

Regulatory Frameworks and Policies for Ensuring Sustainable Fisheries and Aquaculture Practices

^{1*} Dr. Kavya Subramaniam, Vidyadeep University of Engineering, India.

Abstract: The world fisheries and aquaculture industries are increasingly affected by issues of overfishing, habitat degradation, climate change, and illegal, unreported, and unregulated (IUU) fishing. These impacts require effective policy solutions at all levels of governance, including international, regional and national. This review systematically analyzes the design of regulatory frameworks managing sustainable fisheries and aquaculture at the international level by focusing on some of the most important instruments, such as the UNCLOS, CCRF, PSMA, and the WTO Fisheries Subsidy Agreement, along with selected regional and national policies. Based on the comparative policy analysis method, the study assesses the content of regulatory instruments in terms of scope, enforcement mechanisms, and impact on the ground within different geographic contexts. Results show that, in general, legal, binding instruments have a higher rate of compliance and quantifiable outcomes than voluntary instruments, while for the case of small-scale fisheries governance, where legal enforcement capability is low, voluntary instruments could still be effective. Large implementation gaps were identified in particular for developing countries and managing transboundary stocks. This research shows that adaptive governance structures integrating international commitments and management contexts are essential; the monitoring and surveillance capacities need to be enhanced, and ecosystem-based management principles should be included in binding instruments. Finally, policy recommendations are made on closing the gap between normative goals and actual performance in the international seafood production system.

Keywords: Sustainable Fisheries; Aquaculture Governance; Regulatory Frameworks; IUU Fishing; International Fisheries Law; Ecosystem-Based Management; Marine Policy.

(Submitted: December 29, 2025; Revised: February 02, 2026; Accepted: March 05, 2026; Published: March 31, 2026)

I. Introduction

The world fisheries and aquaculture industry is a major provider of animal protein and livelihoods for hundreds of millions. In 2022, the total world fisheries and aquaculture production reached an unprecedented 223.2 million tons, with the volume produced in aquaculture exceeding that in capture fisheries for the first time (Woodward, 2004). This milestone is indicative of a global expansion in the sector, fueled over decades by rising consumer demand, technological innovation, and intensify production systems, yet simultaneously suggestive of intensifying environmental pressures that cannot be resolved by a single governance authority.

Fishing stocks remain vulnerable to overexploitation, with estimates suggesting that the portion of analyzed marine fish stocks harvested at biologically unsustainable levels has increased from 10% in 1974 to 37.7% in 2021 Johnstone (2022). Coupled with these pressures are loss of aquatic habitat, water quality concerns in aquaculture farms that discharge effluents, shifting fish stocks due to global warming and unprecedented rates of Illegal, Unreported and Unregulated fishing. The value of lost catch due to IUU fishing alone is between \$10 and \$23 billion, with estimates placing this at between 11 and 26 million tons of fish per year. These pressures have spawned an increasingly complex range of treaties, regional agreements, domestic regulations and codes of practice each with varying degrees of ecological, economic and social considerations.

The governance architecture of fisheries and aquaculture regulation is multi-layered with a global layer represented by UNCLOS and CCRF, a regional management level consisting of Regional Fisheries Management Organizations (RFMOs) and a national regulatory layer where rules may include quotas in fisheries and EIAs in aquaculture. The multitude of regulatory regimes, however, exists in the face of deficits in implementation and insufficient capacity. Limited technical capacities and divergent national imperatives often impede the operationalization of international norms in developing nations.

This review consolidates current understanding of the regulatory regime for the sustainability of fisheries and aquaculture, examines the relative strengths and weaknesses of compulsory versus voluntary instruments and proposes areas for further policy research. Existing empirical and comparative assessments published between 2015 and 2025 on regulatory issues in the sector are reviewed, with a focus on the post-SDG 14 era which marks a period of increasing accountability for ocean governance. This review offers evidence-based guidance for ocean governance researchers, policymakers and practitioners on the most suitable policies and governance strategies to employ for enhancing fisheries sustainability.

This article proceeds as follows. Section 1 briefly describes the evolution of international and global Fisheries & Aquaculture regulations and examines their scale. Section 2 discusses the methods used to systematically review and analyze compliance with regulation and its overall effectiveness. Section 3 reviews evidence of regulatory performance at the global, regional, domestic and private level. Section 4 discusses insights for governance design such as adaptive management, ecosystem-based approach and fairness. Section 5 concludes with recommendations for enhancing governance in the Fisheries & Aquaculture sector and suggesting avenues for future research.

