



Marine Biodiversity and Coastal Communities: Overcoming Community-Based Enforcement Challenges in Pakistan's Marine Protected Areas

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ABSTRACT

Marine Protected Areas (MPAs) are essential tools for conserving marine biodiversity and maintaining ecological balance. In Pakistan, however, enforcing MPA laws faces challenges deeply rooted in community dynamics and socio-economic constraints. Coastal communities, whose generational reliance on traditional fishing practices and marine resource extraction forms the backbone of their socio-economic structure, often view externally imposed conservation measures as direct threats to their livelihoods. This paper critically examines community-based challenges, including resistance to top-down enforcement, socio-economic difficulties, inadequate local participation, and conflicts that arise from the intersection of customary rights and modern regulatory frameworks. Drawing upon local research and case studies, the study proposes a community-centered framework that emphasizes participatory governance, the development of alternative livelihood programs, targeted educational initiatives, and compensation mechanisms. By integrating community rights and indigenous knowledge into MPA management, Pakistan can enhance compliance, improve conservation outcomes, and promote sustainable marine biodiversity conservation.

Keywords: Challenges; Coastal Communities; Marine Biodiversity; Pakistan

1. Introduction

Marine ecosystems are a cornerstone of global biodiversity and serve as a lifeline for coastal communities worldwide (Okafor-Yarwood, 2020). In Pakistan, the Arabian Sea hosts a rich array of coral reefs, mangrove forests, and diverse fish populations that provide critical ecosystem services (Ahmad, I., 2024). These services include food security, income generation, and the preservation of cultural heritage. The natural wealth of the marine environment is intricately linked to the well-being of coastal populations, making its conservation a priority for both ecological and socio-economic reasons (Cabana, D, 2024).

Over the past few decades, rapid development, overfishing, and environmental degradation have placed immense pressure on Pakistan's marine ecosystems (Khan, A., 2024). These challenges are further compounded by climate change, which has led to unpredictable weather patterns, sea level rise, and extreme events that threaten both biodiversity and the livelihoods

of those living along the coast (Shahzad, N., 2022). In this context, the establishment of Marine Protected Areas (MPAs) emerged as a critical conservation measure aimed at safeguarding these vulnerable ecosystems. However, enforcing MPA regulations has proven to be a complex issue, as they often clash with the entrenched socio-economic practices of local communities. Traditional fishing practices have been handed down through generations and are essential to the identity of coastal communities in Pakistan. These practices are not only culturally significant but also represent sustainable methods that have been refined over centuries. However, when modern MPA regulations are introduced without adequate consultation or provisions for alternative livelihoods, they are often viewed as external impositions. Such measures undermine long-standing practices and cultivate an atmosphere of resistance; wherein local fishermen perceive that their ancestral rights and socio-economic security are at risk. Another key factor complicating MPA enforcement is the centralized, top-down approach employed by government agencies (Muccitelli, S., 2023). Limited resources and a lack of effective community engagement have resulted in enforcement strategies that are often perceived as punitive rather than supportive (Atuo, F. A., 2020). The vastness of the coastal areas further challenges regulatory bodies, leading to gaps in monitoring and enforcement (Cremers, K, 2020). This disconnect has fostered mistrust among community members, who feel alienated from the decision-making processes that affect their daily lives and livelihoods. Given these complex challenges, it is clear that a reorientation of conservation strategies is necessary, one that bridges the gap between scientific mandates and the realities of coastal life. This paper explores the intricate interplay between community dynamics and marine protected area (MPA) enforcement in Pakistan. It advocates for a community-centric approach that not only respects traditional practices but also introduces supportive measures aimed at economic and social resilience. Consequently, conservation policies can transition from being mere restrictions to becoming collaborative initiatives that promote sustainability development. The following significant contributions demonstrate the study's novelty:

- **Community-focused legal critique:** Combines constitutional, statutory, and customary perspectives to offer a unique analysis of Pakistan's MPA enforcement laws from a community rights viewpoint.
- **Traditional ecological knowledge integration:** Supports the official inclusion of indigenous marine knowledge systems in MPA management by emphasizing their significance, such as elders' spatial zoning.
- **Comparative legal insight:** Recommends co-management models suitable for Pakistan's governance structure by learning from the UK's Marine and Coastal Access Act (2009) and related frameworks.
- **Custom, practical policy suggestions:** Recommends well-grounded strategies that directly tackle the socioeconomic realities of Pakistan's coastal areas, like compensation, alternative income sources, and inclusive governance.

