CHAPTER 23

Fisheries Economics: Balancing Profitability with Conservation Goals

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SUMMARY

Fisheries play a pivotal role in the global economy, providing a crucial source of food, employment and economic activity. Sustainable fisheries is considered as a caretaker for the oceans. Sustainable fisheries play an indispensable role in maintaining the delicate equilibrium of marine ecosystems and regulating the long-term health of aquatic biodiversity. The economics of fisheries is crucial for the sustainable management of aquatic resources, supporting the assessment of the economic impact of fishing activities and guiding policy decisions. Fisheries economics possesses the ability to actively modulate a balance between the economic advantages of fishing and the imperative to conserve ecosystems and sustain livelihoods. Balancing profitability with conservation goals holds great significance in ensuring a sustainable future. This approach not only safeguards biodiversity and ecosystems but also demonstrates a commitment to social responsibility. Businesses integrating conservation strategies contribute to societal well-being, meeting the expectations of environmentally conscious consumers. Beyond immediate gains, this balance protects long-term business viability by mitigating environmental risks and ensuring the availability of essential resources. Therefore, in this chapter, we will explore the complex connection between the economics of fisheries, their profitability and conservation goals. As the global demand for seafood rises, the fishing industry faces a critical challenge in achieving sustainable practices that balance economic viability with environmental preservation. This chapter also examines the complexities involved in managing fisheries as dynamic socio-ecological systems, emphasizing the necessity for innovative economic strategies to ensure sustained profitability while safeguarding marine ecosystems.

INTRODUCTION

The world's oceans and water bodies have long been a source of food and maintenance for communities around the globe. Fisheries, the economic activities linked with the harvesting of aquatic resources, play an essential role in providing the nutritional needs of billions of people around the world. However, the increasing demand for seafood, coupled with unsustainable fishing practices, has led to concerns about the sustainability of fisheries and the health of marine ecosystems (Sumaila et al., 2016).

Fisheries are a principium of the global economy, providing employment opportunities for millions and subordination significantly to international trade. The economic attention of fisheries extends beyond the coastal communities directly engaged in fishing activities. It concerns a vast network of industries, including processing, transportation, and marketing, that rely on the supportable availability of fishery resources (Thorpe, 2005). The appeal for seafood has surged as a result of population growth, changing dietary habits, and upgraded awareness of the nutritional benefits of fish. The rising application has led to intensified fishing efforts, often driven by economic motives. However, the indiscriminate exploitation of fisheries can have deleterious effects on the environment, leading to overfishing, habitat degradation, and dispersion of fish stocks.

Fisheries administration policies across many countries are working to achieve a diverse range of biological, conservational, and economic goals (Cochrane, 2000; Hilborn, 2007). Whereas a growing emphasis on approaches such as the Ecosystem Approach to Fisheries (EAF) and Ecological Sustainable Development (ESD), which promote a thorough evaluation of the biological, conservational and economic aspects of fisheries, along with their practical implementation remains a significant challenge (Begg et al., 2014). The diverse ultimatum that potentially involves the management of biological, conservational and economical aspects of fish includes gaps in governance, objectives, disciplinary breath, and integrative methodology (Stephenson et al., 2017).

A considerable challenge is the lack of a formal governance behest or empowered to comprehensively address the ecological, social, and economic dimensions of fish. In the cases where social and economic cognition are considered they are often grasped separately at governance tables or checked through a political lens that selectively interprets ecological advice. Moreover, fisheries management predominantly examine on biological objectives related to the productivity of

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a target stock that unconcern the conservational and economic objectives which receive notably less attention. Although there is a rising trend in management plans to incorporate economic as well as conservational consideration (Begg et al., 2014).

Over the past few years, there has been a widespread trend toward adopting the Ecosystem Approach to Fisheries (FAO, 2003; Garcia et al., 2003) as a part of a broader strategy for maintaining marine ecosystems (Charles, 2014). An integral foundation of this approach is the recognition of the requirement to go beyond the local traditions aiming on maintaining individual fish species. Besides it, there is raising emphasis on including broader goals linked to the health of the entire aquatic ecosystem. This also involves considering goals for human well-being and boosting effective governance (Charles, 2014).

The latest proffered method for manipulating the conservation of the structure and functioning of ecosystem in fisheries management is assigned as "Balanced Harvesting" (BH) (Zhou, 2008). BH offered a shift from the traditional center of individual fisheries excisions on a specific reserve and species to a broader approach that considers the overall productivity and impacts on ecosystems. If widely accepted, BH would involve dividing fishing pressure across a diverse range of species, reservoirs, and size in an ecosystem that orients it with their natural productivity. This stipulates a shift away from the conventional approach where the focus is typically on selectively capturing a confined range of species in an ecosystem (Garcia et al., 2012).

Adjusting the economic interest of fisheries with the demand for conservation poses a notable challenge. Overfishing, where the rate of fish discarding increases the natural reproduction capacity of the stocks, is a basic concern. This not only endangers the livelihood of those relying on fisheries but also alarms the ecological balance of marine ecosystems (Erisman et al., 2020). Ecosystem-based management has turned up as a key concept in addressing conservation provocations. This passage recognizes the interconnectedness of species and habitat within marine ecosystems and seeks to manage fisheries in a way that manage the health and resilience of these systems (Kenny et al., 2018). However, in this chapter, we will inspect Fisheries Economics, examining the delicate balance between profitability and conservational goals in managing aquatic resources.

THE ECONOMICS OF FISH

Economic drivers

The fisheries sector plays an important role in global economies and provides livelihoods for millions of people as well as contributes to considerable portion of world's protein consumption. As a complicated and multi-layered industry, the economic drivers in the fishing industry are diverse and interconnected and involves variety of factors that influence its growth, sustainability, and impact on economies (Pradeepkiran, 2019). In this consult, we will explore the key economic drivers in the fishing industry along with certain problems such as demand, technological avenue, regulatory frameworks, environmental feasible and social as economic well-being of fishing communities.