II. Materials and Methods

Study Design and Scope

This analysis uses a methodology based on a systematic narrative review approach; as applied to similar environmental policy issues (Pitcher et al., 2009). Instruments examined range across international, regional and national levels and were included if: (i) the instrument directly addresses any issue of fishing harvest level, aquaculture environmental management or control of IUU fishing, (ii) it was published, ratified or significantly reviewed between 1982 and 2024, and (iii) empirical or analytical study assessing the effectiveness of the instrument was published between 2015 and 2025.

Literature Search Strategy

Peer-reviewed literature was located by conducting systematic literature searches in the Web of Science, Scopus, and Google Scholar databases using the strings fishery regulation, aquaculture governance, IUU fishing policy, marine protected areas, ecosystem-based fisheries management, UNCLOS implementation, and CCRF compliance. Grey literature (e.g. FAO technical papers and country review reports, OECD reviews of fisheries sectors, IPCC Blasiak & Yagi, (2016) assessments, and World Bank Ocean economy studies) was also searched to complement peer-reviewed data. All references were managed in standard bibliographic software and duplicates were removed before initial screening.

Analytical Framework

Regulatory instruments were assessed using a standardized framework of four criteria: (i) legal bindingness and degree of ratification, (ii) geographical and species coverage of the instrument, (iii) compliance and enforcement measures, and (iv) known or predicted effectiveness on the basis of evidence from published sources. Effectiveness of regulatory instruments was estimated using a qualitative ranking (Low, Low-Moderate, Moderate, Moderate-High, High, Emerging) based on compilations of compliance data, fish stock trajectories, and professional judgments reported in the analysed literature. The framework was developed using and adapting for fisheries use the typologies of regulatory effectiveness developed by (2023) Young, (2011) and Cowan et al., (2012).