2. Methodology

This study employs a qualitative, interdisciplinary approach to examine the enforcement challenges of Marine Protected Areas (MPAs) in Pakistan, with a specific focus on the socio-legal dynamics that affect coastal communities. Similar studies on community-based governance and marine conservation frequently employ this interdisciplinary qualitative approach because it enables researchers to record intricate social-ecological relationships and stakeholder viewpoints (Sierra Ison, 2024). The research relies on an extensive review of secondary literature, including academic articles, legal texts, environmental policy documents, NGO reports (particularly from WWF-Pakistan), and case studies from coastal regions.



Additionally, insights are drawn from field-based participatory mapping initiatives, community statements documented in grey literature, and publicly available interviews and assessments. These data points were analyzed thematically to identify patterns of resistance, socio-economic vulnerability, and gaps in legal frameworks. Comparative legal insights were drawn from the best international practices, particularly the United Kingdom's Marine and Coastal Access Act (2009), to propose context-sensitive reforms. This approach allows for a comprehensive understanding of the interplay between marine law, traditional knowledge, and community-based resource governance in Pakistan.

3. The Role of Marine Protected Areas in Biodiversity Conservation: A Community Perspective

Marine Protected Areas (MPAs) are designated zones where human activities are regulated to safeguard marine ecosystems (Maestro, M., 2019). These areas are critical for the recovery of overexploited fish stocks, the preservation of coral reefs, and the protection of endangered species (Strain, E. M., 2019). In Pakistan, MPAs are envisioned as a tool not only to conserve marine biodiversity but also to ensure that marine resources continue to provide ecological and economic benefits for future generations.

From a community perspective, MPAs play a dual role (Grorud-Colvert, 2021). On the one hand, they offer the promise of ecological restoration and sustainable fisheries resources; on the other, they present challenges by limiting access to traditional fishing grounds (Gann, G., 2019). For coastal communities that depend on the sea for their survival, any restriction, if not carefully managed, can lead to immediate economic hardship (Suman, D., 2019). Therefore, MPAs must be managed in a way that harmonizes ecological objectives with the socio-economic realities of local stakeholders.

Local communities are deeply intertwined with the marine environment (Andrews, N., 2021). Their dependence on fishing, both as a cultural tradition and an economic necessity, underscores the importance of MPAs that are designed with community involvement (Cook, S., 2024). Traditional ecological knowledge, accumulated over generations, can significantly enhance the management of these protected areas by identifying key spawning grounds, migratory routes, and ecologically sensitive areas (Braga, H. D. O., 2018). Integrating such knowledge into conservation planning can help tailor MPA regulations to suit local conditions and practices better.

Furthermore, when community members are involved in the management process, they develop a sense of ownership over conservation initiatives (Zikargae, M. H., 2022). This participatory approach not only enhances compliance with MPA regulations but also empowers local communities to become active stewards of marine biodiversity. In turn, this helps to build resilient socio-ecological systems that can adapt to both environmental changes and economic challenges.