Market demand and global trade: The prime economic driver in the fisheries is market demand. As the world population continues to grow, it increases the command for seafood products. Fish and other marine resources are requisite sources of protein for a substantial portion of the global population, and as income rise, individuals tend to consume more seafood. According to the Food and Agriculture Organization (FAO), the per capita utilization of fish has exhibited a consistent increase over the past few years. Accordingly, to FAO, the per capita utilization of fish has exhibited a consistent rise over the past few years. In 1961, the average individual's annual fish expenditure was 9.9 kg, and by 2018, it massively increased to 20.5 kg. This increasing demand drives economic activities in the fisheries that influence production and cost dynamics (Obiero et al., 2019). Additionally, the fishing industry is effectively integrated into world trade networks. Many countries strongly await seafood imports to meet domestic demand which leads towards a convoluted web of international trade relationships (Crona et al., 2016). Economic attention, as comparative advantage and specialization, has a considerable role in evaluating which countries are major exporters of seafood products. The economic interdependence in global fisheries mentions the importance of international cooperation and trade agreements (Andreff & Andreff, 2009).

Technological advancements: Technological elevations have been transformative in the fishing sector, persuading both the efficiency of fishing operations and the sustainability of resource consumption. Introductions in fishing gear, navigation system, and fish processing technologies have extremely increased the industry's productivity (Nham & Hoa, 2023). One of the transformative technological ameliorations in fisheries is the development and widespread implementation of sonar (Sound Navigation and Ranging) technology. Sonar uses sound waves to ascertain and locate underwater bodies, including communities of fish. This has revolutionized the adaptability of fishing operations by providing authentic information about the occurrence and location of fish. Previously, fisherman entirely depends up on traditional methods and guesswork to locate the fish. Now, sonar technology, they can now specifically recognize the depth, size, and density of fish schools. This not only increases the chance of a successful catch but also assist to reduce bycatch as fishermen can target specific species without vandalism non-target marine life (Corbières & Mosca, 2017). Global Positioning System (GPO) and advanced navigation systems have abundantly enriched the selective capturing and safety of fish. Fishermen can now identify through open waters with precisely locate specific fishing grounds and plan routes that optimize fuel competency. GPS navigation systems have made it possible for fishermen to revisit prime fishing spots consistently. This mitigates the time spend searching for suitable fishing grounds and reduce fuel consumption as well as environmental impact. Furthermore, concrete navigation contributes to the safety of fishing operations and prevents vessels from drifting in to inhibited or ecologically sensitive range (Behivoke et al., 2021).

Preferments in fishing gear technology have led to the development of more efficient and selective tools. Advanced gear designs focus on abating bycatch and mark down environmental impact and ameliorate fishing efficiency. Selective fishing gear such as "smart" nets attired with sensors and escape mechanism, allows for the release of non-target species. These nets can perceive the size and species of caught fish and enable fisherman to release undersized or non-commercial species back into the water (Deshpande & Haskins, 2021).

The potency of modern fishing technologies has the potential to lead to overfishing if not properly managed. Active damage of fish stocks can have austere ecological inferences that affects marine ecosystems. Industrial-scale fishing operations entangled with sophisticated technologies can unintentionally harm marine habitats, disrupts migratory patterns, and lead to stocks damaged. Balancing technological improvement with environmental sustainability is crucial to minimizing these impacts (Godø, 2009).

Different fishing methods and economic implications: The fishing sector uses variety of methods to consume marine resources, each with its own set of economic implication. These methods range from local traditional to present revenue industrial practices. The choice of fishing method not only effects the economic viability of particular fishing operation but also has wide implication for resource manageably, market dynamics, and the socio-economic well-being of fishing communists (Browman et al., 2004). In this colloquy, we will explore various fishing method with their economic implications.

Traditional and artisanal fishing methods

Traditional and artisanal fishing methods, often involving small-scale operations using simple gear, have been practiced for centuries (Fig 1). These methods belonged to their low environment impact and reliance on local knowledge (Pita al., 2016). Handling fishing engages using a single fishing line with a hook and bait. It is a labor-intensive method generally used by artisanal fishermen. The economic implications of handline fishing are firmly tied to the individual fishermen's skill and efforts. While it may curtail the efficiency of industrial methods, handline fishing often results in higher-quality catches (Eighani et al., 2019). Gillnets are vertical panels of netting that trapper fish by entangling them in their mesh. Gillnetting is a widespread method used in artisanal fisheries but has economic challenges related to bycatch and gear loss. Efforts to knock down these issues, such as the use of biodegradable materials in nets, can impact the economic support of this method (Kim et al., 2020). Trap and pot fishing comprise the use pf baited traps or pots to capture target species. While this method is discriminately reduced by catch, the economic implications that are influenced by factors such as the cost of gear, the need for frequent checking and maintenance, and the ability to evaluate markets for specific catch (Stevens, 2021). Ancestral and artisanal fishing methods often involves considerably local economies, providing livelihoods for coastal communities. However, their economic allowably is threatened by overfishing, environmental degradation and competition with industrial operations.

Industrial fishing methods: Industrial concern to fishing methods entail large-scale operations using advanced technology and machinery. These methods are highly adequate but can have substantial economic and environmental consequences. Trawling is one of the most applicable methods which commits dragging a larger net through the water to capture fish. While highly businesslike, trawling is linked with concerns such as bycatch, habitat damage, and overfishing. The economic assumption includes high initial investment in vessels and gears, fuel cost, and potential market backlash due to environmental concerns (Kumar & Deepthi, 2006). Longlines uses a central fishing line with variety of baited hooks. This method is generally employed for high-value species such as tuna and swordfish. The economic indications revolve around the cost of gear, fuel, and vessel managing. Supportably longline practices, such as the utilization of circle hooks to reduce bycatch can positively impact market access (Fitzgerald, 2013). Purses seining contain surrounding a group of fish with a larger net and then drawing the bottom closed to capture the fish. This method is often account for species like tuna. Economic consideration entails the cost of vessels, nets, and the ability to access distant fishing grounds. Sustainable practices, such as the use of Fish Aggregating Devices (FADs), can elevate economic and environmental outcomes (Breen et al., 2012). Industrial fishing methods predominate world seafood production due to their efficiency and capacity to meet the demands of large-scale markets. However, deportment over their ecological impact and the depletion of fish stocks have led increased scrutiny and demands for sustainable practices.