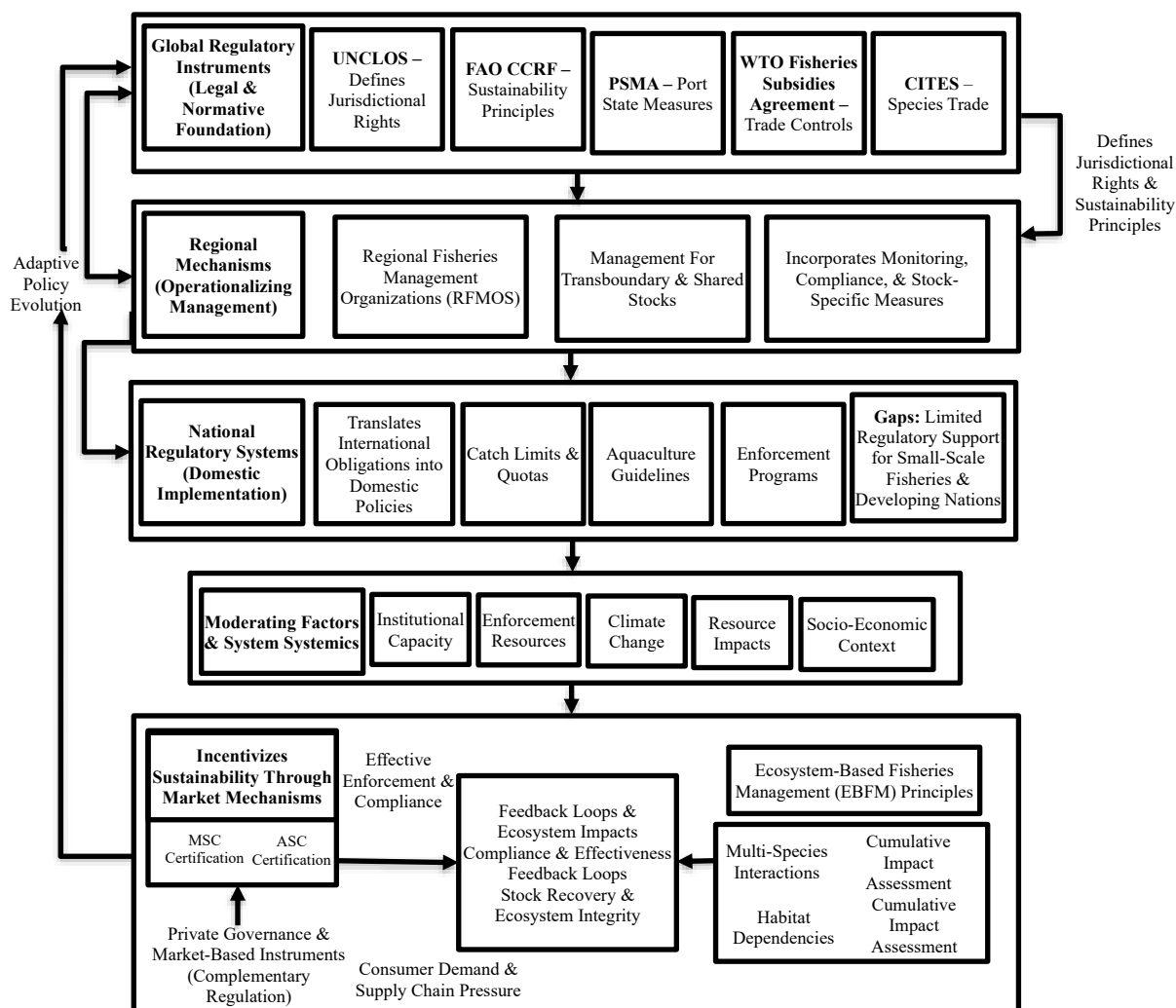


Figure 1: Conceptual Framework for Multi-Layered Governance for Sustainable Fisheries and Aquaculture

In this figure 1 shows the multi-layered structure of governance for sustainable fisheries and aquaculture. Global instruments such as the UNCLOS, FAO CCRF, PSMA, WTO Fisheries Subsidies Agreement, and CITES form the legal and normative framework, defining rights of jurisdiction, principles of sustainability and mechanisms to control trade. At the regional level, such mechanisms as the RFMOs have been designed to manage transboundary and shared fish stocks through monitoring and enforcement activities and provide species-specific controls. At the national level, legislation and management systems operationalize international commitments by, for instance, establishing national allocations, licensing requirements and aquaculture practices, and programs for implementation and enforcement. Private governance, market-based mechanisms (such as the MSC and ASC certifications), add incentives and additional controls to support sustainable fisheries management, while moderating factors such as capacities of institutions and availability of enforcement resources, climate change impacts, socio-economic context shape governance implementation. Feedback loops between stock condition and fisheries management as well as the ecosystem-based fisheries management principles are integrated and show how fish stocks and ecosystem are affected and management practices are adjusted accordingly. The governance system integrates principles of ecosystem-based fisheries management (EBFM) which entails the multi-specific nature of interactions and habitat dependencies, and impacts of various activities and thus cumulative impacts assessments. Finally, gaps in the support of small-scale fisheries and developing countries are identified.

III. Results

International Regulatory Instruments: Architecture and Scope

There are three central international frameworks defining the governance structure of international fisheries and aquaculture: the UNCLOS, the FAO CCRF and the UNFSA; accompanied by a growing number of conventions and agreements focusing on specific aspects like trade, port entry or subsidy reform. The UNCLOS of 1982 entered into force in 1994, creating juridical framework of national jurisdiction by establishing Exclusive Economic Zones (EEZs) 200 miles from the baselines that allows coastal states sovereign rights over fishery resources within the EEZ (Blasiak & Yagi, 2016). With 90% of commercial exploitable fish resources being under the sovereignty of coastal states, governance gaps are created in areas outside national jurisdiction (ABNJ) and managed today partly by the High seas Treaty adopted in 2023 Warner, (2014).

In this table 1 shows comprehensive voluntary guideline providing recommendations on the conduct of responsible fishing and aquaculture practices are established in the FAO's CCRF of 1995. The recommendations include elements like gear selection, bycatch mitigation, effects on the ecosystem and aquaculture management and although the guidelines are voluntary, they represent the standard of responsible fishing and aquaculture and their implementation is widely monitored through biennial compliance reports issued by the FAO Jiang & Guo, (2023). The Port State Measures Agreement (PSMA), which was agreed in 2009, became binding in 2016 and is the first international binding instrument specifically prohibiting illegal fishing by giving access control to port states. The PSMA has been ratified by 72 states by 2024.

