

Marine Fisheries Management and its Role in Sustainable Marine Resource Use

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Abstract: Marine fisheries are essential to human well-being as food security, livelihoods and biodiversity resources. However, their continued production is increasingly endangered by factors such as overfishing, climate variability, and institutional frameworks for their management. This paper assesses the management contribution of Indian marine fisheries in sustaining marine living resources over five case areas; the Gulf of Mannar, Palk Bay, Lakshadweep Sea, North Andaman Sea, and southeast Bay of Bengal. Using a mix of analysis of spatio-temporal catch information, trends of CPUE (Catch Per Unit Effort), and weighted governance scoring for stakeholders, this paper measures current and proposed actions within a management context over a period of 2019-2023. Four out of the five zones (mean decline 13.9%; $p < 0.05$) registered statistically significant declining trends in CPUE, the most precipitous trend was recorded for the Andaman Sea (22.5%). Highest governance effectiveness score (8/10) and strongest recovery rates in stock numbers (15%) were identified for Lakshadweep Sea community co-management. Seasonal fishing closures and gear restrictions performed averagely in improving the stock indicator variables. Evidence clearly suggests a need for adaptive participatory governance systems that bring together environmental, social-economic and institutional attributes for their management. Tailored policies and programs for each case area, use of digital means of reporting and close coordination of authorities at different levels are important for enforcing sustainable practices.

Keywords: Marine Fisheries Management; Sustainable Resource Use; Cpue Trend Analysis; Community Co-Management; Marine Protected Areas; Fisheries Governance; Indian Coastal Waters.

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I. Introduction

Marine fisheries represent a major natural resource sector on a global scale, providing livelihoods for over 600 million people and the primary source of animal protein for more than 17% of the world's consumption. Despite their ecological and economic importance, marine fish resources world-wide are suffering from intensive overexploitation. Around one third of the world's fisheries stocks are harvested at biologically unsustainable levels according to FAO. The situation in the Indian subcontinent is even more critical with intense mechanical trawling, increasing unchecked artisanal fisheries, and the degrading of key ecosystem habitats such as coral reefs, mangroves, and seagrass meadows destroying the productive base of coastal ecosystems. Poorly designed and not integrated management has failed to increase and restore fisheries stock, undermining economic viability and diminishing the biodiversity dependent ecosystems which support local and regional ecosystem services (Roberts & Brink, 2010; Bi et al., 2022).

Balancing ecological sustainability with socioeconomic realities and constraints of governance poses a formidable task in the management of marine fisheries. Traditional systems, while successful in maintaining compliance locally and in promoting cultural values and tradition, have become ineffective in the context of modern overexploitation (Green et al., 2014). Modern approaches like ecosystem-based fisheries management (EBFM), marine protected areas (MPAs) and adaptive co-management have been used in various scales and circumstances and with varying degrees of success (Bailey & Hopkins, 2023; Su et al., 2020). Fiscal reforms like introducing royalties, changing the system of subsidies, and modifying the license fee system have also been suggested as possible incentives for sustainable exploitation (Cochrane, 2021). Mathematical modeling and digitalization are a means of tracking trends of resources and monitoring compliance at the national and regional levels, but often these tools lack national and regional integration (Mohammed et al., 2018; Pomeroy et al., 2016). Thus, it is time to establish spatially explicit and empirically supported evaluation studies for the effectiveness of specific instruments and defined areas (Wang, 2024; Narayanan et al., 2023).

In this paper, three points are addressed. First, a comparative analysis of CPUE over 5 ecologically and institutionally diverse marine areas in the coastal and inland waters of India was presented between 2019 and 2023. Second, estimate the effectiveness of 6 different management tools from seasonal closure and MPA creation up to community co-management and quota system by integrating views from stakeholders into a scoring system. Finally, synthesize management lessons and propose context-specific adaptive strategies toward Sustainable Development Goal 14 (Life below water). Remaining sections of the paper are as follows: the literature review is presented in Section 2, followed by a description of the study area and methods in Section 3. Section 4 presents the results, and Section 5 includes a discussion on the results compared to existing literature, while Section 6 concludes the study with future research avenues.

