

Fisheries

Trade, Climate, and Net Zero Pathways: Scenarios and Implications for Developing Countries and Climate-Resilient Development

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Acknowledgements

The author wishes to thank Christophe Bellmann and Yasmin Ismail of TESS for their support and for the invitation to contribute to this series. He also wishes to thank the Social Sciences and Humanities Research Council of Canada for their support of the Solving FCB Partnership project.

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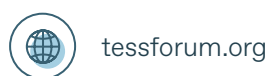
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Recommended citation: Sumaila, U.R. (2024). *Fisheries – Trade, Climate, and Net Zero Pathways: Scenarios and Implications for Developing Countries and Climate-Resilient Development*. Forum on Trade, Environment, & the SDGs (TESS).

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About This Series of Sectoral Briefing Notes

This briefing note is part of a series of sectoral notes commissioned by TESS intended to inform a final report on *Trade and climate scenarios on the road to 2050: Implications for developing countries and climate-resilient development*.

The series and the report aim to provide an overview of current and anticipated transformations in trade on the road to 2050 in the context of the unfolding climate crisis and the international community's climate action agenda and to discuss potential scenarios and implications for developing countries.

A wider objective of the series is to contribute to a better understanding of emerging trade and trade policy trends and dynamics and their implications within the various sectors, with a focus on supporting developing countries in identifying and advancing their climate change trade-related interests and priorities in international discussions.

The sectors covered in the series include agriculture, border carbon adjustments, carbon markets, critical minerals, digital trade, fisheries, energy, heavy industries, textiles, tourism, and transport, each authored by experts in these respective fields.

Abbreviations

CO2	Carbon Dioxide
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GHG	Greenhouse Gas
IPCC	Intergovernmental Panel on Climate Change
IUU	Illegal, Unreported, and Unregulated
NAP	National Adaptation Plan
PTA	Preferential Trade Agreement
RFMO	Regional Fisheries Management Organization
RTA	Regional Trade Agreement
SIDS	Small Island Developing States
SPS	Sanitary and Phytosanitary
TBT	Technical Barriers to Trade
WTO	World Trade Organization

1. Fisheries in the Nexus of Climate Change, Trade, and Sustainable Development

The fisheries sector is deeply interlinked with the climate crisis in two significant ways. Overfishing exacerbates the climate crisis by depleting fish stocks, leading to excessive carbon dioxide (CO₂) emissions, and disrupting aquatic ecosystems, which reduces their resilience to climate change (Sumaila & Tai, 2020). Also, removing large fish through overfishing diminishes marine life's capacity to sequester carbon, further intensifying atmospheric CO₂ levels (Lee et al., 2023). On the other hand, the climate crisis negatively impacts fish stocks through rising sea temperatures (Cheung et al., 2021), ocean acidification (Figuerola et al., 2021), deoxygenation (Grégoire et al., 2021; Kim et al., 2023), and sea level rise. These changes cause fish species to migrate, perish, and/or face habitat destruction, such as coral bleaching and loss of coastal nurseries like mangroves. What is more, increased frequency of extreme weather events disrupts fishing activities, damages infrastructure, and causes abrupt environmental changes, further harming fish populations (Mendenhall et al., 2020).

Fisheries are a crucial source of protein and essential nutrients, particularly in developing countries where alternative animal protein is often scarce or expensive. Rich in omega-3 fatty acids, vitamins, and minerals, fish contributes significantly to improved nutrition and food security (Srinivasan et al., 2010; Omukoto et al., 2024). The sector also provides direct and indirect employment to millions of people, from fishers to processors and traders, making it a vital source of livelihood for coastal communities (The & Sumaila, 2013; Scherrer et al., 2024). Additionally, fisheries play a key role in national economies through exports, trade, and revenue generation (Bellmann et al., 2016), with sustainable management enhancing economic stability and growth. Climate action and resilience efforts are essential to protecting fish stocks and ensuring these benefits continue into the distant future, thereby achieving "Infinity Fish" (Sumaila, 2021).