Recent development in the area of international fisheries and aquaculture management is represented by the WTO Agreement on Fisheries Subsidies (2022) that banned subsidies for fishing on overfished stocks, for Illegal, Unreported and Unregulated (IUU) fishing and on activities carried out in unregulated areas (Sumaila et al., 2010). Although the details of its implementation plan are still under development, this agreement addresses crucial drivers for overcapacity and economic feasibility of illegal activities. In addition, the trade in of commercially exploited marine species, and thus the control of commercial exploitation of fish stocks, is to a certain extent regulated by CITES listing of commercially important marine fish species (e.g. Sharks, some groupers, seahorses) in Appendix II that requires permit procedures for commercial trade (Gnaneshwar et al., 2023).

Table 1: Comparative Overview of Key Regulatory Instruments for Sustainable Fisheries and Aquaculture

Policy Instrument	Scope	Key Provisions	Enforcement Mechanism	Effectiveness Rating
FAO CCRF (1995)	Global	Voluntary; covers capture, aquaculture, trade	Peer review, national reporting	Moderate
UNCLOS (1982)	International waters	EEZ rights; high-seas governance	ITLOS arbitration	High
PSMA (2009)	Port access	Denies port entry to IUU vessels	Port State inspection	High
EU CFP (2013)	European Union	Maximum sustainable yield; discard ban	EU inspection regime	High
Magnuson-Stevens Act	USA (federal)	Annual catch limits; rebuilding plans	NOAA enforcement	High
WTO Fisheries Subsidies Agreement (2022)	Global trade	Bans harmful subsidies to IUU fishing	WTO dispute mechanism	Emerging
CITES Appendix II	Global trade	Trade controls on over-exploited species	Import/export permits	Moderate-High
FAO Voluntary Guidelines SSF (2015)	Small-scale fisheries	Rights-based; social equity focus	Self-regulatory	Low-Moderate
CBD Kunming-Montreal GBF Target 3	Global	30x30 marine protected areas	National action plans	Emerging
Regional Fishery Bodies (e.g., CCAMLR)	Regional	Stock-specific conservation measures	Consensus-based monitoring	Moderate-High

Regional Fisheries Management Organizations and Governance Effectiveness

RFMOs are the most significant institutional means of managing shared and straddling fish stocks transboundary. There were 17 such bodies operating across the world in 2024, addressing key commercial fish species, such as tuna, swordfish, Antarctic toothfish and groundfish complexes. Decisions made at RFMOs – by consensus among members – are enshrined in binding conservation and management measures (CMMs), monitored by, among other things, vessel monitoring systems (VMS), observers and port inspections (Cullis-Suzuki & Pauly, 2010).

However empirical researches on the performance of RFMOs have yielded mixed results. The CCAMLR is commonly cited as among the most successful, having sustained toothfish populations through precautionary management and rigorous monitoring (Mpamije & Chikuni, 2023). However, some tuna RFMOs have proven unable to reverse dwindling stock levels of bluefin and bigeye tuna, mainly due to an excess of fishing capacity, failure to adhere to catch quotas, and membership of non-compliant states with flag of convenience flags (Pinsky et al., 2018). RFMOs' effectiveness therefore hinges on their structure of membership, decision-making processes and the commitment of key fishing states to short term profit over long term conservation.

The under-representation and disempowerment of SIDS and developing coastal states in managing fish stocks on which these nations have traditionally depended, and on which they depend today for livelihoods, has been identified as a critical structural shortcoming among many RFMOs. This perpetuates a history of resource exploitation of the ocean-dependent peoples and fails to contribute to the social validity of the conservation effort (Surendar, 2024).

