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Climate Changes Effect on Wild Fisheries: Difficulties & Strategies

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ABSTRACT

It is anticipated that freshwater and marine fisheries, as well as the companies and people that depend on them, will be severely impacted by climate change. The fishing sector may also face additional challenges due to its greenhouse gas emissions and the potential rise in fossil fuel prices. As climate change alters fish stock distribution, it will harm ecosystems, increase ocean acidity, displace populations and damage coastal infrastructure. The degree of vulnerability in communities and fisheries is determined by their sensitivity and adaptation with economically disadvantaged and marginalized groups being particularly at risk. While it's essential to adapt and sustain fisheries, the exorbitant expenses and restrictions on adaptability emphasize the importance of prioritizing mitigation efforts.

Keywords: Vulnerability, coastal communities, carbon taxes, trade impacts, fuel efficiency, biodiversity, greenhouse gas emissions, aquaculture

Introduction

Fisheries are essential to global food security providing vital nutrients to millions of people around the world. However, the industry is currently facing serious challenges, with many fish populations already overfished or threatened and climate change is expected to worsen these problems. The ongoing poverty in many fishing communities is often linked to the overuse of common resources, resulting in low profitability. This is an unduly simplified perspective small scale fishing must be understood in the context of larger social and economic issues [1]. The enduring poverty in numerous fishing communities is frequently linked to the overuse of open access resources and the consequent low profits. It is necessary to examine small scale fishing in the context of broader socioeconomic and cultural frameworks in which they exist [2, 3]. Climate change affects the five categories of assets natural, physical, financial, human, and social transforming the vulnerability landscape and influencing institutions, policies and processes. The ability of fisheries to react and adapt is what largely determines how vulnerable they are to climate change. Understanding adaptive capacity is crucial for formulating effective strategies to reduce the impact of climate change on fisheries [3].

Fisheries and the reduction of climate change

Contribution of fisheries to carbon emissions

The fisheries sector plays a role in greenhouse gas (GHG) emissions, which drive human-induced climate change. These emissions arise not only from fishing operations but also from the transportation, processing and storage of fish. Although the sector's overall contribution to climate change is relatively limited, fishing fleets reportedly use as much oil as the entire nation of the Netherlands. This section delves into the origins of these emissions and potential strategies for reducing them [4].

Emissions from fisheries operations

Most fishing boats are motorized and run on fossil fuels, with the type of fuel depending on the size of the vessel. A. Smith's personal communication, small vessels use gasoline or diesel, medium sized boats operate on diesel and large vessels (over 1,000 tons) rely on heavy oil.

In 2001, approximately 90,000 ships over 100 tons in the global fleet emitted almost two times as much NOx (21.4 Tg) as CO2. Of these, about 23,000 were fishing boats, contributing 69.2 Tg of CO_2 annually, which accounted for roughly 8.5% of total shipping emissions. Included all vessels in their calculations, while Eyring only considered the largest ships, and the FAO factored in a potential reduction in fleet size from 2001 to 2005 [5].

Fuel efficiency varies by gear type, static gears are more efficient than movable gears, such as those used in demersal trawls. Fisheries employing industrialized passive gear may also consume significant amounts of fuel. In 2005, fuel costs for mobile demersal gears represented up to 50% of income in developing nations and about 30% of revenue in industrialized nations. Ineffective fisheries management can further decrease fuel efficiency [6].

Mitigation of operational emissions

The fishing sector will likely experience increased pressure to enhance fuel efficiency as fuel prices rise. This may involve adopting more energy-efficient equipment or vessels, such as shifting from single to twin trawls, which could lead to fuel savings of 20% or more. Small scale fishermen might revise their fishing methods, utilize sails, or improve their boats' efficiency to cut fuel consumption [7, 8].