Aquaculture, or fish farming is another crucial way of fishing industry. While not a method of capture, it considerably contributes to seafood production. Economic connections of aquaculture contain investment in facilities, feed, and disease management (Bondad-Reantaso et al., 2005). Consequent important examples of how aquaculture or fish farming contributes to fish economics. Cage farming involves bastille fish in netted cages submerged in open water. Economic attentions comprise the cost of cage, feed, and potential environmental impacts. Cage farming can afford to local economics by creating jobs and supplying seafood to stock exchange. Additionally, pond farming is the rearing of fish in enclosed pond or tanks. Economic factors allow for land and water access, feed costs, and disease management. In some cases, pond farming can be more resource-efficient and conventional capture methods (Chu et al., 2020). It is reported that recirculating aquaculture system (RAS) is considered as top-notch way for economic manageably which involves maintaining a closed-loop system where water is persistently recycled. While RAS craves significant initial investment, it offers advantages such as reduced environmental impact, better disease management, and enhance yield. Aquaculture plays a clamorous role in meeting global seafood demand and provide an alternative to wild-caught fish. However, it bears challenges related to habitat alteration, waste management, and the reliance on wild fish feed.

Economic Implications and Challenges: Overfishing, aftermath of certain fishing method, can evacuate fish stocks and threaten the long-term viability of fisheries. This has direct economic intimation, as a depleted stock reduce catch size and ultimately effects the income of fishermen and the profitability of fishing enterprises. Besides, fishing methods such as trawling and longline often close in bycatch-catching non-target fish species. Bycatch mannerism a threat to economic stability through various channels, containing the economic loses linked with discarding unwanted catch, the potential imposition of regulatory penalties, and the harm administer upon ecosystems (Squires et al., 2021).

Annihilative fishing methods such as bottom trawling can cause habitat disturbance and alter marine ecosystems. The economic conferences include the loss of ecosystem services, impacts on tourism, and imaginable long-term damage to fisheries (Carneiro & Martins, 2021). Furthermore, the choice of fishing method can have deep social and community implications. Large -scale industrial fishing may lead to the displacement of small-scale, artisanal fishermen, affecting local economics and traditional ways of life (Damasio et al., 2020). However, sustainable practices that minimize bycatch can effectively mitigate these economic challenges.

ECOLOGICAL IMPACT OF VARIOUS FISHING METHODS

Traditional and artisanal fishing

Conventional and artisanal fishing methods such as handline fishing, gillnetting and trap fishing are commonly considered to have lower ecological impacts as compared to industrial methods. However, selection of gear utilized in ancestral fishing can vary, leading to unintentional catches of non-target species (Yıldız & Karakulak, 2016). Additionally, artisanal methods such as gillnetting and trap fishing have least habitat impact, as they do not involve bottom-contact gear. However, localized habitat disturbance can occur, specifically in areas with high fishing pressure. As an example, repeated use of traps in particular locations may impact benthic habitat (Kaiser et al., 2003). Furthermore, conventional and artisanal fishing are often seriously knotted with the social and cultural status of coastal communities. While these methods may have lower ecological footprints, they accord to the socio-ecological dynamics of these communities, supporting local economies and conserving traditional fishing knowledge.

Industrial fishing

Industrial fishing methods such as trawling and longlining, can advance to overfishing and the devastation of target species. The efficiency of these methods allowances for the rapid capture of large quantities of fish often enlarging the natural reproduction rates of the populations. This overfishing can lead to the collapse of fisheries and disintegration in the ecosystem's trophic structure (Luikart et al., 2010). Trawling, in pneumatology, is articulated with significant bycatch the unintentional capture of non-target species. This can comprise juvenile fish, non-commercial species and even endangered species. Bycatch bestows to ecosystem imbalances, as it discards individuals that play central role in maintaining biodiversity and ecosystem functioning. However, removing unwanted catch at sea further aggravate these ecological consequences.

Benthic trawling, a method that inculpates dragging nets along the seafloor, causes substantial habitat destruction. This practice can proceed in the removal of bottom organisms, damage to seafloor structures, and disturbs of habitat crucial for variety of marine organisms. The long-term results of habitat destruction engroove the loose of essential breeding and feeding grounds (Halpern et al., 2008). The ecological consequences of industrial fishing amplify beyond the target species. Abolishing specific components of the ecosystem through high-intensity fishing can alter the reliance of marine ecosystem to environmental changes. However, ecosystem-based maintenance strategies are important to consider the broader ecological context and manage the health of entire marine ecosystems (Halpern et al., 2008).

Aquaculture

Aquaculture is the rearing of aquatic organisms such as fish and shellfish and it has experienced substantial growth in response to elevating world demand for seafood. While it plays an extraordinary role in managing protein needs and supporting economic development, it concurrently increases concerns about its ecological impact (Subasinghe et al., 2009).

Primary ecological concern linked with aquaculture is habitat alteration. The institution of aquaculture facilities often entails the conversion of natural ecosystems, such as mangroves, wetlands, or coastal areas, into ponds or pens for fish farming. This conversation damages the delicate balance of these ecosystems, proceeding to the loose of biodiversity and significant habitat function (Diana, 2009). Mangrove, for instance, serve as midmost breeding grounds for many marine species and serve as buffer against coastal erosions. The abolition of mangrove for shrimp or fishponds not only eradicates these functions but also contribute to the abating of various species depend on these habitats (Chaudhuri et al., 2015) as showed in Fig 2 and Table 1.