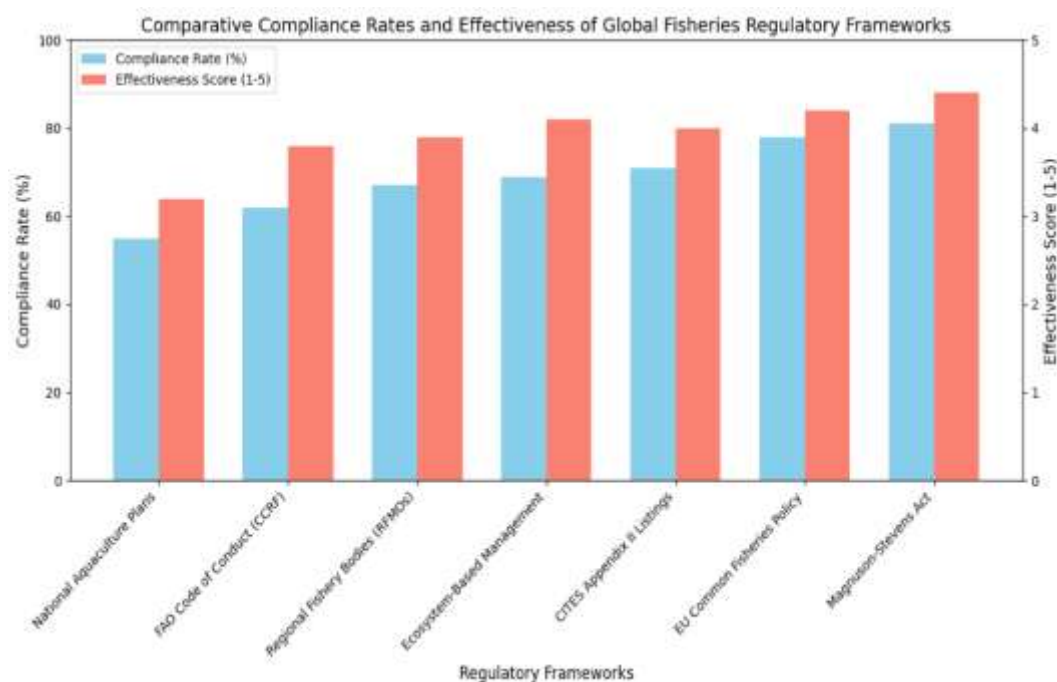


Figure 2: Compliance and Effectiveness of Global Fisheries Regulatory Frameworks

In this figure 2 shows comparison of main regulatory regimes in relation to level of member state compliance and scores for effectiveness. This table shows that schemes with a stronger institutional basis like Magnuson-Stevens and the EU Common Fisheries Policy score the highest for both compliance (above 78%) and effectiveness (above 4/5) and national and regional approaches like National Aquaculture Plans score lower for both effectiveness (3.2/5) and compliance (55%). The graph generally indicates that an international scheme with stronger reporting and enforcement measures achieves more compatible outcomes with sustainable fisheries.

National Regulatory Systems: Case Comparisons

National regulatory frameworks have vastly different levels of ambition, design and implementation capability. The US Magnuson-Stevens Fishery Conservation and Management Act (MSA), which has been reauthorized in 2006 and 2007 and was initially passed in 1976, is regarded as among the world's most sophisticated fisheries management frameworks. Under the MSA, fishing activities are regulated through scientifically-determined annual catch limits (ACLs), rebuilding plans are required for overfished stocks, overfishing is required to be eliminated within a certain time frame, and are governed by a network of eight Regional Fishery Management Councils (Kaakandikar & Wawre, 2024). Consequently, the percentage of federally managed stocks subject to overfishing fell from 21% to 10% between 2000 and 2022, indicating the success of legally mandated sustainability limits. The EU Common Fisheries Policy (CFP), most recently reformed in 2013, additionally sets mandates that all fishing will take place at Maximum Sustainable Yield (MSY) levels by 2020, that discards will be banned (the landing obligation), and that fisheries targeting key assemblages must have multi-annual management plans. Some stocks in the Northeast Atlantic have recovered under the reformed CFP, but there continue to be issues with the management of mixed fisheries, were technical interactions among target and non-target species complicate quota adherence (Murawski, 2010). In addition to this, EU aquaculture is managed through Strategic Guidelines for Aquaculture (2021-2030), aiming to encourage environmental certification and the use of integrated multi-trophic aquaculture (IMTA) and reduce antibiotic use. In comparison many developing nations lack the administrative capacity, monitoring systems and the enforcement capabilities that would allow for implementation of comparable standards. The granting of access in West African fishing agreements, for example, undermined national management goals by granting access rights in excess of sustainable yields and blocking technology transfer (Lee & Yoo, 2014). The political economy context, which results in inequities, cannot be ameliorated by technical reforms alone.