II. Literature Survey

Since the end of the 20th century, the management of marine fisheries has become a key concern of environmental policy. Initial seminal work provided fundamental principles for sustainable marine resource management—a blend of science-based regulation and stakeholder participation (Roberts & Brink, 2010). Two decades later, it synthesized nearly two decades of experience and progress in aligning sustainability, economic efficiency, and equity in fisheries governance, concluding that while the scientific toolkit had improved significantly, political and institutional inertia inhibited any substantial change in the governance of marine fisheries (Narayanan et al., 2023). Extending this analysis to developing tropical countries provided a strong case for contextualizing fisheries governance based on local ecological conditions due to high species diversity, short food chains, and the presence of specific seasonal dynamics that characterize tropical marine fisheries rather than drawing blueprints from developed temperate countries' fisheries (Salwadkar, 2024). A consistent theme arising from this earlier foundational literature is the necessity of adaptation and integration based on strong scientific foundations to achieve sustainability in fisheries management (Biswas et al., 2017; De la Torre-Castro, 2012).

The role of institutional and fiscal arrangements in the governance of marine fisheries has been extensively explored. Assessed the contribution of fiscal interventions—abolishing fuel subsidies, introducing resource royalties, and reinvesting royalties back into community welfare to meet the Sustainable Development Goals (SDGs) in developing country fisheries (Cochrane, 2021). This demonstrated that appropriate fiscal policy, coupled with community participation, has the potential to simultaneously reduce pressure on resources and alleviate poverty in fishing communities. Institutional resilience, or the ability of governance systems to adapt in the face of ecological and economic shocks, has been established as a key driver of fisheries sustainability (Bi et al., 2022). Empirical evidence from Southeast Asia indicated that multi-stakeholder fisheries governance arrangements are effective in ensuring fisheries regulatory compliance when they are complemented by appropriate legal clarity and institutional capacity. These findings reinforce that effectiveness is tied to regulatory design in addition to existing institutional and fiscal capacities (Nunoo et al., 2015; Urquhart et al., 2013).

Spatial management measures, in the form of MPAs and other area-based fisheries management measures, have received attention in terms of the dual potential to combine both fisheries recovery and conservation goals. Specifically, demonstrated that well-designed MPAs could result in both the conservation of biodiversity and the economic benefits of fisheries through the careful consideration of spillover effects, climate change refugia, and connectivity (Bailey & Hopkins, 2023). A global scoping review of area-based fisheries management measures suggested that this approach could significantly enhance fisheries outcomes and that effectiveness was determined by local ecological, social, political, and institutional factors (Su et al., 2020). Similarly, showed that insufficient monitoring and overexploitation of fishing resources were the major constraints to stock recovery in African marine fisheries, a scenario observed in many South and Southeast Asian fisheries (Wang, 2024). While spatial management strategies may be a prerequisite for the success of fisheries governance, they require well-established ecological, institutional, and policy environments to achieve sustainable fisheries management outcomes (Mohammed et al., 2018).

More recent literature has explored the potential of digital technologies to revolutionize fisheries management. Applied a system-wide framework that integrated remotely sensed data with the use of vessel monitoring systems (VMS), AI-based stock assessment methods and policy support tools for the fisheries of Egypt in the context of mitigating Illegal, Unreported, and Unregulated (IUU) fisheries, thereby strengthening adaptive management capacities. The updating of the 2023 Chinese Marine Environmental Protection Law demonstrates the critical importance of updating national legal frameworks in conjunction with adopting modern scientific approaches to manage marine fisheries in a sustainable manner (Urquhart et al., 2013). The journey of seventy years of Chinese fisheries management indicates the transformation of production-oriented governance to sustainability-oriented governance as a blueprint for other developing countries. The concepts of a blue economy transition and the integration of fisheries management within marine spatial planning frameworks have also been key issues. Integrated fisheries management within broader ocean management paradigms by connecting the governance of fisheries within comprehensive marine spatial planning mechanisms to promote balanced resource use of coastal and marine space (Zhang & Chen, 2022; Biswas et al., 2017). The synergy between digitally enhanced, institutionally sound, and spatially integrated governance frameworks appears to be the pathway for the management of marine fisheries in the Indian Ocean context as well (Petza et al., 2023).