Water quality abasement is another considerable ecological impact of aquaculture, intensive aquaculture operations stimulated large number of organic dilapidations, uneaten feed and chemicals, which can edge to nutrient enrichment and oxygen depletion is surrounding water bodies (Miller & Semmens, 2002). Boundless nutrient inputs, specifically nitrogen and phosphorus, can result in algal blooms, disrupting the natural balance of the ecosystem. These blooms can lead to hypoxia, where oxygen levels in the water are depleted, causing detriment to fish and other aquatic organisms. Moreover, the utilization of antibiotics, pesticides, and other chemicals in aquaculture can preface harmful substances into environment, affecting not only the culture species but also non-target organisms (Rathore et al., 2016).

Disease hauling is a sensitive ecological concern coupled with aquaculture. The highly intensive stock density in aquaculture practices creates favorable conditions for the rapid spread of disease among cultured organisms (Krkošek, 2010). Pathogens such as bacteria, viruses and parasites can

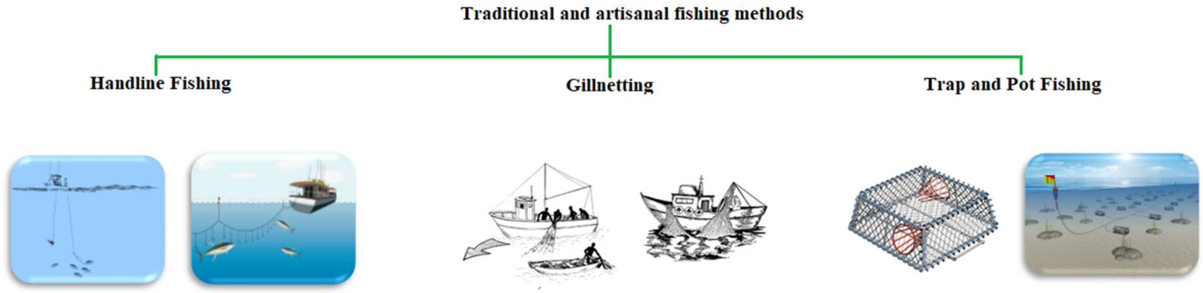

Fig 1. Various traditional and artisanal methods

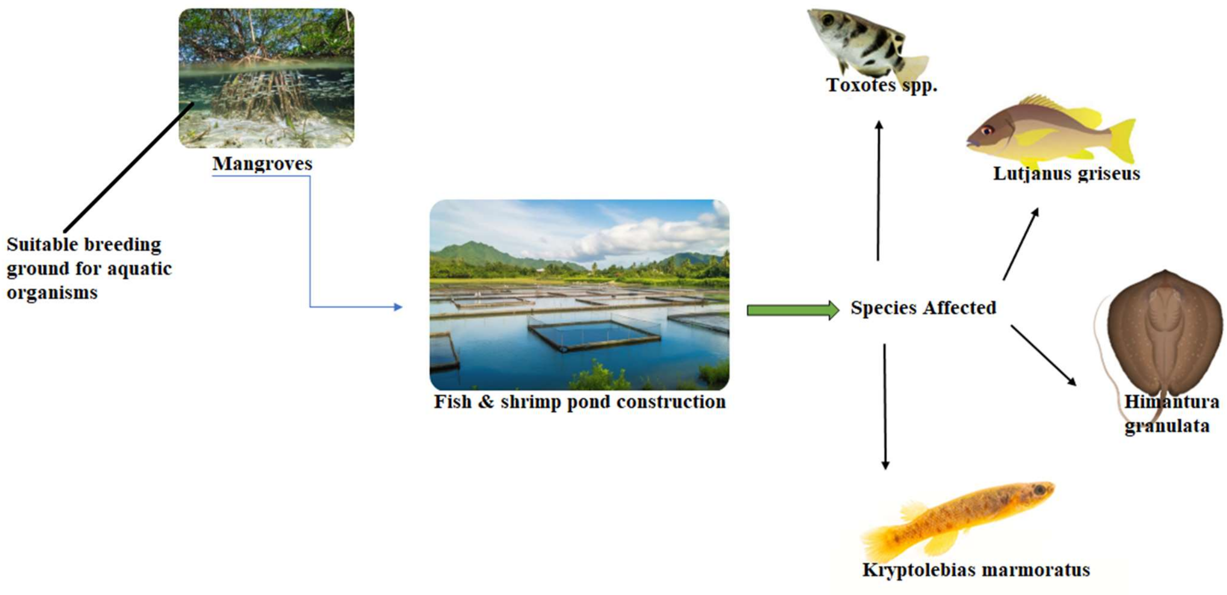

Fig 2. Impact of mangroves degradation on different fish species

reattribute in crowded conditions, proceeding to outbreaks that can abrogate entire population of farmed fish or shellfish. These diseases can also disgorge wild populations, posing a threat to biodiversity (Erkinharju et al., 2021). The transmission of disease from aquaculture sectors to wild populations is especially concerning in areas where farmed and wild species share the same habitat, as it can lead to the introduction of various pathogens and the emergence of new diseases (Johansen et al., 2011).

Genetic impacts exemplify another dimension of the ecological consequence of aquaculture. Escapees from aquaculture facilities, whether intentional or accidental, can cross-fertilize with wild populations which leads towards genetic hybridization. This can result in dilution of the genetic candor of wild stocks and potentially mitigate their ability to adapt to natural environmental change (Waples et al., 2012; Akbar & Ijaz, 2024; Hayat et al., 2024). Furthermore, the selective breeding practices exert in aquaculture to enhance desirable character in farmed species can proceed to genetic homogenization, where the genetic diversity of reared population reduced. This reduction in genetic diversity may form culture species more aroused to disease and environmental change, posing a long-term risk to the sustainability of aquaculture operations [Eknath et al., 2007 (Fig 1.)]