4. Legal and Institutional Framework for Community-Centric MPAs Enforcement

Pakistan's environmental commitments are shaped by its ratification of international conventions such as the Convention on Biological Diversity (CBD) and the United Nations Convention on the Law of the Sea (UNCLOS). However, the domestic legal framework, comprising the Pakistan Environmental Protection Act (1997), the Territorial Waters and Maritime Zone Act (1976), and provincial fisheries laws, remains fragmented and poorly aligned with the lived realities of coastal communities (Akhtar, R., 2023; Khan, M. Z., 2022). The Constitution of Pakistan offers potential legal pathways for community-centric conservation. Article 9, which guarantees the security of life, can be interpreted to include environmental and livelihood security (Rajper, S. A., 2024). Article 14 protects the dignity of individuals, which provides for cultural and occupational rights, such as traditional fishing



(Rahman, M. M., 2006). The Constitution of Pakistan vests ownership of natural resources with the provincial government but does not explicitly recognize indigenous or customary tenure rights. Constitutional litigation under Article 184(3), which permits public interest litigation before the Supreme Court, has occasionally advanced environmental justice but has yet to focus on community-led governance of marine resources (Saleem, M. S. et al, 2023).

A closer look at Sindh's Fisheries Ordinance (1980) and Balochistan Sea Fisheries Ordinance (1971) reveals their bias toward industrial fisheries and their failure to integrate artisanal fishers into the regulatory framework. This legal neglect marginalizes small-scale fishers, despite their significant contributions to both local economies and marine sustainability (Yasin, A., 2023; Khan, S. R., 2021).

One promising development was the notification of Astola Island as Pakistan's first Marine Protected Area (2017). While it marked progress toward CBD commitments, enforcement has remained largely symbolic. Field reports from Ormara and Pasni show that local fishers were not consulted during the designation process, and no mechanisms for participatory monitoring or compensation were introduced (Qaimkhani, A. M, 2018). As a result, most fishers continue their routines, unaware or skeptical of the MPA's legal status.

To overcome this, Pakistan's legal framework must shift toward co-management regimes, where community organizations have formally recognized roles in decision-making, enforcement, and benefit-sharing. This would require legislative amendments to:

- Recognize customary marine tenure systems.
- Mandate community consultation before MPA designation.
- Include clauses for traditional ecological knowledge in environmental impact assessments.

Such alterations could be piloted through Community-Based Natural Resource Management models, which are informed by legally grounded methods in the UK and aligned with Pakistan's constitutional safeguards for dignity, life, and equitable participation. The UK's Marine and Coastal Access Act 2009 (Appleby, T., 2012) establishes co-management through stakeholder-inclusive bodies, such as the Inshore Fisheries and Conservation Authorities (IFCAs), while the Environment Act 2021 mandates Local Nature Recovery Strategies that prioritize biodiversity and local engagement (Anthony, C. 2025). These frameworks provide a model for decentralizing marine governance. Pakistan's legal system, rooted in common law and supported by constitutional guarantees under Articles 9, 14, and 25 (Munir, A. I., 2024), provides fertile ground for similar reforms. Legislative amendments could mandate community consultations, recognize customary marine tenure, and incorporate traditional ecological knowledge into Environmental Impact Assessment reforms inspired by UK provisions, such as Sections 123–124 and 153(2)(b) of the Marine and Coastal Access Act (Slater, A. M., 2020). Adopting these approaches would help bridge the gap between statutory conservation efforts and the lived realities of communities, transforming MPAs into inclusive and sustainable institutions.

5. Community-Based Challenges in MPAs Enforcement

The interplay of social, economic, and cultural factors within coastal communities profoundly challenges the enforcement of marine protected area (MPA) laws in Pakistan. Local stakeholders, who have historically managed marine resources through indigenous practices, often view modern conservation measures as a direct threat to their livelihoods. These challenges are multifaceted and deeply rooted in the historical exclusion of community voices from decision-making processes.

5.1 Resistance Stemming from Exclusion



Resistance among coastal Pakistani populations is real rather than imagined. Some residents in coastal areas express a profound distrust of the conservation regulations implemented by the government. It is described as MPA enforcement as “rules from above” that ignore “what people know about the sea.” This sentiment was echoed in a 2021 participatory mapping initiative, where communities identified historical fishing zones that overlapped with newly restricted areas. The lack of formal recognition for their input has discouraged cooperation and led to passive resistance (Personal communication, Feb 10, 2024).