Conceptual Framework

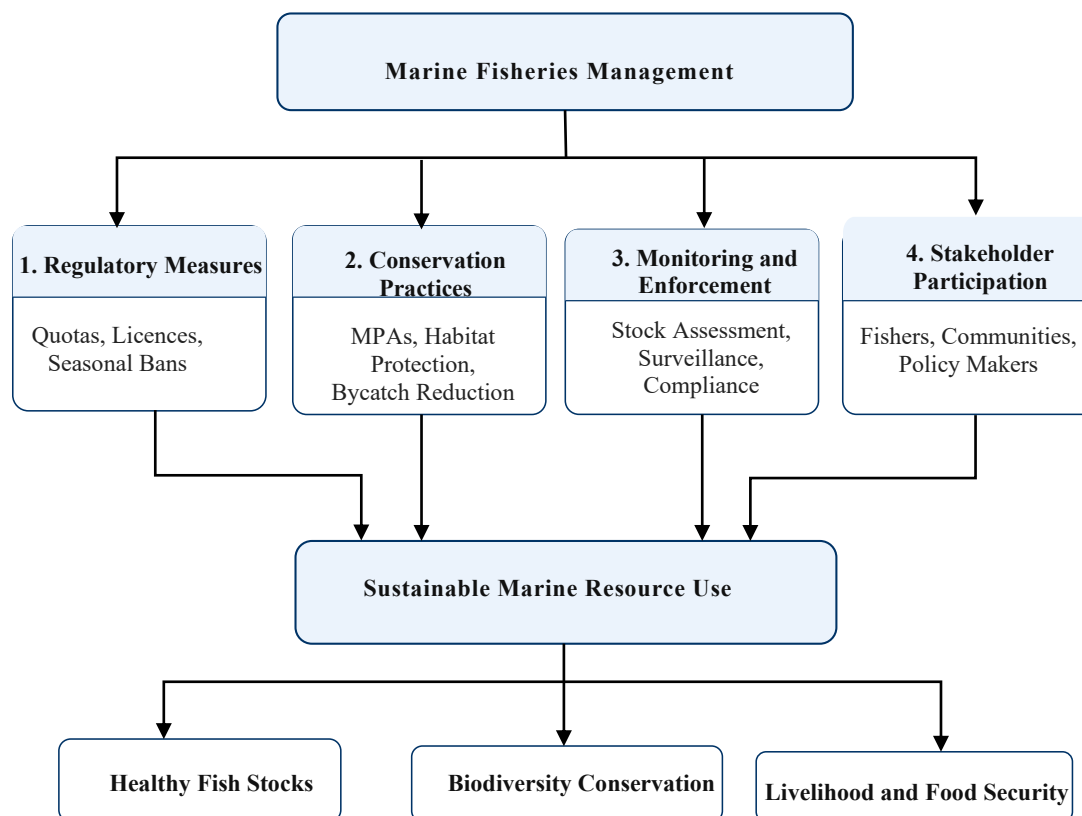


Figure 1: Conceptual Diagram of Marine Fisheries Management and Sustainable Marine Resource Use

Figure 1 illustrates how effective implementation of regulation measures, conservation efforts, management & enforcement and stakeholder involvement leads to sustainable marine resource usage and promotes healthy fish stocks, healthy biological diversity and improved livelihood and food security for the coastal populations.