Aquaculture-Specific Governance Frameworks

Aquaculture involves unique issues regarding the management of water quality, disease, genetic interactions between cultured and wild stocks, land use and zoning, feeds, and chemical inputs. At an international level, guidance is provided through the FAO Technical Guidelines for Responsible Aquaculture and CCRF Chapter 9 on aquaculture development, but these lack legal authority. Consequently, national level implementation of aquaculture management varies considerably, from highly developed environmental licensing systems in many industrial nations to gaps in governance in the largest producers of aquaculture which account for over 85% of global aquaculture production in volume Woodward (2004) but exist primarily in Asia. Third party certification systems, notably the Aquaculture Stewardship Council (ASC) and Best Aquaculture Practices (BAP) standards from the Global Aquaculture Alliance (GAA), provide an additional market-based system for governance, by incorporating sustainability considerations into seafood value chains. In 2024, about 1.5 million tonnes of aquaculture was ASC certified, with aquaculture farms located in 107 different countries (Partelow & Boda, 2015). The market-based approaches are still dominated by export industries targeting premium markets in Europe, North America and Japan, with the majority of global aquaculture production by volume, occurring in small holder systems, unregulated.

Governance Gaps and Implementation Challenges

Five cross-cutting governance gaps emerge from the literature reviewed: monitoring, control and surveillance (MCS) remain the most critical factor, particularly in developing coastal states where VMS is patchy and observer programs under-funded, and port inspections remain inadequate; IUU fishing exploited the space between national and high seas governance via flag of convenience schemes (PSMA only partly addresses this); international cooperation fails where major players are not involved (RFMOs) or where agreement on catch limits is the product of politics, not science; climate change means the scientific basis for stock management will become increasingly inaccurate (e.g., shifts in species distribution, food web

disruptions) Lotze et al., (2019); inequity between industrial and small-scale fishing governance as small scale fishing is responsible for employing over 90% of all fishers globally (Surendar, 2024).

IV. Discussion

The Effectiveness Paradox: Legal Bindingness Versus Adaptive Governance

This continued tension between the normative robustness required by legally binding instruments and the capacity for practical flexibility demanded by well-functioning and responsive fisheries governance, seen above in this example, has yet to be fully reconciled. Legal, binding instruments like the MSA and EU CFP perform demonstrably better in terms of evidence of successful sustainability outcome, as evidenced by the patterns of recovery trajectories observed in both the North Atlantic and the US EEZ (Murawski, 2010; Lee & Yoo, 2014) than do non-binding, voluntary instruments. However, uniform, legal and binding sustainability objectives assume the existence of attributes not necessarily present in the developing world, namely, scientifically run stock assessment programs, functioning legal and enforcement systems and adequately funded regulatory institutions. The unilateral imposition of legally binding compliance obligations absent capacity-building leads to de jure sustainability and de facto unimplemented obligations. This inherent paradox is not easily solved by simply shifting to universally applied, legally binding fisheries governance, but rather by doing so incrementally and as jurisdictionally capacities warrant. Graduated approaches to regulation that incorporate implementation timelines, technical and financial assistance to developing states, and are in alignment with the common but differentiated responsibility principle applied in other domains of international environmental law, would serve as a useful conceptual framework for designing the next generation of fisheries treaties (Young, 2011).

Ecosystem-Based Management as the Emerging Paradigm

As a framework for structuring fisheries governance, Ecosystem-Based Fisheries Management (EBFM) is an increasingly favored idea. Beyond managing individual species stocks, EBFM attempts to encompass interactions between ecologically varied marine components, dependence on various habitat structures and the cumulative human impacts upon both Pitcher et al., (2009). Advanced national systems such as those in Australia, Iceland and New Zealand have all incorporated aspects of EBFM into the formal legal structures of fisheries management. Likewise, a new United Nations Sustainable Development Goal (14, the ocean) is committed to sustainable EBFM. However, integrating EBFM into operational management systems is limited both by the scale of data needed compared to actual collection capacity and the rigid structures of existing sectors that make multi-species decision-making difficult. The integration of EBFM with climate adaptation is a critical area of innovation required. If climate change impacts productivity and distributions, fixed-quota systems based on historic baselines will fall out of sync. Dynamic systems that update quota based on climate projections within predefined thresholds could offer promising adaptations, although scientific understanding and flexible institutions are required for these innovations (Lotze et al., 2019).