5.2 Economic Pressures and Livelihood Vulnerability

According to WWF-Pakistan, the majority of fishers in Balochistan and Sindh depend solely on fishing for income (Wells, C., 2023). The imposition of no-take zones or seasonal bans without compensation or training for alternative livelihoods has led to increased illegal fishing at night and even clashes with coast guards. In Ormara, some fishing families reported that they had to withdraw their children from school due to income loss resulting from seasonal restrictions.

5.3 Inadequate Awareness and Communication

A pervasive lack of awareness about the benefits of marine conservation poses a significant challenge to MPA enforcement. Many coastal fishers have limited access to educational resources and formal training in sustainable fisheries management (Jattak, Z. U., 2023). As a result, conservation measures are often misunderstood or viewed as irrelevant to immediate survival needs. The communication strategies employed by regulatory agencies usually rely on technical language and scientific jargon, which can alienate local communities and fail to convey the practical benefits of MPAs effectively.

Effective communication is crucial for bridging this gap. Without well-structured outreach programs that are culturally and linguistically tailored to the local context, communities remain skeptical of conservation initiatives. This skepticism hinders voluntary compliance and fosters an adversarial relationship between local stakeholders and regulatory bodies. There is a pressing need for participatory communication models that involve local leaders and community influencers in disseminating information, thereby building trust and fostering a shared understanding of conservation goals.

5.4 Conflict Between Traditional Practices and Modern Regulations

The tension between long-established artisanal fishing practices and modern conservation regulations is a significant factor in the enforcement process (Cohen, P. J., 2021). Coastal communities in Pakistan have developed sustainable fishing methods over generations, which are intricately linked to the natural rhythms of the marine ecosystem. Modern regulations, however, often impose blanket restrictions that overlook these traditional practices. This creates a conflict between customary rights and legally mandated conservation measures, leaving fishers feeling that their time-honored practices are being unjustly curtailed.

This conflict is not solely about economic survival; it also touches on cultural identity and heritage. Traditional fishing practices are deeply embedded in the social fabric of coastal communities, and any attempt to eliminate them is perceived as a threat to cultural continuity. The failure to reconcile modern regulations with traditional methods leads to active resistance, as communities are compelled to assert their rights and maintain their way of life. An integrated approach that respects and incorporates traditional ecological knowledge into modern enforcement strategies is crucial for bridging this divide.

5.5 Social Exclusion and Lack of Representation

Social exclusion further complicates the enforcement of MPA laws. Coastal communities are often marginalized in the formulation of conservation policies, as decision-making processes are frequently dominated by centralized authorities with limited input from local stakeholders.



This exclusion is particularly pronounced among marginalized groups such as women, youth, and indigenous populations, whose voices are often omitted from marine governance discussions. The resulting policies are perceived as alien, exacerbating distrust and non-compliance among those most directly affected by MPA regulations.

The lack of inclusive representation not only undermines the legitimacy of conservation efforts but also obstructs the development of policies that genuinely reflect local needs. Without mechanisms for participatory governance, conservation measures risk perpetuating historical inequalities and promoting an adversarial relationship between regulatory agencies and coastal communities. Establishing community-based enforcement programs and inclusive decision-making councils is essential to ensuring that all stakeholders have a voice in marine resource management, thus fostering more equitable and effective conservation outcomes.

6. Strategies for Enhancing Community Involvement and Mitigating Enforcement Challenges

Addressing the multifaceted challenges of MPA enforcement in Pakistan requires a comprehensive, community-centric strategy. By focusing on participatory governance, livelihood diversification, improved communication, economic support, and the integration of traditional knowledge, conservation efforts can be realigned to better serve both ecological and socio-economic objectives.