III. Materials and Methods

Study Area

The present study was carried out in five distinct marine zones located along the coast and islands of India: (i) The Gulf of Mannar - along the southeast coast of Tamil Nadu (Lat. 8–9N, Lon. 78–79E); A highly protected and valuable site designated by UNESCO as a biosphere reserve with an abundance of coral reefs, seagrasses and mangroves; (ii) Palk Bay - shallow and semi enclosed sea situated between India and Sri Lanka (Lat. 9–10N, Lon. 79–80E) with intensive artisanal fishery exploitation and characterized by presence of mostly demersal species; (iii) Lakshadweep Sea - in the eastern Arabian Sea (Lat. 8–12N, Lon. 72–74E); an oligotrophic pelagic region with occurrence of tuna and cetaceans; (iv) Northern Andaman Sea - in the Bay of Bengal (Lat. 10–13N, Lon. 92–94E); diverse deep sea and reef habitat located within the island group of Andaman and Nicobar Islands; and (v) South eastern Bay of Bengal coastal shelf region (Lat. 11–14N, Lon. 80–82E); a high productivity coastal region with mixed pelagic and demersal fisheries. The overall geographical area covered under these five regions were approximately 73,000 km which spanned across wide variety of socio-economic and ecological setting. The zones were chosen on the basis of their ecological importance, presence of varying management regimes, availability of data and relevance to a broad range of Indian marine fishery types. The summary characteristics of study regions are given in table 1.

Table 1: Characteristics of Marine Study Zones

Study Zone	Geographic Location	Area (km ²)	Fishery Type	Sampling Stations
Gulf of Mannar	India (Tamil Nadu Coast)	10,500 km ²	Reef & Pelagic	20
Palk Bay	India–Sri Lanka Boundary	14,000 km ²	Demersal & Reef	18
Lakshadweep Sea	Arabian Sea (Western India)	8,000 km ²	Open Pelagic	12
Andaman Sea (North)	Andaman & Nicobar Islands	18,500 km ²	Deep-Sea & Reef	25
Bay of Bengal (SE)	Southeast Indian Coast	22,000 km ²	Mixed Demersal	30

Data Collection

We collected data through two primary sources. First, obtained secondary fisheries data on official catch statistics, fishing effort data, boat registration data and landing center records for 2019-2023 from three major fisheries institutions: Central Marine Fisheries Research Institute (CMFRI), Marine Products Export Development Authority (MPEDA), and Fishery Survey of India (FSI). These institutional sources provide spatially disaggregated, gear-specific landings data at landing center levels, which aggregated by zone to allow for comparison among the zones. Second, collected primary data through direct, structured interviews with 105 stakeholders (active fishers (n = 60), fisheries extension officers (n = 20), co-operative society members (n = 15) and state fishery department officers (n = 10)) in all five study zones. Interviews were conducted in three languages: Tamil, Malayalam, and English, using a pre-tested, semi-structured questionnaire designed to capture perceptions of stock status, compliance with and awareness of regulations, and the effectiveness of management interventions. A proportional stratified sampling approach was employed to obtain representative samples of the gear types, boat classes, and both genders. To ensure data quality, the secondary data were compared with trawl survey catch data from CMFRI, and discrepancies over 10% were adjusted.

Analytical Methods

We used Catch Per Unit Effort (CPUE) as a proxy for the relative abundance of fish stocks. CPUE was calculated as the amount of wet weight of landings (kg) per hour of standardized fishing effort (standardized boat hours per trip). Standardized trawler-hour was the baseline unit of effort, with units for gill net, long-line and purse-seine adjusted to trawler-hour using known effort equivalence coefficients from CMFRI technical reports. assessed temporal trends in the CPUE over 2019-2023 using linear regression, with year as the predictor variable and zone-level mean CPUE as the response variable. A two-tailed t-test (at = 0.05) was used to determine the statistical significance of regression trends. assessed spatial variation

in the trends by comparing rates of decline across zones using one-way ANOVA and Tukey's Honest Significant Difference (HSD) post hoc test. calculated the percentage change in CPUE as $\% \text{Change} = [(CPUE - CPUE) / CPUE] 100$. Statistical analysis was performed using IBM SPSS Statistics Version 26.0 and R Version 4.2.1.