Sustainable and inclusive trade in the fisheries sector could be a long term cornerstone of the global economy, providing essential food, livelihoods, and economic growth into the distant future. Fish trade currently generates significant revenue, especially for large ocean states (or small island developing states – SIDS), with export earnings contributing to national incomes and economic development. Sustainable and equitable fisheries trade would support millions of jobs across the value chain, from fishing to processing, transportation, and marketing. It could also ensure the availability of fish in regions where local production falls short, bolstering global food security. By enabling access to a diverse range of fish species, trade enhances dietary diversity and nutritional intake. For developing countries, access to international markets that are fair and equitable is crucial for the growth of their fisheries sector, offering opportunities for economic expansion through sustainable fair trade agreements and export markets. Moreover, such trade can stimulate investment into value-added processing and supply chain infrastructure, increasing the economic value of fishery products and facilitating the transfer of technology and best practices in sustainable fisheries management from developed to developing countries.

All of the above potential contribution are being threatened by climate change (Sumaila et al., 2011). Greenhouse gas (GHG) emissions, resulting in climate change and its impacts are projected to increase by 2050 and beyond (2). Rising sea temperatures are already disrupting fish distributions and productivity. This is projected to worsen by 2050, leading to increased fishing effort and fuel consumption, which could elevate GHG emissions (Chen et al., 2023). As climate change affects ocean ecosystems, aquaculture is expected to expand, potentially increasing emissions from energy-intensive farming practices and feed production. With these changes,

transitioning to low-emission technologies, more sustainable practices, and improving energy efficiency in the fisheries sector will be critical to offset potential emission increases. Projections indicated that the fisheries sector, including both wild fisheries and aquaculture, could contribute a larger share of GHG emissions without significant efforts to decarbonize (Chen et al., 2023). These trends underscore the need for urgent adaptation and mitigation strategies in fisheries management (Cheung et al., 2019; Sumaila et al., 2020; FAO, 2022; Allan et al., 2023).

If global warming exceeds 2°C, the fisheries sector could see a significant rise in GHG emissions due to increased fishing effort, the use of more energy-intensive equipment, and expanded aquaculture. Without mitigation, emissions from fisheries could surpass current levels by up to 30–40% due to these factors, especially as fishing grounds shift and production costs rise. Current sea surface temperatures have increased by about 1.2°C since pre-industrial times. Projections suggest an additional increase of 0.6°C to 3.0°C by 2100, depending on emission scenarios. The warming of oceans has far-reaching impacts on marine ecosystems and fish stock availability. Global fish catches are expected

to decline by 3–25% by 2050, with regional impacts varying widely. Tropical developing regions, which contribute relatively less CO₂ per capita and where fisheries are vital for livelihoods, are projected to experience the most severe reductions due to changing ocean conditions and shifts in species distributions (FAO, 2022; Allan et al., 2023).

Climate actions aimed at resilient supply chains—such as investments in climate-proof infrastructure, species diversification, and sustainable trade policies—can stabilize fish trade and reduce dependency on vulnerable stocks. Integrating carbon pricing and reforming subsidies can incentivize low-carbon practices and support sustainable fisheries. Fair and equitable trade agreements that incorporate climate goals would promote alignment with international targets, while regional agreements can enhance cooperation in managing shared fish stocks and implementing climate strategies. Furthermore, such trade can drive innovation in climate-smart technologies (Santos et al., 2024), such as aquaculture and climate-resilient species, and facilitate global data sharing and research on climate adaptation.

2. Climate Action and Impact Scenarios in the Fisheries Sector

We provide in Table 1 a summary of the global actions proposed overtime to mitigate climate change, help people and nature to adapt, and compensate countries and people of the Global South for the loss and damage they have suffered as a result of climate change. The commitments highlighted in the table demonstrates the global recognition of the need to integrate climate change mitigation, adaptation, and loss and damage considerations into the sustainable and equitable management of the fisheries sector. These efforts

are supported by international commitments such as the Paris Agreement, national adaptation plans, and frameworks provided by organizations such as the Food and Agriculture Organization of the United Nations (FAO) and the Intergovernmental Panel on Climate Change (IPCC). Ensuring sustainable fisheries practices, enhancing resilience, and providing support for affected communities are crucial components of these global strategies.