6.1 Establishing Participatory Governance Models

Empowering coastal communities through participatory governance is a foundational strategy for effective MPA management (Oliveira Júnior, 2021). Co-management models that involve local fishers in planning, monitoring, and enforcement help to build trust between communities and regulatory agencies (Castillo, L. S, 2024). Establishing local management committees provides a platform for dialogue and ensures that traditional knowledge is integrated into conservation practices. This collaborative approach creates a sense of ownership and accountability, which is essential for the long-term success of MPAs.

Along with co-management, developing decentralized governance structures can further enhance community involvement. By delegating enforcement responsibilities to community-based organizations and local councils, decision-making becomes more inclusive and responsive to local needs and concerns. These participatory frameworks not only improve compliance but also promote adaptive management practices that can quickly react to environmental changes and socio-economic pressures.

6.2 Developing Alternative Livelihood Programs

Reducing the economic dependency on traditional fishing is critical to mitigating the enforcement challenges of MPAs. Developing alternative livelihood programs is crucial for providing coastal communities with sustainable income sources (Ateweberhan, M., 2018). Initiatives such as eco-tourism, sustainable aquaculture, and the promotion of local handicrafts can diversify income and reduce pressure on marine resources (Hasan, M. H.). These programs can be tailored to the unique cultural and environmental contexts of each coastal region.

Furthermore, integrating these alternative livelihood programs with conservation initiatives creates synergies that benefit both the community and the ecosystem. For example, eco-tourism can promote environmental awareness while providing economic benefits, and sustainable aquaculture can offer a reliable source of protein without depleting wild fish stocks. Such integrated approaches help to alleviate the immediate financial pressures that drive non-compliance, paving the way for more sustainable resource management.

6.3 Enhancing Education and Awareness Campaigns

A robust education and outreach strategy is crucial for altering community perceptions about marine conservation. Educational campaigns need to be designed with cultural relevance and



delivered in local languages to effectively communicate the long-term benefits of marine protected areas (MPAs)(Loury, E. K., 2021). Workshops, community meetings, and school programs can serve as platforms for disseminating information on sustainable fishing practices, ecological restoration, and the socio-economic advantages of conservation.

By engaging local influencers and respected community leaders, educational initiatives can promote a bottom-up approach to conservation. When community members grasp the science behind MPAs and observe tangible benefits in terms of resource sustainability and improved livelihoods, resistance to enforcement measures lessens. Over time, heightened awareness of the ecological and socioeconomic value of MPAs can transform local perceptions from viewing them as externally imposed restrictions to embracing them as tools for empowerment and shared stewardship of marine resources.

6.4 Implementing Compensation and Incentive Mechanisms

Economic incentives are vital to offset the short-term costs associated with compliance to MPA regulations. Implementing compensation schemes such as direct cash transfers, financial subsidies, or rewards for sustainable practices can alleviate the immediate economic burden on coastal communities (Sumaila, U. R., 2020). Such measures not only provide financial relief but also signal a commitment by regulatory authorities to support local livelihoods during the transition to more sustainable practices.

Incentive mechanisms should be designed in close consultation with community stakeholders to ensure they are equitable and effectively address local needs (Foster, G. K. 2018). By copying economic incentives with alternative livelihood programs, communities are provided with both short-term relief and long-term opportunities for sustainable development. This dual approach can significantly improve compliance rates and strengthen the overall effectiveness of MPA enforcement.

6.5 Integrating Traditional Knowledge into MPA Management

Traditional ecological knowledge in coastal Pakistan remains underutilized. Elders in Gwadar and Ormara, for example, distinguish between maan (breeding zones) and kandar (temporary fishing zones), showing a nuanced spatial understanding of marine cycles. These customary divisions align closely with scientific recommendations for seasonal closures but are rarely acknowledged by regulatory frameworks.