CONSERVATION MEASURES

Fisheries play an imperative role in providing food, livelihoods and economic opportunities for millions of people worldwide. However, the intensification of fishing activities, brace with insubstantial management practices, has resulted in overfishing, habitat destruction and exhaustion of fish stocks. Apperception of the global nature of marine resources and their interconnection, various countries have come together to configuration international agreements and initiatives to address the challenges underlying fisheries sustainability (Pitcher & Cheung, 2013).

International efforts to promote sustainable fisheries

One of the stellar mechanisms for international collaboration on fisheries management is the enactment of regional fisheries management organizations (RFMOs). These organizations are actualized by countries in specific regions to collectively manage and conserve fish stocks. For instance, the North Atlantic Fisheries Organization (NAFO) and the Indian Ocean Tuna Commission (IOTC) are archetype of RFMOs that bring together nations to coequal measures for sustainable fisheries in their particular regions (Cullis-Suzuki, 2009). The RFMOs play a chief role in regulating fishing gear and interfaith conservation measure to inhibit overfishing. These organizations facilities cooperation among member states and regulate the manageable use of marine resources. However, challenges such as the need for improved assent, enforcement mechanisms, as well as addressing the impact of climate change of fish stock perseverate (Hsu, 2018).

The United Nation Convention on the law (UNCLOS) of the sea was adopted in 1982 and it is a basal international legal framework that decrees the rights and schoolmates of nations concerning the utilization of the global oceans. UNCLOS provides a discursive framework for the conservation and management of fish stocks through the regulation of the principals such as the agreement to prevent overfishing, the requirement for sustainable management and responsibilities to regulate conservation of fish stocks (Nordquist, 2011). Under UNCLOS, various countries are animate to cooperate the regional level through RFMOs and other mechanisms to certify the effective management of fishery resources. The clambake also establishes the concept of an Exclusive Economic Zone (EEZ) which regulates coastal states absolute rights to manage and exploit marine resources within 200 nautical miles of their coastlines (Nemeth et al., 2014). The FAO of the Unites Nations has played a crucial role in promoting sustainable fisheries through its Code of Conduct for Responsible Fisheries. This code was adopted in 1955 and it accommodates a comprehensive set of principles and standards for responsible fisheries management aspects such as conservation, environmental impact and socio-economic considerations (Doulman, 2000).

This code applauds states to adopt ecosystem-based management approaches which helps to mitigate bycatch and enforcement measures to protect habitats and biodiversity. Its strengths the importance of responsible aquaculture practices and implements the reduction of waste and post-harvest losses. Additionally, this code serves as a maintaining framework for countries in developing their national fisheries policies and practices (Doulman, 2000). The international community, through the United Nations, has diagnosed the importance of sustainable fisheries in the context of ecosystem sustainability. Sustainable Development Goal 14 (SDG 14) targets particularly on “LIFE BELOW WATER,” that intension to conserve and maintain sustainable use of oceans, sea and marine resources. Target 14.4 particularly mark on the interfaculty of effective and supportable fisheries management (Molony et al., 2022). SDG 14 lamplights the interconnection of marine ecosystems, the importance of small-scale fisheries, and the need to scrutinize the impacts of overfishing and illegal, unreported, and unregulated fishing. The ambition set by SDG 14 serves as a global route for countries to align their policies and actions with the markable objectives of preserving marine life and ensuring the sustainable use of marine resources (Ntona & Morgera, 2018).

Economic instruments for fisheries management

The management of fisheries is very requisite for the sustainable utilization of marine resources and entails the application of economic tools such as quotas, taxes and tradeable permits. Quotas, which constitute the limits on fish harvests, play a key role in preventing overfishing and providing a level of predictability for fishermen. However, the enforcement of quotas presents challenges and there is a committal to address concerns related to discarding practices in this framework (Arnason, 2000).

Fisheries taxes, appliance through charges on catches or accessories, are designed to discourage overfishing and contribute to conservation initiatives. While taxes attempt potential benefits, their implementation requires careful consideration to prohibit disproportionately affecting smaller-scale fishermen and to manage potential resistance in the fishing community (Cisneros-Montemayor et al., 2016). Tradeable liberty, also known as individual quotas (ITQs), admeasure specific portions of the total catch to individual fishermen. These permits can be bought, sold, or leased, creating economic incentives for adopting sustainable fishing practices. While tradable permits advocate conservation and economic efficiency, ensuring a fair initial allocation and establishing robust monitoring and enforcement procedures is crucial for their success (Copes & Charles, 2004).

CHALLENGES IN BALANCING PROFITABILITY AND CONSERVATION GOALS

Balancing profitability in the fishing sector with the indispensable of conservation poses a critical challenge. One

Table 1. Ecological impacts of aquaculture

Ecological Concern	Consequences	References
Habitat metamorphosis	Agitate biodiversity and habitat functions	Diana, 2009
Water Quality abasement	Cause algal blooms, and oxygen diminution in water bodies	Rathore et al., 2016
Disease Transmission	High stocking densities facilitate rapid disease spread	Erkinharju et al., 2021
Genetic Impacts	Causing genetic hybridization.	Waples et al., 2012

Table 2. Challenges in balancing profitability and conservation goals

Challenge	Influence	References
Overfishing	Excessive catch rates endanger fish populations, conflicting with profit motives.	Gebremedhin et al., 2021
Technological Advancements	Advanced equipment enhances overfishing and environmental harm.	Caddy & Seijo, 2005
Regulatory Challenges	Inadequate resources and corruption hinder effective regulations	Mora et al., 2009
Climate Change	Cause habitat degradation	Ficke et al., 2007
Market Forces	Consumer demand for cost and variety cause unsustainable practices	Roheim & Wessells, 2001

major concern is overfishing, where fish are bent at a rate surpassing their adeptness to reproduce, leading to a decline in population and endangering the long-term sustainability of fisheries. This issue occurs when the admiration for making money comes into conflict with the necessity to protect these groups of organisms (Gebremedhin et al., 2021).