Table 1. Proposed Global Climate Actions, Their Objectives and Relevance to Fisheries

Agreement	Action	Objective	Relevance to fisheries	Implementation
Paris Agreement (2015)	Mitigation	Limit Global temperatures rise to well below 2°C above pre-industrial levels, with efforts to limit the increase to 1.5° C.	Reducing greenhouse gas emissions can mitigate ocean warming and acidification, which directly impact marine ecosystems and fish populations.	Countries' nationally determined contributions (NDCs) may include specific measures to reduce emissions from the fisheries sector, such as improving fuel efficiency in fishing vessels and reducing carbon footprints in fish processing.
Kyoto Protocol (1997)	Mitigation	Legally binding targets for developed countries to reduce greenhouse gas emissions.	Legally binding targets for developed countries to reduce greenhouse gas emissions.	Invest in low-carbon technologies and practices within the fisheries sector.
Paris Agreement (2015)	Adaptation	Enhance adaptive capacity, strengthen resilience, and reduce vulnerability to climate change.	Supports the development of National adaptation plans (NAPs) that include specific strategies for the fisheries sector to cope with changing ocean conditions, such as shifts in fish stock distribution and breeding patterns.	Encourages the sharing of knowledge and best practices for adapting to climate impacts in fisheries, such as sustainable aquaculture and ecosystem-based management approaches.
Cancun Adaptation Framework (2010)	Adaptation	Enhance action on adaptation, particularly for developing countries.	Facilitates the development of adaptation strategies tailored to the fisheries sector, ensuring food security and livelihoods for communities dependent on fisheries.	Promotes capacity-building, technology transfer, and financial support for adaptation initiatives in the fisheries sector.
Nairobi Work Programme (2005)	Adaptation	Improve understanding and assessment of impacts, vulnerability, and adaptation to climate change.	Provides a platform for sharing information on the impacts of climate change on fisheries and successful adaptation strategies.	Supports research and data collection on climate impacts on marine ecosystems and fisheries, aiding in the development of evidence-based adaptation policies.
Paris Agreement (2015)	Loss and Damage	Recognize the importance of averting, minimizing, and addressing loss and damage associated with the adverse effects of climate change.	Promotes international cooperation and support for addressing loss and damage in the fisheries sector, ensuring resilience and sustainable livelihoods.	Encourages the development of comprehensive risk management strategies and insurance schemes to protect fisheries and fishing communities from climate-induced losses.
Warsaw International Mechanism for Loss and Damage (WIM) (2013)	Loss and Damage	Address loss and damage associated with the impacts of climate change, including extreme and slow onset events.	Acknowledges the need to address economic and non-economic losses in the fisheries sector, such as loss of fish stocks, degradation of marine habitats, and impacts on fisherfolk communities.	Facilitates support for affected communities, including financial assistance, technology transfer, and capacity building to manage and recover from climate-related losses.

Source: Author's elaboration.

Looking across continents, we see some similarities and differences in the approach to mitigating climate change in the fisheries sector. Across all continents, energy-efficient practices and renewable energy are being adopted in aquaculture as part of mitigation strategies, while comprehensive adaptation strategies are developed to address shifts in fish stock distribution, extreme weather events, and habitat restoration. National adaptation plans (NAPs) and regional frameworks are crucial in guiding these efforts. Similarly, both the Global South and Global North are actively engaged in mitigating and adapting to climate change impacts on the fisheries sector, with similarities including the adoption of energy-efficient practices, renewable energy in aquaculture, and the development of comprehensive adaptation plans aligned with international commitments like the Paris Agreement. However, there are notable differences. The Global North generally has more resources and advanced technologies for implementing these strategies, with robust policy frameworks and funding mechanisms, for example the EU Common Fisheries Policy and the European Maritime and Fisheries Fund. In contrast, the Global South often relies more on regional initiatives and international support, focusing on livelihood resilience

and food security due to a higher dependency on fisheries, while the Global North emphasizes technological innovation and sustainable practices.

