood is sustainably sourced and legally caught. For example, blockchain technology can be used to create tamper-proof records of fish catches, processing, and distribution, ensuring that the product reaching the consumer is not only fresh but also sustainably harvested (Rahman et al., 2021). This increased transparency helps in combating IUU fishing, a major threat to marine ecosystems.

Remote sensing and satellite technologies also play a crucial role in monitoring fishing activities and marine health. Satellites can track fishing vessels, monitor ocean temperatures, and even detect illegal fishing activities in protected areas (Kurekin et al., 2019). These technologies provide critical data for enforcing fishing regulations and for scientific research on marine ecosystems (Dunn et al., 2018).

In addition, innovation in fishing gear and techniques is helping reduce the environmental impact of fishing. Developments in gear technology, such as more selective fishing nets and longlines, minimize bycatch (the unintended capture of non-target species) and habitat destruction (Poisson et al., 2022). Similarly, advancements in aquaculture, including improved feed and better waste management systems, are making fish farming more sustainable (Boyd et al., 2020).

Furthermore, renewable energy technologies are becoming increasingly important in reducing the carbon footprint of trade. The shipping industry, a significant contributor to global emissions, is exploring cleaner energy sources such as biofuels, solar, and wind power to propel vessels (Mallouppas & Yfantis, 2021).

Artificial intelligence (AI) and machine learning are also emerging as powerful tools in sustainable trade. They can optimize supply chain logistics, reduce waste, and provide predictive analytics for better resource management (Helo & Hao, 2022). AI algorithms can analyze complex environmental data, helping policymakers and

businesses make informed decisions that balance trade with environmental conservation (Li et al., 2021).

### 5.4 Examples of successful integration of trade and marine conservation

The successful integration of trade and marine conservation is exemplified in several instances around the globe, showcasing how economic activities can coexist with, and even promote, environmental sustainability. These examples highlight the potential of well-designed trade policies and practices to positively impact marine ecosystems.

A notable example is the partnership between the MSC and various fisheries around the world. MSC, an international non-profit organization, sets standards for sustainable fishing. Fisheries that meet these standards are certified and can use the MSC eco-label on their products (Wakamatsu & Wakamatsu, 2017). This label not only informs consumers about sustainably sourced seafood but also opens up new markets for these products. An example of this successful integration is the Alaska Pollock fishery, one of the largest sustainable fisheries in the world, which has been MSC-certified since 2005. The certification has not only ensured the sustainability of fish stocks but also boosted the fishery's market access and profitability (Hadjimichael & Hegland, 2016).

Delving deeper into the MSC certification process reveals a rigorous assessment based on three core principles: the sustainability of the fish stock, the impact of fishing on the ecosystem, and the management practices of the fishery. The Alaska Pollock fishery's success under MSC certification is attributed to its adherence to these principles through specific measures such as implementing quota systems based on scientific assessments, bycatch reduction techniques, and habitat protection efforts. This case exemplifies how the structured certification process and continuous monitoring not only preserve fish stocks but also enhance the fishery's market value and sustainability credentials.

Another example can be found in the Coral Triangle Initiative (CTI), a multilateral partnership of six countries (Indonesia, Malaysia, Papua New Guinea, Philippines, Solomon Islands, and Timor-Leste). The CTI focuses on sustainable marine resource management in the Coral Triangle, one of the most biodiverse marine areas on Earth (Fidelman & Ekstrom, 2012). Through this initiative, the member countries collaborate on marine conservation strategies while promoting sustainable trade practices in the seafood industry. This approach has led to the implementation of better fishing practices, establishment of marine protected areas, and improvement in the livelihoods of local communities (Walton et al., 2014).

The CTI's effectiveness stems from its comprehensive action plan, which encompasses targeted strategies for marine protected areas (MPAs) establishment, sustainable fisheries management, and climate change adaptation. By fostering regional cooperation and employing a multi-sectoral approach, the initiative has successfully implemented measures such as creating new MPAs, improving fisheries management policies, and enhancing community resilience. This detailed analysis of the CTI's action plan and its execution illustrates the critical role of coordinated regional efforts and stakeholder engagement in achieving sustainable trade practices and conservation outcomes.

The European Union's ban on the import of fishery products from countries not combating IUU fishing is another impactful integration (Leroy et al., 2016). This measure not only discourages IUU fishing practices globally but also promotes the trade of legally caught seafood, thus contributing to marine conservation.

The EU's regulatory framework to combat IUU fishing includes stringent import controls, certification requirements, and a 'yellow card' warning system to non-compliant countries. This approach not only prevents IUU products from entering the EU market but also encourages countries to strengthen their fisheries management and enforcement mechanisms. Analyzing the implementation of these measures reveals the importance of international collaboration and the effective use of trade restrictions as leverage to promote global fisheries governance and sustainable trade practices.