Technological betterment, while enhancing the efficiency of fishing, contributes to overfishing. Industrial-scale operations, expedited by sophisticated equipment, can harm the environmental and proceed to unintended catches. Achieving equilibrium comprises using technology responsibly to ensure sustainable fishing practices that reduce adverse environmental impacts (Caddy & Seijo, 2005). Regulatory challenges supplementary complicate the balance between profitability and conservation. Incommensurate resources, corruption, and limited international cooperation hinder the effectiveness of regulation. Advancement of this challenge requires the establishment of strict rules and increased global collaboration to ensure consistent and effective implementation (Mora et al., 2009). Climate change poses a considerable threat to fisheries conservation by altering oceanic conditions and impacting fish habitats. Escalating sea temperature and habitat alteration extremely contribute to the challenges. Balancing profitability with conservation in the face of climate change requires adaptive management strategies, along with creation of marine protected areas and the promotion of resilient fishing practices (Ficke et al., 2007; Bennett & Dearden, 2014).

Market forces play a fundamental role in regulating fishing practices, as consumer selection prioritizes cost and array over sustainability. The accrual demand for seafood globally can drive unsustainable fishing practices. Acquiring a balance necessitates influencing market forces through certification programs, consumer intelligence, and promoting sustainable choices (Roheim & Wessells, 2001). Table 2 authenticate a summary of challenges and their influence on balanced profitability and conservation goals.

CONCLUSION

In conclusion, it is clamorous to establish an equilibrium between the economic consideration of fisheries and conservation objectives. Attainment of a regulated balance between profitability and conservation aims is pivotal for ensuring the sustainability of fisheries. Conjunction among policymakers, industry stakeholder, and environmental advocates is central to implement effective management strategies that endorse responsible fishing practices. By the development of cooperation between economic interests and conservation activities, we can safeguard marine ecosystem while also heightened the source of revenue of those dependent on fisheries.

REFERENCES

Akbar A & MU Ijaz, 2024. Pharmacotherapeutic potential of ginkgetin against polystyrene microplastics-instigated testicular toxicity in rats: A biochemical, spermatological, and histopathological assessment. Environmental Science and Pollution Research 31:9031-44. https://doi.org/10.1007/s11356-023-31662-7

Andreff M & W Andreff, 2009. Global trade in sports goods: International specialisation of major trading countries. European Sport Management Quarterly 9:259-94. https://doi.org/10.1080/16184740903024029

Arnason R, 2000. Economic instruments for achieving ecosystem objectives in fisheries management. ICES Journal of Marine Science 57:742-51. https://doi.org/10.1006/jmsc.2000.0733

Begg G, KJ Brooks, RL Stephenson et al., 2014. Practical implementation of social and economic elements in ecosystem-based fisheries management and integrated fisheries management frameworks. In SARDI Publication No. F2014/000315-1 SARDI Research Report Series No. 765. Adelaide: South Australian Research and Development Institute (SARDI), Australia, pp: 85.

Behivoke F, MP Etienne, J Guitton et al., 2021. Estimating fishing effort in small-scale fisheries using GPS tracking data and random forests. Ecological Indicators 123:107321. https://doi.org/10.1016/j.ecolind.2020.107321

Bennett NJ & P Dearden, 2014. From measuring outcomes to providing inputs: Governance, management, and local development for more effective marine protected areas. Marine Policy 50:96-110. https://doi.org/10.1016/j.marpol.2014.05.005

Bondad-Reantaso MG, RP Subasinghe, JR Arthur et al., 2005. Disease and health management in Asian aquaculture. Veterinary Parasitology 132:249-72. https://doi.org/10.1016/j.vetpar.2005.07.005

Breen M, B Isaksen, E Ona et al., 2012. A review of possible mitigation measures for reducing mortality caused by slipping from purse-seine fisheries. ICES CM 100:12.

Browman HI, KI Stergiou, PM Cury et al., 2004. Perspectives on ecosystem-based approaches to the management of marine resources. Marine Ecology-Progress Series 274:269-303. https://doi.org/10.3354/meps274269

Caddy JF & JC Seijo, 2005. This is more difficult than we thought! The responsibility of scientists, managers and stakeholders to mitigate the unsustainability of marine fisheries. Philosophical Transactions of the Royal Society B 360:59-75. https://doi.org/10.1098/rstb.2004.1567

Carneiro M & R Martins, 2021. Destructive Fishing Practices and their Impact on the Marine Ecosystem. In: Life Below Water. Encyclopedia of the UN Sustainable Development Goals (Filho LW, AM Azul, L Brandli et al., eds). Springer, Cham, USAm pp: 1-11. https://doi.org/10.1007/978-3-319-71064-8_10-1

Charles A, 2014. Human dimensions in marine ecosystem-based management. In: Marine Ecosystem-based Management. The Sea. Ideas and Observations on Progress in the Study of the Seas (Fogarty MJ & JJ McCarthy, eds): Harvard University Press, Cambridge, USA, pp: 57-75.

Chaudhuri P, S Ghosh, M Bakshi et al., 2015. A review of threats and vulnerabilities to mangrove habitats: With special emphasis on east coast of India. Journal of Earth Science and Climate Change 6:4. https://doi.org/10.4172/2157-7617.1000270

Chu YI, CM Wang, JC Park et al., 2020. Review of cage and containment tank designs for offshore fish farming. Aquaculture 519:734928. https://doi.org/10.1016/j.aquaculture.2020.734928

Cisneros-Montemayor AM, E Sanjurjo, GR Munro et al., 2016. Strategies and rationale for fishery subsidy reform. Marine Policy 69:229-36. https://doi.org/10.1016/j.marpol.2015.10.001

Cochrane K, 2000. Reconciling sustainability, economic efficiency and equity in fisheries: The one that got away? Fish and Fisheries 1:3-22. https://doi.org/10.1046/j.1467-2979.2000.00003.x

Copes P & A Charles, 2004. Socioeconomics of individual transferable quotas and community-based fishery management. Agricultural and Resource Economics Review 33:171-81. https://doi.org/10.1017/S106828050000575X

Corbières C & F Mosca, 2017. September. Real-time acoustic fishing selectivity for sustainable practices. In OCEANS 2017-Anchorage, IEEE, pp: 1-8.