Comparing key current and expected climate impacts on fisheries across continents, we find that all continents, particularly those on or close to the equator, are experiencing significant shifts in fish stock distribution due to ocean warming, ocean acidification affecting shellfish and coral reefs, and extreme weather events causing damage to fisheries infrastructure. Sea level rise is resulting in habitat loss and coastal erosion, while deoxygenation and the loss of marine biodiversity are common threats impacting coastal communities dependent on fisheries. However, because the Global South is more severely affected by poverty and food insecurity, the climate crisis harms it more. Each continent also faces unique regional characteristics and challenges. For example, the Humboldt Current with its special features is located in South America while the Gulf of Guinea and the Coral Triangle are in Africa and Asia, respectively. Furthermore, the Global North generally has more robust infrastructure, resources, and policies to adapt to these changes, compared to regions in the Global South.

3. Trade-Related Trends and Dynamics in the Fisheries Sector

Trade Impacts Resulting From the Physical Impacts of Climate Change

Climate action policies and measures have significant implications for trade trends in fisheries, affecting everything from fish stock availability and distribution in aquatic ecosystems and regulatory environments to economic, social, and technological aspects. While these policies can pose challenges, they also offer opportunities for enhancing sustainability, resilience, and competitiveness in global fisheries trade. Adapting to and mitigating climate impacts will require coordinated

efforts and innovative solutions to ensure the long-term viability and prosperity of the fisheries sector in the face of a changing climate.

The climate crisis is already impacting trade in fisheries in many ways, and thereby is influencing every aspect of the industry from biological productivity to economic stability. Biological and ecological impacts include shifts in fish stock distribution because warming oceans are causing many fish species to migrate towards cooler waters, often towards the poles or into deeper waters. This shift can disrupt traditional fishing grounds and

lead to changes in the availability of certain species in different regions (Lee et al., 2023; Sumaila et al., 2019; Lam et al., 2020). Changes in water temperature and chemistry can alter the composition of fish communities, impacting biodiversity and the balance of marine ecosystems. This can lead to the decline of some commercially important species and the rise of others thereby altering trade flows. Climate change is also fuelling ocean acidification, which particularly affects shellfish by weakening their shells (Figuerola et al., 2021).

Since the climate crisis affects the biophysics of aquatic ecosystems, it is obvious that it affects life in the ocean including fish populations, and therefore the economic activities that depend on them (Tai et al., 2019). Economic impacts as a result of the climate crisis include changes in the supply and demand and therefore the price of fish (Sumaila et al., 2019), as well as altering migration patterns and changes in fish stock productivity and supply variability. This unpredictability can affect market stability and pricing, influencing international trade. Also, regions that lose their traditional fish stocks, in particular in the Global South, would face economic hardships (Sumaila et al., 2019; Lam et al., 2020), while new fishing opportunities in other regions, for example the Arctic (Tai et al., 2019), may arise, shifting global trade dynamics. These shifts lead to changes in costs and investments in the fisheries sector (Sumaila et al., 2019), as fishers and related industries may face increased operational costs due to the need for climate adaptation measures, including investing in new fishing technologies, changing fishing practices, or relocating operations (Chen et al., 2023). On the other hand, the climate crisis may open new investment opportunities, at least in the short term, in sustainable fishing practices, aquaculture, and climate-resilient infrastructure, which can create novel economic opportunities and trade advantages. Unfortunately, these opportunities would accrue mainly to countries in the Global North, where the highest per capita CO₂ emissions are generated, creating inequality reinforcing dynamics where there is a mismatch between those who fuel the climate crises the most (i.e. the Global North) and those who pay the highest price imposed by

the crisis—the Global South (Sumaila et al., 2019; Lam et al., 2020).

Closely related to the economic impacts are the social and community effects on indigenous and coastal people worldwide due to the climate crisis. Climate impacts such as sea-level rise and extreme weather events can displace fishing communities, disrupting traditional livelihoods and trade networks, and efforts to diversify livelihoods to reduce dependency on fisheries can lead to changes in labour availability and skills within the fishing industry, impacting trade.

Trade Impacts of Policy Measures Implemented to Address or Respond to Climate Change

The evolving trade-related trends and policies in the fisheries sector are reshaping competitive advantages, trade relations, development strategies, and geostrategic dynamics. Trade relations are being influenced by new standards and regulations, with the potential for both cooperation and conflict. Development strategies are aligning more closely with global sustainability goals, while geostrategic tensions over resources are likely to persist. Addressing these diverse impacts requires a cooperative approach that balances economic, environmental, and social considerations.