Market-Based and Private Governance Mechanisms

An increasingly prevalent approach to fisheries governance has been the development and use of private third-party certification programs, driven by the goal of applying market signals that extend beyond those captured by formal regulations. The certification programs for capture fisheries (Marine Stewardship Council) and aquaculture (Aquaculture Stewardship Council), together accounting for tens of thousands of certified sites, have demonstrated a capacity for developing sustainability standards in some cases more ambitious than those in applicable legislation (Partelow & Boda, 2015). The impetus to track seafood and the actual requirements imposed on importing countries like the U.S. (SIMP), EU (IUU regulation) and Japan increased accountability through market mechanisms Partelow & Boda (2015), though the mechanisms failed to address inclusiveness and equity goals. High costs of certification and the technical knowledge required for small-scale fishers in developing countries are prohibitive and have therefore

allowed large, export-oriented firms to take the lead in accessing the gains while excluding much of the world's fish catch (Lee & Yoo, 2014). Consumer confusion stemming from the multitude of various standards for market instruments reduced the strength of market signals as fisheries governance tools. Increased consistency between public and private standards through recognition or co-regulation would contribute to stronger fisheries governance regimes.

Financing for fisheries governance

One of the main prerequisites of fisheries governance, and especially for developing countries, is a consistent financial source. The agreement on Fisheries Subsidies under WTO aims to eliminate the overuse of capacity-enhancing subsidies but the provision of positive financing for management schemes, stocks assessments and the small-scale fisheries sector remain weak compared to the demand (Sumaila et al., 2010). Official development assistance (ODA) has been sporadic and often dictated by non-conservation objectives. There are also a growing number of innovative funding mechanisms, such as debt-for-nature swaps, green bonds that promote marine conservation or PES linked to fisheries productivity that might supplement the insufficient financing stream (Cowan et al., 2012).

V. Conclusion

Over the last four decades fisheries and aquaculture sustainability governance has developed into a highly complex regime beyond the state, ranging from international treaties that bind parties, regional management organizations, domestic laws, and private sector-based certification schemes. Although major legal and treaty instruments such as UNCLOS, CCRF, PSMA, WTO Fisheries Subsidies Agreement constitute major gains in normative terms, challenges with regard to implementation, differentiated implementation capacity and emerging climate change and IUU fishing threaten ecological benefits. Comparisons lead to several conclusions, of paramount importance to the design of future policy. The strong legal-based governance of fisheries has, where institutional capacity is sufficiently high, achieved clearly better environmental results than voluntary arrangements. Voluntary actions and private certification schemes offer great benefits when official measures are lacking or not feasible, but face legitimate issues regarding representation and authority. Developing ecologically appropriate climate-adaptive strategies alongside ecosystem-based management frameworks are the required way forward, although they rely heavily upon robust scientific and institutional capacities. Equitable processes are critically needed to ensure participation of both small-scale fishers and developing countries in global governance regimes.

Future research could investigate in a longitudinal fashion how climate impacts may affect regulatory regimes, evaluate novel financing methods designed to bolster fisheries governance in developing countries, and explore new forms of hybrid governance systems integrating state, market, and civil society actors. The sustainability of fisheries and aquaculture globally rests upon both effective institutional capacity and appropriately designed, equitable governance.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflict of Interest

The author declares no conflict of interest.

Data Availability Statement

This review is based on publicly available published literature. No new primary datasets were generated. All cited sources are listed in the References section.