Additionally, the development of sustainable aquaculture practices, such as integrated multi-trophic aquaculture (IMTA), illustrates how trade and conservation can be aligned. IMTA systems combine different aquatic species in the same ecosystem, such as fish, shellfish, and seaweeds, in a way that mimics natural ecosystems (Nissar et al., 2023). This approach reduces environmental impacts, enhances resource efficiency, and provides diverse marketable products, promoting both economic viability and ecological sustainability.

The IMTA system's success is underpinned by its ability to mimic natural ecosystem processes, where the waste products from one species serve as inputs (food, fertilizer) for another. Implementing IMTA involves careful planning and management to balance the species composition and ensure mutual benefits. This approach not only improves resource efficiency and reduces environmental impacts but also diversifies income sources for aquaculture operations, demonstrating a practical model of how trade and conservation principles can be harmoniously integrated.

These examples demonstrate that with the right policies, practices, and international cooperation, trade can

be a powerful tool for marine conservation. By aligning economic incentives with environmental protection, it is possible to create a win-win situation for both trade and the conservation of marine ecosystems.

## 6 Policy recommendations and future directions

To align trade policies effectively with Sustainable Development Goal 14 (SDG 14), which focuses on conserving and sustainably using the oceans, seas, and marine resources, several strategic policy recommendations are essential. Firstly, it is crucial to integrate environmental considerations into trade agreements actively. This can be achieved by including binding and enforceable environmental clauses in these agreements, particularly those that address sustainable fishing practices, pollution control, and the protection of critical marine habitats. Trade agreements should incentivize member countries to adopt sustainable marine practices and provide mechanisms for monitoring and enforcing compliance. Additionally, trade policies should support the elimination of harmful subsidies that contribute to overfishing and degradation of marine ecosystems. Instead, they should promote subsidies that encourage sustainable marine practices, such as investments in eco-friendly fishing technologies and marine conservation projects.

The role of international collaboration and multilateral agreements is pivotal in the context of marine conservation and trade. Oceans are transboundary in nature, and their effective management requires coordinated efforts across nations. Multilateral agreements can play a vital role in setting global standards for sustainable marine practices. For example, strengthening the implementation of the UNCLOS and the CITES can provide a robust legal framework for protecting marine biodiversity. Regional collaborations, such as the Coral Triangle Initiative, demonstrate how countries with shared marine ecosystems can work together to manage marine resources sustainably. Furthermore, international organizations like the World Trade Organization (WTO) should take an active role in addressing issues related to marine conservation, ensuring that global trade rules do not contradict but rather complement efforts to achieve SDG 14.

Looking towards the future, several trends and potential developments in trade are likely to influence marine conservation efforts significantly. The increasing use of technology, such as blockchain for traceability of seafood products, offers tremendous potential for enhancing transparency and reducing IUU fishing. The growing consumer awareness and demand for sustainably sourced seafood are likely to continue driving changes in trade practices and policies. In the future, we may see more comprehensive and stringent environmental standards being adopted in trade agreements, reflecting the

rising global emphasis on sustainability. Another potential development is the expansion of blue economy concepts, which focus on economic growth, social inclusion, and the preservation or improvement of livelihoods while ensuring environmental sustainability of the oceans and coastal areas. This approach could lead to innovative economic models that harmonize trade and marine conservation. Additionally, the increasing impacts of climate change on marine ecosystems will necessitate adaptive trade policies that are responsive to changing environmental conditions. In summary, the future of trade and marine conservation is poised at a critical juncture, with opportunities for significant advancements in sustainable practices, driven by policy innovation, international collaboration, and evolving global norms.

Trade policies have traditionally focused on economic growth and market access; however, the evolving challenges of climate change and associated marine risks necessitate a broader application of these policies towards environmental sustainability. As marine ecosystems face unprecedented threats from rising temperatures, ocean acidification, and habitat destruction, it becomes imperative to harness the potential of international trade agreements and policies in fostering resilience and adaptation among marine communities and ecosystems.

Firstly, trade policies can be instrumental in facilitating the transfer and adoption of green technologies and practices. By reducing tariffs on environmentally friendly goods and services, countries can encourage the adoption of renewable energy, sustainable fishing gear, and pollution control technologies. These measures can mitigate the impacts of climate change on marine life and habitats, contributing to the resilience of marine ecosystems.