Current trends in regulations and sustainability standards include (i) increasing use of eco-labels (e.g. Ocean Wise) to promote sustainable fishing practices and provide market incentives and (ii) national and international regulations requiring adherence to sustainability standards for fisheries management (e.g. EU Common Fisheries Policy). In terms of prospective trends, future policies may enforce stricter sustainability criteria, impacting market access for fisheries that do not comply. Also, efforts to harmonize sustainability standards globally to facilitate trade and ensure uniformity in environmental protection could be accelerated.

The climate crisis is already creating regulatory and policy impacts. It could lead to stricter sustainability standards and regulations aimed at mitigating climate

impacts, which can increase compliance costs for fishing enterprises but they can also open access to markets that demand sustainably sourced products. What is more, countries that fail to implement effective climate and sustainability measures may face trade barriers or sanctions from markets with stringent environmental requirements, affecting their export capabilities. An example of this is the EU's carding system via its European Commission Regulation (EC) No. 1005/2008, which aims to incentivize fish and fish product exporters to the EU to act to reduce illegal, unreported, and unregulated (IUU) fishing in their waters (Sumaila, 2019). Several authors have studied the likely impact of climate change on the management of shared fish stocks and they have all concluded that climate change would affect international cooperative fisheries management agreements aimed at sustainable management of shared fish stocks—for example, the International Pacific Halibut Commission's work; the joint management of cod in the Barents Sea; the work of the Benguela Current Convention; and the management of the shared fish populations in the East China Sea ecosystem. These changes that are already visible in many parts of the world would influence trade patterns, potentially leading to less equitable and stable trade relationships between, in particular, countries of the Global South and the Global North.

The climate crisis poses significant challenges to the fisheries sector, affecting biological resources, economic stability, regulatory environments, social structures, technological advancements, and geopolitical relations. However, it also presents opportunities for innovation, sustainability, and international cooperation. Adapting to these changes will require comprehensive strategies that integrate environmental, economic, and social considerations to ensure the long-term viability and prosperity of global fisheries trade. The key point to note is that the distributions of costs and benefits being generated by the climate crisis, between and within countries, continents, the Global North and Global South, are the defining moral, ethical, economic, and social challenges and potential opportunities stemming from the ongoing climate crisis.

The push for traceability and transparency is currently taking the form of electronic catch documentation schemes to track the origin and legality of fish products; including through adoption of blockchain technology for traceability in the supply chain to prevent IUU fishing. Looking into the future, regulations mandating comprehensive traceability systems to ensure sustainable and legal sourcing of fish products seem to be in the card. In addition, the development of integrated global systems for monitoring and reporting fisheries data in real time may well be accomplished. However, it is worth noting that these developments may only happen to a significant level in the Global North because of the skewed distribution of currently available global resources towards these countries.

Subsidies have always been a big part of global efforts to make trade fairer more generally. However, in terms of the fisheries sector, they have taken greater relevance because most of the subsidies provided by governments to the sector are harmful in the sense that they can catalyse overcapacity and overfishing (Sumaila, Skerritt, et al., 2019; Sumaila et al., 2021). Hence, there has been a big global effort via the World Trade Organization (WTO) and other bodies to reduce or eliminate subsidies that contribute to overfishing and environmental degradation. In addition, some countries are reforming their subsidy programmes to eliminate incentives for harmful fishing practices. The current effort to remove harmful subsidies would continue in the future until strong enough global agreements to phase out harmful subsidies are reached. A really important point that should motivate governments is that current harmful subsidies can be redirected towards sustainable practices and conservation efforts to promote resilience in the fisheries sector, as well as improve the livelihoods of fishers and non-fishers alike.