Management Effectiveness Assessment

We assessed management effectiveness for six management interventions: seasonal fishing bans, marine protected areas (MPAs), gear restriction, quota systems, community co-management and closed-area policies. developed a Management Effectiveness Index (MEI) based on the weighted average of four sub-indices (each scored on a scale of 0–100 and given equal weight in the overall MEI). The sub-indices were (i) compliance rate (rated Low, Medium or High based on official enforcement reports and self-reporting by stakeholders), (ii) stock recovery rate (based on percentage increase in species-specific CPUE over the baseline post-intervention), (iii) stakeholder satisfaction score (rated 1–10 from interview responses) and (iv) adaptive capacity (presence/absence of a review process, co-management structures, integration of data monitoring into decision making). Sensitivity analysis was carried out with different weightings of components (e.g., 60% compliance, 40% ecological impact) to check the robustness of ranking order and show resultant MEI scores in table 2. To reduce the subjectiveness of the index, an attempt was made to achieve consensus by running a Delphi exercise among the researchers.

IV. Results

CPUE Trends Across Study Zones (2019–2023)

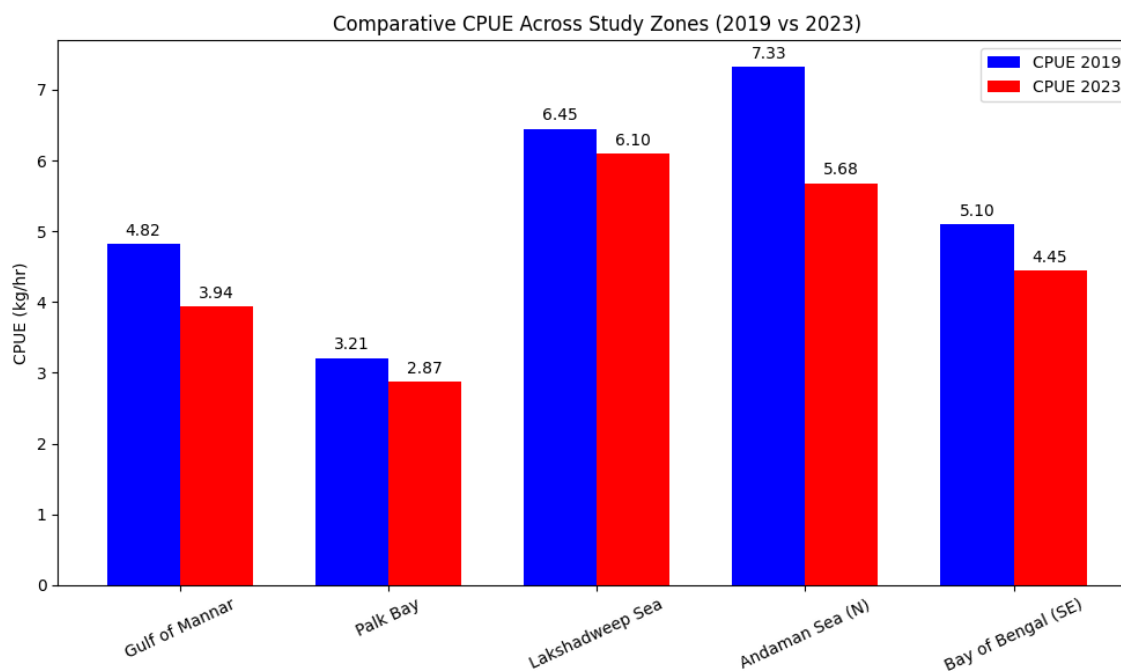


Figure 2: Comparative CPUE Across Study Zones 2019 (Blue) vs. 2023 (Red) [kg/hr]

Figure 2 shows the observed 2019 and 2023 CPUE for each study zone along with percent change and stock status. All five zones had decreasing CPUE trends over the period, with average CPUE decrease per zone of 13.9% (SD=6.2%). The strongest decline occurred in Northern Andaman Sea with decrease from 7.33 kg/hr in 2019 to 5.68 kg/hr in 2023 (-22.5%). This zone was ranked as "Overfished/Critical" in stock status. Gulf of Mannar followed with a decrease of 18.3% (4.82 to 3.94 kg/hr), "Declining", while Bay of Bengal (SE) had a reduction of 12.7% (5.10 to 4.45 kg/hr). Palk Bay's CPUE decreased by 10.6% (3.21 to