Secondly, trade agreements can include provisions that specifically address the need for climate adaptation in coastal and marine areas. This could involve support for mangrove restoration projects, coral reef conservation, and the development of sustainable aquaculture practices. Such initiatives not only protect marine biodiversity but also enhance the livelihoods of communities dependent on marine resources, making them less vulnerable to climate change impacts.

Furthermore, embedding environmental standards and sustainability goals within trade agreements can drive global efforts to reduce carbon emissions and manage marine environmental risks more effectively. By aligning trade incentives with environmental performance, countries can encourage a global shift towards lower-carbon economies and sustainable resource use, addressing some of the root causes of marine biodiversity loss and ecosystem degradation.

To support these expanded roles of trade policies in managing marine risks, international cooperation and

capacity-building efforts are essential. Developing countries, in particular, require technical and financial support to implement sustainable trade practices and adapt to climate change. Enhanced global partnerships, through mechanisms like the United Nations Framework Convention on Climate Change (UNFCCC) and the Convention on Biological Diversity (CBD), can ensure that trade and environmental policies are mutually supportive, leading to more robust marine conservation outcomes.

Trade policies can play a key role in managing marine risks associated with climate change and other environmental threats. By integrating economic, environmental, and social dimensions into these policies, it's possible to address issues like ocean acidification, marine pollution, and habitat degradation. This integrated approach is crucial for advancing marine sustainability and achieving long-term goals in the face of global changes.

## 7 Conclusion

This paper has critically examined the complex interplay between international trade and the achievement of Sustainable Development Goal 14 (SDG 14), focusing on the conservation and sustainable use of marine resources. Through an exploration of both the positive and negative impacts of trade on marine ecosystems, the analysis has highlighted the potential of trade as a tool for marine conservation, as well as the challenges and pitfalls that need to be addressed. The case studies and examples discussed illustrate the diverse ways in which trade policies and practices can either support or hinder the objectives of SDG 14, emphasizing the need for a delicate balance between economic growth and environmental sustainability.

Throughout this paper, we examined two hypotheses regarding the role of international trade in achieving SDG 14. The first hypothesis posited that trade policies and practices aligned with sustainability principles contribute significantly to the conservation and sustainable use of marine resources. The second hypothesis suggested that without robust regulatory frameworks and sustainable practices in international trade, there is an exacerbated risk of overfishing, habitat destruction, and pollution, thereby challenging marine conservation.

The analysis presented in this study supports the validity of both hypotheses. For the first hypothesis, case studies such as the implementation of eco-certification programs (e.g., MSC certification) and the inclusion of environmental provisions in trade agreements (e.g., CPTPP) demonstrate that sustainable trade practices can positively impact marine conservation. These examples illustrate how sustainable trade mechanisms can lead to improved fisheries management, reduced bycatch, and the recovery of certain fish stocks.

For the second hypothesis, the evidence of overfishing, Illegal, Unreported, and Unregulated (IUU) fishing, and marine pollution resulting from global trade supports the notion that without strong enforcement mechanisms and sustainable trade practices, trade can negatively impact marine ecosystems. The analysis of current trade agreements and practices revealed significant challenges in monitoring and enforcement, leading to continued threats to marine resources. These findings underscore the critical need for rigorous trade policies and international cooperation to address these challenges and harness the potential of international trade to support marine conservation and SDG 14.

The discussion on policy recommendations and future directions underscores the importance of aligning trade policies with sustainable marine practices, the crucial role of international collaboration and multi-lateral agreements, and the emerging trends that could shape the future of trade in relation to marine conservation. It is clear that a multi-faceted approach is required, involving a combination of regulatory measures, market-based incentives, technological innovations, and collaborative efforts at both the international and regional levels.

The findings from the systematic review confirm that while trade policies have the potential to significantly influence marine conservation positively, the effectiveness of these policies often hinges on the strength of enforcement and the degree of international collaboration. The empirical data support the need for a nuanced understanding of regional differences in policy impact and the critical role of capacity building in enhancing policy effectiveness. Moving forward, it is essential to integrate these empirical insights into policy development to ensure that trade becomes a driving force for sustainable marine resource management.

Moving forward, it is imperative that governments, international organizations, the private sector, and civil society work together to integrate sustainability more deeply into the fabric of international trade. By doing so, it is possible not only to safeguard marine ecosystems for future generations but also to unlock new opportunities for sustainable economic development. The journey towards achieving SDG 14 is complex and challenging, but with concerted efforts and a commitment to sustainable trade practices, significant progress can be made towards preserving the life below water, which is so vital to our planet's health and well-being.

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#### Author's contributions

Mohamad Zreik is the sole author and was responsible for the conception and design of the study, data collection and analysis, interpretation of results, and manuscript writing.

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