Environmental tariffs and border measures are important trade tools (Bellmann et al., 2016). Currently, preferential tariffs for sustainably sourced fish products under preferential trade agreements (PTAs) and regional trade agreements (RTAs) are deployed. Prospective trends would likely include the introduction of tariffs or trade measures to penalize unsustainable practices

and promote eco-friendly products. It is also possible that carbon border adjustment mechanisms would be deployed to account for the carbon footprint of imported fish products. Non-tariff measures are also useful tools currently used to support sustainable trade. For example, sanitary and phytosanitary (SPS) measures are employed to ensure that imported fish products meet health and safety standards to protect consumer health and prevent the spread of invasive species. In addition, regulations on labelling, packaging, and processing standards for fish products are used in this regard. Peering into the future, we expect stricter standards that enhance SPS and technical barriers to trade (TBT) measures focusing on sustainability and climate resilience. Efforts to harmonize non-tariff measures internationally to facilitate trade while ensuring environmental and health protections would likely be intensified with time.

Shifts in fish populations due to climate change are already impacting existing international joint agreements

for managing shared stocks (Killer et al., 2013), and should lead to more changes to these agreements into the future. Potential new multilateral agreements focused on climate-resilient fisheries management and trade should also become more common with time. Greater international cooperation to address the impacts of climate change on fisheries, including data sharing and joint conservation efforts, would be highly desirable as the climate crisis intensifies as expected. We expect future RTAs to include more comprehensive clauses addressing climate change, sustainability, and resilience in fisheries trade, including the expansion of regional initiatives aimed at promoting sustainable fisheries and mitigating climate impacts. As the climate crisis intensifies, these trends are likely to continue, with increased emphasis on sustainability, transparency, and international cooperation. The success of these policies will depend on global collaboration, innovation, and the commitment of all stakeholders to integrate climate resilience into the fisheries trade framework.

4. Opportunities and Challenges for Developing Countries

Potential Trade Opportunities

A crucial avenue for trade opportunities is value addition. Developing countries should engage more in the processing and packaging of their fish and fish products for local, regional, and international trade. They need to invest in local processing facilities that can increase the value of raw fish products, creating jobs and retaining more economic benefits within the country and in the Global South. To succeed, developing countries have to aim for high quality products that meet international processing and packaging standards as doing so would open up new markets and export opportunities. Developing countries can enhance their export revenues by focusing on value-added products such as fillets, canned seafood, and ready-to-eat items. Tightly connected to value addition is the need for developing

countries to invest in innovation to help them develop new products that cater to health and wellness trends, such as omega-3 supplements, fish protein powders, and organic seafood so they can help meet growing consumer demand for such products. Adequate investment in non-traditional fish species and developing unique culinary products can differentiate offerings from these countries in the global market, thereby putting them in a position to tap into emerging trends and diversify their export portfolios.

An area of great opportunity for developing countries is digital transformation and traceability. More specifically for fisheries, investing in blockchain technology can improve traceability, ensuring the legality and sustainability of fish products, and thus open up new markets both domestically and internationally. Similarly, investment in smart

fishing technologies can increase productivity and sustainability, creating new trade opportunities.

Developing countries have a unique opportunity to deploy nature-based solutions to the climate crisis because of the diversity and richness of their aquatic ecosystems. This could be achieved by restoring mangroves and coastal ecosystems to enhance biodiversity, which, in turn, supports fisheries, and provides coastal protection. Ecosystem restoration can improve fishery productivity and create new revenue opportunities through ecosystem services and carbon markets. These countries can also deploy indigenous wisdom such as the Seventh Generation Principle—to think of the seventh generation after you in your actions and to remember the seventh generation who came before—to help ensure that the fisheries sector is both sustainable and equitably conserved and used to the benefits of all generations.

Last but not the least, developing countries should increase their active participation in regional and global collaborative fora tackling the climate and biodiversity crises because these do provide platforms for them to influence policies and secure favourable trade terms. Important to regional and global collaboration are trade agreements. There is an opportunity for developing countries to negotiate trade agreements that include provisions for sustainable fisheries as well as make room for preferential market access. Engaging in international trade agreements can also bring technical assistance and capacity building and information sharing opportunities, thus allowing developing countries to strengthen their contribution to trade agreements in ways that can help open new markets while providing support for developing sustainable fisheries practices.