Emissions from trade

In 2004. approximately 53 million tons of fish were exchanged globally. High-value fish products, such as tuna, are frequently shipped to Japan by air freight, a method associated with particularly high emissions. Air imports of fish were estimated at 200,000 tons for the US, 100,000 tons for Europe, and 135,000 tons for Asia. Fish transported by air produces substantially higher emissions per kilogram compared to fish transported by sea. According to Saunders, international air freight emits approximately Fish weighing 8.5 kg emits 8.5 kg of CO2, which is more than 90 times higher than ejection from local transport and 3.5 times greater than those from sea freight. Consequently, the 435,000 tons of fish imported by air to the US, Europe, and Asia would generate around 3.7 Tg CO_2, representing 3–9% of the emissions from operating fisheries [8].

Other possible contributions from fisheries to climate action

Studies have examined the use of waste from fish processing to create biodiesel. For instance, a Honduran tilapia processing facility transforms residual fish fat into fuel for its vehicles and for power generation. While fish are nutritionally valuable, this approach provides a sustainable alternative to fossil fuels. Nevertheless, it is improbable that it will see broad implementation in capture fisheries [9].

Consequences of global climate policies for fisheries

At present programs for ejection trading do not apply to the aviation or shipping industries, Fuel duties are paid for by vessels that fish within their Exclusive Economic Zones. Distant water fishing vessels refueled outside territorial waters are exempt from domestic fuel taxes. Most fishing operations, heavily reliant on fossil fuels, are vulnerable to fuel price increases. For example, the doubling of diesel costs in 2004-2005 rendered many fishing enterprises unprofitable, and higher transportation and shipping costs due to carbon taxes could impact food security in poorer fish importing nations and reduce industry profitability [10].

Climate change effects on fisheries

Possible consequences and pathways of impact

Climate change impacts fisheries in multiple ways and for various reasons. These effects result from transformations in political, financial and societal structures in addition to changes in aquatic natural systems and can be both direct and indirect. This section examines climate change's effects on fishing operations, fishermen and their communities [11].

Impacts across different sectors

Regional and handcrafted marine fishing

Small scale fisheries dependent on delicate ecosystems like coral reefs are highly vulnerable to climate change effects such as rising temperatures and ocean acidification. Climate change can cause infrastructure damage and increase maritime risks, while socioeconomic challenges include health issues, rising fuel prices and migration, leading to higher fishing pressure and conflicts. A Fiji case study shows that, in subsistence communities, export market opportunities may sometimes outweigh ecological concerns, complicating sustainable fisheries management [12].

Large scale marine fisheries

Large-scale fisheries, such as the anchoretic fishery in Peru, are highly sensitive to environmental shifts. For instance, El Niño events have caused notable variations in Peruvian anchoretic catches. New patterns of fish stocks might. The Purpose of spatial management strategies less effective, while direct climate effects, like extreme weather and rising sea levels, can damage infrastructure. Indirect consequences include disruptions to markets and

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employment, though declines in some fisheries might result in increased prices for alternative species, as observed with Baltic sprat during El Niño years [13].

Inland fisheries

Climate change induced changes in precipitation and runoff greatly affect inland fisheries. For example, diminished lake levels and catches may adversely impact lake fisheries in southern Africa. On the other hand, increased runoff and discharge rates in river basins can boost fish production by creating more spawning and feeding areas. In Bangladesh, expanded flooded regions could significantly raise annual fish yields. However, alterations in hydrological patterns and shortened dry season might counteract these benefits. Furthermore, extensive infrastructure projects, including irrigation systems, hydroelectric dams and flood protection measures, could greatly influence inland fisheries [14].

Market and trade impacts:

Hurricanes and other climate-related disasters can profoundly impact local fisheries by limiting access to essential supplies like fuel and ice. Heavy rainfall can further impede market access and transportation, negatively affecting fishing communities. Moreover, warmer waters can cause more frequent diseases and algae blooms, heightening concerns about fish contamination and possibly decreasing market demand [15].