References

- [1] Woodward, R. (2004). The organisation for economic cooperation and development: Global monitor. *New Political Economy*, 9(1), 113-127. <https://doi.org/10.1080/1356346042000190411>
- [2] Johnstone, I. (2022). 10. Organisation for economic co-operation and development (OECD). *Yearbook of International Environmental Law*, 33(1), 271-276. <https://doi.org/10.1093/yiel/yvad054>
- [3] Lotze, H. K., Tittensor, D. P., Bryndum-Buchholz, A., Eddy, T. D., Cheung, W. W., Galbraith, E. D., ... & Worm, B. (2019). Global ensemble projections reveal trophic amplification of ocean biomass declines with climate change. *Proceedings of the national academy of sciences*, 116(26), 12907-12912. <https://doi.org/10.1073/pnas.1900194116>
- [4] Pitcher, T. J., Kalikoski, D., Short, K., Varkey, D., & Pramod, G. (2009). An evaluation of progress in implementing ecosystem-based management of fisheries in 33 countries. *Marine Policy*, 33(2), 223-232. <https://doi.org/10.1016/j.marpol.2008.06.002>
- [5] Young, O. R. (2011). Effectiveness of international environmental regimes: Existing knowledge, cutting-edge themes, and research strategies. *Proceedings of the National Academy of Sciences*, 108(50), 19853-19860. <https://doi.org/10.1073/pnas.1111690108>
- [6] Cowan Jr, J. H., Rice, J. C., Walters, C. J., Hilborn, R., Essington, T. E., Day Jr, J. W., & Boswell, K. M. (2012). Challenges for implementing an ecosystem approach to fisheries management. *Marine and Coastal Fisheries*, 4(1), 496-510. <https://doi.org/10.1080/19425120.2012.690825>
- [7] Blasiak, R., & Yagi, N. (2016). Shaping an international agreement on marine biodiversity beyond areas of national jurisdiction: lessons from high seas fisheries. *Marine Policy*, 71, 210-216. <https://doi.org/10.1016/j.marpol.2016.06.004>
- [8] Warner, R. M. (2014). Conserving marine biodiversity in areas beyond national jurisdiction: co-evolution and interaction with the law of the sea. *Frontiers in Marine Science*, 1, 6. <https://doi.org/10.3389/fmars.2014.00006>
- [9] Jiang, R., & Guo, P. (2023). Sustainable management of marine protected areas in the high seas: From regional treaties to a global new agreement on biodiversity in areas beyond national jurisdiction. *Sustainability*, 15(15), 11575. <https://doi.org/10.3390/su151511575>
- [10] Sumaila, U. R., Khan, A. S., Dyck, A. J., Watson, R., Munro, G., Tydemers, P., & Pauly, D. (2010). A bottom-up re-estimation of global fisheries subsidies. *Journal of Bioeconomics*, 12(3), 201-225. <https://doi.org/10.1007/s10818-010-9091-8>
- [11] Gnaneshwar, G., Qureshi, N. W., Thapa, A., Kumar, G., & Bhat, N. M. (2023). Navigating antimicrobial use in Indian freshwater aquaculture: Regulatory frameworks and sustainable alternatives. *Journal of Indian Fisheries Association*, 50(1), 15-24. <https://doi.org/10.56093/jifa.v50i1.141730>
- [12] Cullis-Suzuki, S., & Pauly, D. (2010). Failing the high seas: a global evaluation of regional fisheries management organizations. *Marine Policy*, 34(5), 1036-1042. <https://doi.org/10.1016/j.marpol.2010.03.002>
- [13] Mpamije, L. J., & Chikuni, E. (2023). Boundary Element Method for Underwater Acoustic Propagation in Complex Marine Environments. *Advanced Computational Acoustics Engineering*, 1(1), 33-40. <https://doi.org/10.17051/ACAE/01.01.05>
- [14] Pinsky, M. L., Reygondeau, G., Caddell, R., Palacios-Abrantes, J., Spijkers, J., & Cheung, W. W. (2018). Preparing ocean governance for species on the move. *Science*, 360(6394), 1189-1191. <https://doi.org/10.1126/science.aat2360>
- [15] Surendar, A. (2024). Marine Algae Bioreactors for Sustainable Aquafeed and Bioactive Compound Production. *National Journal of Smart Fisheries and Aquaculture Innovation*, 31-40.
- [16] Kaakandikar, R. M., & Wawre, D. D. (2025). Regulatory frameworks and policies for sustainable aviation marketing. In *Sustainable Marketing Practices in the Aviation Industry* (pp. 1-32). IGI Global Scientific Publishing. <https://doi.org/10.4018/979-8-3693-7215-9.ch001>

- [17] Murawski, S. A. (2010). Rebuilding depleted fish stocks: the good, the bad, and, mostly, the ugly. *ICES Journal of Marine Science*, 67(9), 1830-1840. <https://doi.org/10.1093/icesjms/fsq125>
- [18] Lee, M. K., & Yoo, S. H. (2014). The role of the capture fisheries and aquaculture sectors in the Korean national economy: An input–output analysis. *Marine Policy*, 44, 448-456. <https://doi.org/10.1016/j.marpol.2013.10.014>
- [19] Partelow, S., & Boda, C. (2015). A modified diagnostic social-ecological system framework for lobster fisheries: Case implementation and sustainability assessment in Southern California. *Ocean & Coastal Management*, 114, 204-217. <https://doi.org/10.1016/j.ocecoaman.2015.06.022>