Trade-Related Challenges

Developing countries are sure to face big challenges as the climate crisis rages on. Not only because its impacts would hit these countries' fisheries more severely, but also because these countries have limited access to appropriate technology, such as global

positioning systems, sonar systems, and blockchain for traceability, which are often expensive, making it difficult for small-scale and artisanal fishers to afford them. Limited access to modern technologies can hinder the ability of developing countries to compete in global markets that demand sustainable and traceable seafood products. A related challenge is the lack of adequate technical expertise and skilled personnel to operate and maintain advanced fishing technologies.

Lack of finance is the graveyard of good ideas and initiatives; without access to capital, developing country fisheries, especially small-scale fishers and aquaculture enterprises, are unable to invest in sustainable practices, infrastructure, human capacity enhancement, and technology, thereby limiting growth and development in the fisheries sector. Financial institutions may perceive investments in fisheries as high risk due to factors such as fluctuating fish stocks (Sumaila, Walsh, et al., 2021), climate change impacts, and market volatility, which can result in higher interest rates or denial of credit, further constraining access to necessary funding. Other trade-related challenges in the fisheries sector include technological, financial, infrastructural, regulatory, labour, market access, environmental, and geopolitical issues.

Addressing these challenges requires approaches involving investment in technology and infrastructure, capacity building and information sharing, regulatory harmonization, and improved labour conditions as well as international cooperation. By overcoming these barriers, developing countries can enhance their competitive position and fully realize their potential in the global fisheries market. Furthermore, developing countries can strategically put together trade policies and international cooperation arrangements that can help them navigate the transition towards climate-resilient development in the fisheries sector. To achieve this, they will need to implement the critical steps set out in Table 2. The actions listed in the table can strengthen these countries to overcome trade-related challenges, enhance their competitive advantages, and ensure sustainable and resilient fisheries development on the road to 2050.

Table 2. Critical Steps in Trade Policies and International Cooperation Agreements That Can Help With the Transition Towards Climate-Resilient Development in the Fisheries Sector

Strategy	Action	Benefit
1. Strengthening Trade Policies		
a. Implementing Preferential Trade Agreements	Negotiate and enter PTAs that include provisions for sustainable and climate-resilient fisheries.	PTAs can provide developing countries with better market access, reduced tariffs, and support for sustainable practices, enhancing competitiveness.
b. Incorporating Environmental Provisions in Trade Agreements	Ensure that new trade agreements include strong environmental and climate provisions, promoting sustainable fisheries management.	These provisions encourage the adoption of sustainable practices and ensure long-term resource availability, supporting climate-resilient development.
2. Enhancing International Cooperation		
a. Engaging in Regional Fisheries Management Organizations (RFMOs)	Actively participate in RFMOs to manage shared fish stocks sustainably and address challenges like overfishing and climate change impacts.	RFMOs provide a platform for cooperation, knowledge sharing, and coordinated actions, improving resource management and resilience.
b. Forming Strategic Alliances	Form strategic alliances with other developing countries to advocate for fair trade practices, technology transfer, and financial support.	Collective bargaining can lead to more favourable trade terms, increased support for sustainable development, and better access to resources.
c. Accessing International Funding and Technical Assistance	Leverage international funding mechanisms (e.g. Global Environment Facility, Green Climate Fund) and technical assistance programmes.	Financial and technical support can help developing countries implement climate-resilient practices, enhance infrastructure, and build capacity.
3. Building Domestic Capacity		
a. Investing in Education and Training	Develop education and training programmes focused on sustainable fisheries management, advanced technologies, and climate adaptation.	Building human capital ensures that the workforce is skilled and capable of implementing and maintaining sustainable practices.
b. Developing Infrastructure	Invest in infrastructure improvements, such as modern ports, processing facilities, and cold storage.	Enhanced infrastructure reduces post-harvest losses, improves product quality, and facilitates access to international markets.
c. Promoting Research and Development	Encourage research and development in sustainable aquaculture, resilient fish species, and innovative fishing techniques.	Research and development can lead to new solutions that enhance productivity, sustainability, and climate resilience in the fisheries sector.
4. Facilitating Access to Technology and Finance		
a. Technology Transfer Agreements	Negotiate technology transfer agreements with developed countries and international organizations.	Access to modern technologies improves efficiency, sustainability, and resilience, helping developing countries compete in global markets.