Crona BI, X Basurto, D Squires et al., 2016. Towards a typology of interactions between small-scale fisheries and global seafood trade. Marine Policy 65:1-10. https://doi.org/10.1016/j.marpol.2015.11.016

Cullis-Suzuki S, 2009. High seas, high risk: A global evaluation of the effectiveness of regional fisheries management organizations. Doctoral dissertation, University of British Columbia, USA.

Damasio LM, MG Peninno & PF Lopes, 2020. Small changes, big impacts: Geographic expansion in small-scale fisheries. Fisheries Research 226:105533. https://doi.org/10.1016/j.fishres.2020.105533

Deshpande PC & C Haskins, 2021. Application of systems engineering and sustainable development goals towards sustainable management of fishing gear resources in Norway. Sustainability 13:4914. https://doi.org/10.3390/su13094914

Diana JS, 2009. Aquaculture production and biodiversity conservation. Bioscience 59:27-38. https://doi.org/10.1525/bio.2009.59.1.7

Doulman DJ, 2000. Code of conduct for responsible fisheries: Development and implementation considerations. In: Current Fisheries Issues and the Food and Agriculture Organization of the United Nations, Rome, Italy, pp: 307-30. https://doi.org/10.1163/9789004502772_022

Eighani M, SY Paighambari & SM Bayse, 2019. Comparing handline and trolling fishing methods in the recreational pelagic fishery in the Gulf of Oman. Scientia Marina 83:215-22. https://doi.org/10.3989/scimar.04864.10A

Eknath AE, HB Bentsen, RW Ponzoni et al., 2007. Genetic improvement of farmed tilapias: Composition and genetic parameters of a synthetic base population of *Oreochromis niloticus* for selective breeding. Aquaculture 273:1-14. https://doi.org/10.1016/j.aquaculture.2007.09.015

Erisman BE, A Grüss, I Mascareñas-Osorio et al., 2020. Balancing conservation and utilization in spawning aggregation fisheries: A trade-off analysis of an overexploited marine fish. ICES Journal of Marine Science 77:148-61. https://doi.org/10.1093/icesjms/fsz195

Erkinharju T, RA Dalmo, M Hansen et al., 2021. Cleaner fish in aquaculture: Review on diseases and vaccination. Reviews in Aquaculture 13:189-237. https://doi.org/10.1111/raq.12470

FAO, 2003. Fisheries Management. 2. The Ecosystem Approach to Fisheries. FAO Technical Guidelines for Responsible Fisheries, 4 1688 Charles et al. Downloaded from https://academic.oup.com/icesjms/article/73/6/1679/2458695 by guest on 29 December 2023 (Suppl. 2). Food and Agriculture Organisation of the United Nations, Rome, Italy, pp: 112.

Ficke AD, CA Myrick & LJ Hansen, 2007. Potential impacts of global climate change on freshwater fisheries. Reviews in Fish Biology and Fisheries 17:581-613. https://doi.org/10.1007/s11160-007-9059-5

Fitzgerald KT, 2013. Longline fishing (how what you don't know can hurt you). Topics in Companion Animal Medicine 28:151-62. https://doi.org/10.1053/j.tcam.2013.09.006

Garcia SM, A Zerbi, C Alliaume et al., 2003. The ecosystem approach to fisheries. Issues, terminology, principles, institutional foundations, implementation and outlook. FAO Fisheries Technical Paper 443. FAO, Rome, Italy. Pp: 71.

Garcia SM, J Kolding, J Rice et al., 2012. Reconsidering the consequences of selective fisheries. Science 335:1045-7. https://doi.org/10.1126/science.1214594

Gebremedhin S, S Bruneel, A Getahun et al., 2021. Scientific methods to understand fish population dynamics and support sustainable fisheries management. Water 13:574. https://doi.org/10.3390/w13040574

Godø OR, 2009. Technology answers to the requirements set by the ecosystem approach. In: The Future of Fisheries Science in North America (Beamish RJ & BJ Rothschild, eds), Springer, Dordrecht, USA, pp: 373-403. https://doi.org/10.1007/978-1-4020-9210-7_21

Halpern BS, KL McLeod, AA Rosenberg et al., 2008. Managing for cumulative impacts in ecosystem-based management through ocean zoning. Ocean and Coastal Management 51:203-11. https://doi.org/10.1016/j.ocecoaman.2007.08.002

Hayat MF, M Zohaib, MU Ijaz et al., 2024. Ameliorative potential of eriocitrin against cadmium instigated hepatotoxicity in rats via regulating Nrf2/keap1 pathway. Journal of Trace Elements in Medicine and Biology 84:127445. https://doi.org/10.1016/j.jtemb.2024.127445

Hilborn R, 2007. Defining success in fisheries and conflicts in objectives. Marine Policy 31:153-8. https://doi.org/10.1016/j.marpol.2006.05.014

Hsu J, 2018. Effective Governance and Policy Implementation in Governing High Seas Fisheries: A Comparative Study of Three Regional Fisheries Management Organizations.