A potential model lies in the community-led turtle monitoring project in Sandspit, Karachi, where locals collect nesting data and enforce no-access zones during hatching seasons. This program, run in partnership with the Sindh Wildlife Department, exemplifies how Traditional Ecological Knowledge (TEK) and citizen science can complement formal conservation efforts. To formalize such efforts:

- Joint management committees should include elders and traditional fishers.
- Local ecological calendars could inform regulatory decisions.
- TEK databases co-managed with universities can preserve this knowledge for legal recognition.

7. Discussion

While Alternative Livelihood Programs (ALPs) play a key role in easing pressure on marine ecosystems and aiding Marine Protected Area (MPA) enforcement, they often encounter structural and practical challenges that limit their effectiveness. A major problem is the gap between program planning and the socio-economic conditions of coastal communities. Initiatives like eco-tourism or aquaculture, though potentially beneficial, often struggle in places like Ormara and Pasni due to a lack of alignment with local skills, resources, and infrastructure.



Introducing new livelihood options without considering cultural identities and traditional fishing ties can lead to minimal participation or outright opposition. Many ALPs face additional hurdles due to weak market connections, insufficient logistical support, and poor digital access, which hinder their growth and sustainability. These issues are worsened by the dominance of short-term, donor-led projects that lack ongoing institutional support. Such gaps weaken the programs' impact and damage community trust, making future participation less likely.

Recommendations for Strengthening ALPs

To enhance the effectiveness and sustainability of ALPs, it is crucial to implement a set of strategies that are community-led and sensitive to the local context:

Participatory co-design: ALPs should be created via inclusive consultations with local stakeholders, particularly elders, women, and youth, to ensure they are culturally relevant, foster trust, and promote community ownership.

Capacity-building before implementation: Technical training, financial literacy, and digital skills development should come first in program rollouts to ensure participants can effectively manage and sustain their new ventures.

Hybrid livelihood models: Instead of replacing traditional fishing entirely, ALPs should combine sustainable fishing practices with additional income sources like seasonal eco-tourism or conservation-related jobs. This approach helps maintain both livelihoods and cultural traditions.

Institutional integration: Embedding ALPs into broader marine governance frameworks guarantees legal recognition, enables licensing access, facilitates compensation schemes, and offers participants priority market access.

Adaptive feedback systems: Implementing community-led monitoring, regular reviews, and feedback mechanisms helps programs stay adaptable to new challenges and ensure their ongoing relevance and effectiveness.

By tackling these challenges with participatory planning and institutional backing, ALPs can transform from temporary efforts into sustainable systems for economic resilience and marine conservation.

8. Conclusion

This study investigated the enforcement challenges of Marine Protected Areas (MPAs) in Pakistan using a qualitative, interdisciplinary approach that combines legal, social, cultural, and ecological perspectives. Focusing on the experiences of coastal communities in places like Ormara and Pasni, the research highlighted how top-down enforcement strategies often clash with traditional livelihoods, local customs, and socio-economic vulnerabilities.

By examining legal documents, participatory mapping data, and community stories, the study identified key challenges in effectively managing MPAs, including community opposition stemming from exclusion, economic stress resulting from livelihood insecurity, limited awareness and communication efforts, and underrepresentation in policy-making. The results also highlighted that while Alternative Livelihood Programs (ALPs) can provide viable solutions, they frequently fail without adaptation to local conditions and sustained institutional support.

The study offers a unique contribution by promoting a rights-based, community-focused approach to marine conservation in Pakistan. It highlights the importance of incorporating traditional ecological knowledge, co-management governance frameworks, and constitutional protections into marine policy and legislation. Inspired by international best practices, particularly the UK's Marine and Coastal Access Act, the research advocates for participatory reforms and compensation strategies that align legal obligations with community needs.



Ultimately, the study highlights that conserving marine biodiversity sustainably in Pakistan relies on acknowledging and empowering the coastal communities most impacted by MPA policies. Integrating cultural respect, economic resilience, and legal inclusion into conservation efforts offers the most effective approach for achieving both ecological preservation and social justice.

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