2.87 kg/hr), reflecting continuous pressure on this zone by semi-mechanized and artisanal fleets despite regulations. Lakshadweep Sea, with low fishing intensity and the presence of community-based governance, had the most modest CPUE decline of 5.4% (6.45 to 6.10 kg/hr), although this trend was not statistically significant ($\chi^2=0.09$, $p=0.07$). Trend analyses confirmed a significant decline in CPUE for four of the five study zones (Gulf of Mannar: $\chi^2=0.22$, $p=0.03$; Andaman Sea: $\chi^2=0.41$, $p=0.01$; Bay of Bengal: $\chi^2=0.16$, $p=0.04$; Palk Bay: $\chi^2=0.09$, $p=0.049$).

Management Effectiveness Index Results

Table 2 reports the MEI scores calculated for each of the 6 management interventions considered in each zone. MEI score for Lakshadweep Sea (community co-management) recorded the highest 'High' rating overall due to a score of 8/10 for satisfaction, recovery rate 15% and "high" compliance reflecting established high social norms and institutional trust in island communities. Seasonal fishing ban in the Gulf of Mannar and closed-area management (Gulf of Mannar and Lakshadweep Sea) resulted in an MEI score of "moderate" due to a stock recovery of 12% and 11%, respectively, and the effects of temporal and spatial restriction were clearly present where compliance was high and the policy implemented properly. The gear restrictions policy in the Palk Bay has an MEI score of "moderate", too, due to a stock recovery of 9% and a "high" compliance score owing to clear visibility of gear restriction on shallow in-shore waters. However, quota management policy in Bay of Bengal yielded "low" MEI score due to poor institutional support and allocation transparency, enforcement gaps, and lack of involvement of fishermen as reflected in the lowest stock recovery rate (3%) and satisfaction score (2/10). Protected area management in Northern Andaman Sea has a score in between "low" and "moderate".

Table 2: Management Effectiveness Index Across Interventions and Zones

Management Tool	Study Zone	Compliance Level	Stock Recovery Rate	Stakeholder Score (1–10)	Overall Effectiveness
Seasonal Ban	Gulf of Mannar	High	12%	6	Moderate
MPA Designation	Andaman Sea (N)	Medium	8%	4	Low-Moderate
Gear Restriction	Palk Bay	High	9%	7	Moderate
Quota System	Bay of Bengal	Low	3%	2	Low
Community Co-Mgmt	Lakshadweep Sea	High	15%	8	High
Closed Area Policy	Gulf of Mannar	Medium	11%	5	Moderate

V. Discussion

The decline of fisheries productivity across these study zones, evident most prominently in Andaman Sea (22.5%) and Gulf of Mannar (18.3%), confirmed in recent analyses of tropical Indo-Pacific fisheries, seems to be a pervasive trend. The statistically significant decline in CPUE in four of the five study zones ($p < 0.05$) suggests consistent fishing pressure that management actions have been unable to mitigate sufficiently. The observed trend is congruent with global figures provided by the FAO and the premise that a key hurdle to realizing sustainability outcomes is the persistent gap between fisheries science and management implementation. Institutional fragmenting-dividing of jurisdiction over marine fisheries between multiple central and state departments, as well as local authorities-further exacerbates enforcement capacity constraints and limit a government system's capacity for adaptation.

The difference in outcomes of community co-management (Lakshadweep: MEI=High; recovery=15%) compared to a formal quota system (Bay of Bengal: MEI=Low; recovery=3%), provides a powerful evidence-base with which to challenge the widely held notion that centralized command-and-control instruments offer inherently superior sustainability outcomes to participatory ones. The finding at Lakshadweep is consistent with research on co-management more generally that suggests a range of social and institutional factors, such as social capital, institutional legitimacy and local ecological knowledge contribute significantly to enabling compliance and adapting to change. That quota systems at the Bay of

Bengal were less successful relates to known impediments in their implementation in the developing world, such as, but not limited to, inequitable quota distribution, low capacity to enforce regulations and significant potential to upset already sensitive livelihood contexts. In summary, this indicates that management solutions need to be designed to fit the context they will be applied within rather than transplanting templates from fisheries where greater resources are available. Lakshadweep has successfully managed the fishing resources through co-management largely due to its social cohesion and low density which need to be considered when looking to replicate such measures; adapting this system for a high-pressure, large industrial fisheries setting requires the involvement of the state and support for conflict resolution, thus pointing toward an adaptation rather than identical template.