Johansen LH, I Jensen, H Mikkelsen et al., 2011. Disease interaction and pathogens exchange between wild and farmed fish populations with special reference to Norway. Aquaculture 315:167-86. https://doi.org/10.1016/j.aquaculture.2011.02.014

Kaiser MJ, JS Collie, SJ Hall et al., 2003. 12 impacts of fishing gear on marine benthic habitats. Responsible fisheries in the Marine Ecosystem 57:197. https://doi.org/10.1079/9780851996332.0197

Kenny AJ, N Campbell, M Koen-Alonso et al., 2018. Delivering sustainable fisheries through adoption of a risk-based framework as part of an ecosystem approach to fisheries management. Marine Policy 93:232-40. https://doi.org/10.1016/j.marpol.2017.05.018

Kim H, C Jin, M Kim et al., 2020. Damage detection of bottom-set gillnet using Artificial Neural Network. Ocean Engineering 208:107423. https://doi.org/10.1016/j.oceaneng.2020.107423

Krkošek M, 2010. Host density thresholds and disease control for fisheries and aquaculture. Aquaculture Environment Interactions 1:21-32. https://doi.org/10.3354/aei00004

Kumar AB & GR Deepthi, 2006. Trawling and by-catch: Implications on marine ecosystem. Current Science 90:922-31.

Luikart G, N Ryman, DA Tallmon et al., 2010. Estimation of census and effective population sizes: the increasing usefulness of DNA-based approaches. Conservation Genetics 11:355-73. https://doi.org/10.1007/s10592-010-0050-7

Miller D & K Semmens, 2002. Waste management in aquaculture. West Virginia University Extension Service Publication No. AQ02-1, USA, pp: 8.

Molony BW, AT Ford, AM Sequeira et al., 2022. Sustainable Development Goal 14-Life Below Water: Towards a Sustainable Ocean. Frontiers in Marine Science 8:829610. https://doi.org/10.3389/fmars.2021.829610

Mora C, RA Myers, M Coll et al., 2009. Management effectiveness of the world's marine fisheries. PLoS Biology 7:e1000131. https://doi.org/10.1371/journal.pbio.1000131

Nemeth SC, SM Mitchell, EA Nyman et al., 2014. Ruling the sea: Managing maritime conflicts through UNCLOS and exclusive economic zones. International Interactions 40:711-36. https://doi.org/10.1080/03050629.2014.897233

Nham NTH & TTM Hoa, 2023. Influences of digitalization on sustaining marine minerals: A path toward sustainable blue economy. Ocean and Coastal Management 239:106589. https://doi.org/10.1016/j.ocecoaman.2023.106589

Nordquist M, 2011. United Nations Convention on the law of the sea 1982. Brill, USA. https://doi.org/10.1163/ej.9789004191174.iii-488

Ntona M & E Morgera, 2018. Connecting SDG 14 with the other Sustainable Development Goals through marine spatial planning. Marine Policy 93:214-22. https://doi.org/10.1016/j.marpol.2017.06.020

Obiero K, P Meulenbroek, S Drexler et al., 2019. The contribution of fish to food and nutrition security in Eastern Africa: Emerging trends and future outlooks. Sustainability 11:1636. https://doi.org/10.3390/su11061636

Pita P, D Fernández-Vidal, J García-Galdo et al., 2016.The use of the traditional ecological knowledge of fishermen, cost-effective tools and participatory models in artisanal fisheries: towards the co-management of common octopus in Galicia (NW Spain). Fisheries Research, 178:4-12. https://doi.org/10.1016/j.fishres.2015.07.021

Pitcher TJ & WW Cheung, 2013. Fisheries: hope or despair? Marine pollution bulletin, 74:506-516. https://doi.org/10.1016/j.marpolbul.2013.05.045

Pradeepkiran JA, 2019. Aquaculture role in global food security with nutritional value: A review. Translational Animal Science 3:903-10. https://doi.org/10.1093/tas/txz012

Rathore SS, P Chandravanshi, A Chandravanshi et al., 2016. Eutrophication: impacts of excess nutrient inputs on aquatic ecosystem. Journal of Agriculture and Veterinary Science 9:89-96. https://doi.org/10.9790/2380-0910018996

Roheim CA & CR Wessells, 2001. Product certification and ecolabelling for fisheries sustainability (No. 422). Food and Agriculture Organization, Rome, Italy

Squires D, LT Ballance, L Dagorn et al., 2021. Mitigating bycatch: novel insights to multidisciplinary approaches. Frontiers in Marine Science 8:613285. https://doi.org/10.3389/fmars.2021.613285

Stephenson RL, AJ Benson, K Brooks et al., 2017. Practical steps toward integrating economic, social and institutional elements in fisheries policy and management. ICES Journal of Marine Science 74:1981-9. https://doi.org/10.1093/icesjms/fsx057

Stevens BG, 2021. The ups and downs of traps: environmental impacts, entanglement, mitigation, and the future of trap fishing for crustaceans and fish. ICES Journal of Marine Science, 78:584-96. https://doi.org/10.1093/icesjms/fsaa135

Subasinghe R, D Soto & J Jia, 2009. Global aquaculture and its role in sustainable development. Reviews in Aquaculture 1:2-9. https://doi.org/10.1111/j.1753-5131.2008.01002.x

Sumaila UR, C Bellmann & A Tipping, 2016. Fishing for the future: An overview of challenges and opportunities. Marine Policy 69:173-80. https://doi.org/10.1016/j.marpol.2016.01.003

Thorpe A, 2005. Mainstreaming fisheries into national development and poverty reduction strategies: Current situation and opportunities. Food and Agriculture Organization, Rome, Italy.

Waples RS, K Hindar & JJ Hard, 2012. Genetic risks associated with marine aquaculture. NOAA, USA pp: 149

Yıldız T & FS Karakulak, 2016. Types and extent of fishing gear losses and their causes in the artisanal fisheries of Istanbul, Turkey. Journal of Applied Ichthyology 32:432-8. https://doi.org/10.1111/jai.13046

Zhou S, 2008. Fishery by-catch and discards: a positive perspective from ecosystem-based fishery management. Fish and Fisheries 9:308-15. https://doi.org/10.1111/j.1467-2979.2008.00291.x