Potential positive impacts

Climate change might boost the productivity of current fisheries or lead to the emergence of new ones. For instance, rising water levels could allow some species to extend their range, offering new opportunities for artisanal fishermen. Furthermore, the melting of Arctic ice could open up prospects for new fisheries and the creation of management systems to address overfishing concerns.

Observed and future impacts

Climate variability has significantly impacted fisheries, evident in the Peruvian anchovy fishery's response to El Niño events. While environmental changes are clear, the precise effects on fisheries remain unclear. Future challenges include rising sea levels, coral bleaching, and shifts in marine ecosystems, with complex social ecological interactions potentially leading to abrupt and irreversible changes [16].

Susceptibility of areas, communities, and hotspots

Geographic sensitivity to climate change varies, with high-latitude areas potentially facing less direct impact than low-latitude regions dependent on upwelling and coral reefs. Major risks include sea level rise and severe tropical storms, with developing countries and communities heavily reliant on fisheries being particularly vulnerable due to limited adaptation capacity. Vulnerability also varies at sub national and individual levels, with poorer households and marginalized groups facing greater risks, often exacerbated by socio-economic factors [17].

Adjusting fisheries practices to address climate change:

Adapting to climate change involves altering social, ecological, or financial systems to manage or leverage climate shifts. The goal is to improve overall well-being by either mitigating adverse effects or exploiting new opportunities Depending on their objectives, modes of execution or institutional frameworks, adaptation techniques are categorized. It is a continuous process that conforms to current societal norms and practices.

Divergent adaptation approaches

Two primary adaptation strategies for handling resource fluctuations diversifying livelihoods to sustain income from fisheries or transitioning to alternative sources of income. Additional approaches to enhance fishing efforts include investing in modern equipment, prolonging the fishing season, or exploring deeper waters, though these can result in overexploitation in fisheries already under strain [18].

Timing and responsibility in adaptation

Adaptation strategies differ in timing and responsibility between small scale and industrial fisheries [19]. In fisheries, similar approaches include increasing fishing pressure, targeting various species, or transitioning to alternative sources of income. subsistence systems handle risks through mobility, storage, diversification and communal pooling strategies that are also applicable to small scale fisheries adapting to climate change.

Purpose of institutions in adaptation

Formal and informal institutions are vital for adaptation. Although cultural ties to fishing may limit flexibility, traditional practices and alternative livelihoods can enhance adaptability. Local resource management institutions may pose challenges but can also support adaptive management. For instance, in Peru's scallop fishery, formal institutions find it difficult to respond promptly to fluctuations, while regulations in Newfoundland restrict fishermen's ability to adjust to shifting fish stocks [20].

Enhancing adaptive capability in fisheries:

Adaptive capacity can be improved through robust management practices that prioritize sustainability and equity. Yet, many existing fisheries management systems inadequately tackle uncertainty or resilience. Allocating additional resources and concentrating efforts, especially for marginalized communities, is essential. International funding mechanisms, such as the UNFCCC and NAPAs, aid in adaptation but may not fully address the scale of needs or effectively separate adaptation from general capacity-building efforts [21].

Conclusion

Changes in climate are anticipated to possess a profound impact on fisheries and the communities that depend on them. Although the biological effects on aquatic ecosystems are well-documented, there is limited insight into how socioeconomic factors will shape these effects and the adaptation strategies available. Resource management, changes in supply and demand, technological progress and other socioeconomic factors might affect fishing communities even more significantly than the direct ecological changes. The degree of climate change and the capacity of fisheries systems and their users to adapt both affect vulnerability. The sustainable livelihoods framework can help assess these factors. Governments and groups should prioritize cutting back on greenhouse gas emissions and supporting vulnerable populations with adaptation efforts. Identifying at-risk communities and focusing on long-term solutions are crucial. Effective public policy should protect coastal communities, provide reliable information, and strengthen ecological services to ensure resilient fisheries systems.

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