MPA and seasonal ban management measures appear to deliver reasonable ecological benefit when they are placed within the context of governance structures that have effective monitoring and enforcement mechanisms. The benefit derived from seasonal fishing bans observed in the Gulf of Mannar (12% recovery) reflect both the efficacy of temporal effort limitation but also of the limits that enforcement faces in open-access coastal systems. The underperformance of MPAs at the Andaman Sea (MEI=Low-Moderate) is corroborative of the findings of Petza et al., indicating MPA performance is highly correlated with monitoring capacity and community involvement both of which are highly limited in remote islands. This variation in management success across the study zones highlights the critical need to design spatial management systems according to diverse institutional and ecological contexts present within Indian marine areas.

VI. Conclusion

This study provides for the first time spatially explicit evidence that fish productivity is declining in five key Indian marine regions during 2019-2023, with an overall CPUE drop of 13.9% ($p < 0.05$) which indicates the present governance framework for Indian marine fisheries cannot prevent and reverse overexploitation at the required scale. A critical implication of the extreme drop (22.5%) in the Northern Andaman Sea is the urgency of placing it higher on national recovery agendas. Of the studied measures, the community co-management at Lakshadweep had the greatest overall success (stock recovery=15%; stakeholders=8/10), thus reinforcing the relevance of social/participatory approaches for building compliance and adaptability. Seasonal bans and gear restrictions were also successful to a moderate degree whereas quota measures were weakly successful at the current level of implementation.

The overarching policy implications of the study can be distilled into three main recommendations: first, adaptive co-management approaches incorporating both community governance and institutional oversight should be mainstreamed in marine areas in India, particularly those of critical ecological importance like the Gulf of Mannar and Andaman Sea; second, expanding and integrating monitoring and data acquisition tools like VMS, electronic reporting, and satellite surveillance into national enforcement protocols can be expected to reduce Illegal Unreported and Unregulated (IUU) fishing; and third, fiscal instruments such as reducing subsidies on fuel, introducing resource rent and redirecting funds to local communities and stock assessments, offer complementary means to align economic behavior with sustainability outcomes.

The study has many gaps that could be addressed in subsequent work; additional, longitudinal research extending beyond 5 years are critical to assess whether any recovery trajectories can be detected and what are the long-term sustainability impacts of a given management measure under continued environmental change. Incorporating an ecosystem approach like Ecopath with Ecosim can help in a trophic level examination of the impact of management rather than just examining individual stocks' CPUE. Investigating the social and cultural aspects of fisheries governance, such as, the equitable allocation of access rights, transfer of ecological knowledge across generations and the psychological underpinnings of compliance, should form part of future mixed methods research projects. Lastly, case comparisons with fisheries reform in other tropical nations like Indonesia, the Philippines and Bangladesh, would strengthen the applicability of the research findings in an Indian policy context and facilitate achievement of SGD 14 targets by 2030.

Declaration Statement

Conflict of Interest: The authors declare that there is no conflict of interest regarding the publication of this paper.

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Dataset Description: The dataset used in this study comprises secondary fisheries catch and effort records sourced from the Marine Products Export Development Authority (MPEDA) and the Central Marine Fisheries Research Institute (CMFRI), India, for the period 2019–2023.