Table 2. (continued)

Strategy	Action	Benefit
b. Creating Financing Mechanisms	Establish financing mechanisms such as microcredit schemes, grants, and subsidies for small-scale fishers and aquaculture enterprises.	Improved access to finance enables investments in sustainable technologies and practices, promoting long-term growth and resilience.
c. Encouraging Private Investment	Create a favorable investment climate through policies and incentives that attract private sector investment in sustainable fisheries and aquaculture.	Private investment can drive innovation, expand production capacity, and improve market access, contributing to economic development and resilience.
5. Enhancing Market Access and Diversification		
a. Exploring New Markets	Identify and develop new export markets for sustainably sourced seafood, including emerging markets.	Market diversification reduces dependency on a few markets and spreads risk, enhancing economic stability and growth opportunities.
b. Developing Value-Added Products	Focus on producing value-added seafood products, such as fillets, canned fish, and ready-to-eat meals.	Value addition increases profitability, creates jobs, and supports economic development while meeting diverse consumer preferences.

Source: Author's elaboration.

5. Priorities for Policy Engagement and Future Analysis

The following priorities for policy engagement if implemented by developing countries would position them to engage more effectively in equitable trade that is sustainable even in the face of climate change:

1. Promote sustainable fisheries management because without the fish it is game over. Countries should address overfishing by integrating sustainable practices that reduce the depletion of fish stocks, thereby mitigating CO2 emissions and preserving aquatic ecosystems' resilience to climate change.
2. Enhance climate-resilient fisheries by implementing NAPs and other regional frameworks that focus on adapting to climate-induced changes in fish stock distribution, extreme weather events, and habitat restoration and deploying nature-based solutions and strategies.
3. Strengthen climate-proof infrastructure, including those based on preserving natural habitats such as mangroves. Encourage investments in human and nature-based infrastructure that can minimize the impacts of climate change, including species diversification in aquaculture, to stabilize fisheries and ensure the continued availability of fish as a food source.
4. Incentivize low-carbon practices by, among other things, integrating carbon pricing and reforming harmful subsidies to motivate the adoption of low-carbon practices within the fisheries sector and promoting sustainability and alignment with international climate goals.
5. Promote equitable and sustainable fisheries trade. Engage in policies that support fair and sustainable fisheries trade, ensuring access to international markets for developing countries and promoting economic growth through sustainable trade agreements.

6. Foster innovation in climate-smart fisheries by encouraging the development and adoption of climate-smart technologies, such as sustainable aquaculture and climate-resilient species, by facilitating global data sharing, research, and technology transfer and information sharing between developed and developing countries.
7. Support livelihood resilience as well as food and nutritional security. This entails prioritizing policies that enhance the resilience of coastal communities, particularly in the Global South, by ensuring food and nutritional security, livelihood protection, and equitable access to resources in the face of climate change impacts on fisheries.

Future research and analyses that would be necessary to support developing countries as they engage in fish trade under climate change include:

1. Understanding and quantifying the carbon sequestration role of marine life.
2. Conducting more in depth studies of the impact of climate change on fish stock distribution within the waters of developing countries as currently most studies are undertaken in the waters of the Global North.
3. Understanding the long-term effects of rising sea temperatures, ocean acidification, and deoxygenation on the migration patterns, breeding, and survival of various fish species across different regions, in particular in the waters of Global South countries.
4. Focusing on assessing the socio-economic vulnerabilities of coastal communities that rely heavily on fisheries, particularly those in developing countries. This would include evaluating their capacity to adapt to climate change impacts, such as extreme weather events and habitat loss.
5. Identifying best practices and highlighting areas where international cooperation and support are needed; comparing and analysing the effectiveness of different adaptation strategies employed by countries in the Global North and Global South.
6. Exploring the role of sustainable trade in climate adaptation.
7. Conducting comprehensive economic analyses to assess the direct and indirect costs of climate change on global fisheries, including the loss of biodiversity, changes in fish stocks, and the socio-economic impacts on communities. Armed with this research, countries would have a basis for developing targeted policies and compensation mechanisms in support of sustainable and equitable fish trade.

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Chemin Eugène-Rigot 2
CH-1202 Genève
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