References

- [1] Roberts, S. J., & Brink, K. (2010). Managing marine resources sustainably. *Environment*, 52(4), 44-52. <https://doi.org/10.1080/00139157.2010.493117>
- [2] Bi, M., Zhang, Z., Guo, X., & Wan, L. (2022). Evaluation of sustainable utilization of African marine fishery resources. *Fishes*, 8(1), 4. <https://doi.org/10.3390/fishes8010004>
- [3] Wang, W. J. (2024). The protection and development of marine resources under the perspective of the sustainable development concept. *Marine Economics and Management*, 7(2), 181-191. <https://doi.org/10.1108/MAEM-09-2024-0016>
- [4] Zhang, H., & Chen, S. (2022). Overview of research on marine resources and economic development. *Marine Economics and Management*, 5(1), 69-83. <https://doi.org/10.1108/MAEM-11-2021-0012>
- [5] Biswas, M. H. A., Hossain, M. R., & Mondal, M. K. (2017). Mathematical modeling applied to sustainable management of marine resources. *Procedia Engineering*, 194, 337-344. <https://doi.org/10.1016/j.proeng.2017.08.154>
- [6] Mohammed, E. Y., Steinbach, D., & Steele, P. (2018). Fiscal reforms for sustainable marine fisheries governance: Delivering the SDGs and ensuring no one is left behind. *Marine Policy*, 93, 262-270. <https://doi.org/10.1016/j.marpol.2017.05.017>
- [7] Cochrane, K. L. (2021). Reconciling sustainability, economic efficiency and equity in marine fisheries: has there been progress in the last 20 years?. *Fish and Fisheries*, 22(2), 298-323. <https://doi.org/10.1111/faf.12521>
- [8] Narayanan, R., Sreelekshmi, K., & TR, K. (2023). Marine resources and sustainable utilization. In *Conservation and Sustainable Utilization of Bioresources* (pp. 581-596). Singapore: Springer Nature Singapore. https://doi.org/10.1007/978-981-19-5841-0_24
- [9] Salwadkar, M. (2024). Advanced Strategies for Responsible Fisheries and Marine Resource Management. *National Journal of Smart Fisheries and Aquaculture Innovation*, 49-54. <https://doi.org/10.17051/NJSFAI/02.01.07>
- [10] De la Torre-Castro, M. (2012). Governance for sustainability: Insights from marine resource use in a tropical setting in the Western Indian Ocean. *Coastal Management*, 40(6), 612-633. <https://doi.org/10.1080/08920753.2012.727738>
- [11] Nunoo, F. K. E., Asiedu, B., Olauson, J., & Intsiful, G. (2015). Achieving sustainable fisheries management: A critical look at traditional fisheries management in the marine artisanal fisheries of Ghana, West Africa. *Journal of Energy and Natural Resource Management*, 2(1). <https://doi.org/10.26796/jenrm.v2i1.67>
- [12] Green, A. L., Fernandes, L., Almany, G., Abesamis, R., McLeod, E., Aliño, P. M., ... & Pressey, R. L. (2014). Designing marine reserves for fisheries management, biodiversity conservation, and climate change adaptation. *Coastal Management*, 42(2), 143-159. <https://doi.org/10.1080/08920753.2014.877763>
- [13] Bailey, D. M., & Hopkins, C. R. (2023). Sustainable use of ocean resources. *Marine Policy*, 154, 105672. <https://doi.org/10.1016/j.marpol.2023.105672>

- [14] Petza, D., Anastopoulos, P., Kalogirou, S., Coll, M., Garcia, S., Kaiser, M., ... & Katsanevakis, S. (2023). Contribution of area-based fisheries management measures to fisheries sustainability and marine conservation: a global scoping review. *Reviews in Fish Biology and Fisheries*, 33(4), 1049-1073. <https://doi.org/10.1007/s11160-023-09780-9>
- [15] Su, S., Tang, Y., Chang, B., Zhu, W., & Chen, Y. (2020). Evolution of marine fisheries management in China from 1949 to 2019: How did China get here and where does China go next?. *Fish and Fisheries*, 21(2), 435-452. <https://doi.org/10.1111/faf.12439>
- [16] Urquhart, J., Acott, T., & Zhao, M. (2013). Introduction: Social and cultural impacts of marine fisheries. *Marine Policy*, 37, 1-2. <https://doi.org/10.1016/j.marpol.2012.04.007>
- [17] Pomeroy, R., Parks, J., Courtney, K., & Mattich, N. (2016). Improving marine fisheries management in Southeast Asia: Results of a regional fisheries stakeholder analysis. *Marine Policy*, 65, 20-29. <https://doi.org/10.1016/j.marpol.2015.12.002>