

MARINE PROTECTED AREAS (MPAs): A SUSTAINABLE APPROACH TO SHELLFISH CONSERVATION IN NIGERIA

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Abstract

Marine Protected Areas (MPAs) have emerged as a critical tool for the conservation of marine biodiversity and the sustainable management of shellfish resources. In Nigeria, shellfisheries contribute significantly to the livelihoods of coastal communities and play a vital role in local food security. However, overfishing, habitat degradation, and pollution have led to a decline in shellfish populations, threatening both the ecosystem and the economic well-being of these communities. This review explores the potential of MPAs as a sustainable approach to shellfish conservation in Nigeria. The implementation of MPAs can help mitigate the negative impacts of unsustainable shellfish harvesting practices by designating specific areas where fishing activities are restricted or regulated. This allows shellfish populations to recover, promotes biodiversity, and maintains the ecological balance of coastal ecosystems. Despite their potential, the establishment and management of MPAs in Nigeria face several challenges, including inadequate regulatory frameworks and limited stakeholder engagement. There is the need for collaborative management involving local communities, government agencies, and conservation organizations to address these issues. It is recommended that a community management strategy involving the government, local communities, and NGOs will ensure the sustainable use of Nigeria's marine resources. This approach which integrates local knowledge will promote sustainable practices through partnerships, resource sharing, and capacity-building initiatives. By adopting a holistic approach, MPAs can serve as an effective tool for the conservation of shellfish species, while ensuring the sustainability of coastal economies in Nigeria.

Keywords: Marine Protected Areas, Shellfish conservation, Coastal communities

Introduction

Marine ecosystems provide essential services that are vital for human sustenance and the maintenance of ecological balance (Palumbi *et al.*, 2009). They support biodiversity by providing habitats for organisms, including finfish and shellfish, to thrive (Leenhardt *et al.*, 2015). These ecosystems are equally important to humans, as they ensure food security, with shellfish and finfish serving as a primary source of protein for millions of people worldwide (Tacon and Metian, 2013; Azra *et al.*, 2021).

In Nigeria, shellfish play a crucial role in supporting local livelihoods and boosting the economy, especially in coastal areas (Ekpo and Essien-Ibok, 2013; Moruf, 2020). In these coastal areas, locals engage in the practice of harvesting shellfish with the aid of nets, traps, or in most cases by hand. They usually target species like shrimp, oysters and periwinkle which can be found in oceans,

estuaries and tidal flats respectively (Antigha, 2015; Udoh, 2016). However, shellfish harvesting practices, can cause significant environmental degradation when conducted unsustainably (Folke *et al.*, 1998; Carranza and Zu Ermgassen, 2020). Common practices associated with shellfish harvesting, such as mangrove deforestation, dredging, bottom trawling, and overharvesting, are particularly damaging to coastal ecosystems (Bhattacharya and Sarkar, 2003). These activities have damaging environmental impacts which significantly reduce the availability and yield of shellfish (Olaoye and Ojebiyi, 2018; Elisha and Felix, 2021).

Sustainable shellfish harvesting practices, which involve the careful management and regulation of shellfish populations, are key to addressing the negative socio-ecological issues associated with destructive harvesting methods (Carranza and Zu Ermgassen, 2020). One such approach is the establishment of protected areas, which helps maintain a healthy ecosystem. This approach involves monitoring shellfish stocks, setting harvest limits, and implementing sustainable harvesting practices, with the goal of protecting marine habitats (Hartill *et al.*, 2005; Lellis-Dibble *et al.*, 2008). Protected areas are generally believed to offer more effective safeguarding of both native and non-native species from human activities that could disrupt their habitats (Carneiro *et al.*, 2024).

Human activities are regarded as the primary challenge to overcome in achieving sustainable development of marine resources. As a result, the effects of human activities on marine ecosystems have been prioritized in several international agreements, including the United Nations Conference on Environment and Development (UNCED) 1992 (Cicin-Sain and Knecht, 2013).

The establishment of Marine Protected Areas (MPAs) has been widely recognized as an effective strategy for conserving shellfish populations and safeguarding coastal and marine resources (Le Gouvello *et al.*, 2017; Nielsen *et al.*, 2021; de Blok *et al.*, 2024). This ecosystem-based management strategy preserves marine biodiversity, including shellfish, while sustaining ecosystem productivity and ensuring coastal habitat protection (Grorud-Colvert *et al.*, 2021). It also maintains ecological integrity while balancing human activities with environmental sustainability. The interconnectedness of species, habitats and human influences in this approach results in conservation efforts that go beyond the protection of individual species to encompass broader ecosystem dynamics (Crain *et al.*, 2009). By adopting this holistic framework, conservation measures not only safeguard shellfish populations but also enhance the resilience and functionality of the coastal and marine ecosystems they support.

The Nigerian coastline faces a range of challenges, stemming from the lack of effective management and conservation. These challenges which includes overfishing, pollution and habitat destruction have led to poorly managed environmental resources. This situation is further exacerbated by the diverse and often conflicting commercial uses of the coastal zone. These activities significantly impact the marine environment, limiting its ability to provide the full range of ecosystem services on which coastal communities depend. This paper aims to provide an overview of Marine Protected Areas (MPAs), highlighting their benefits for ecosystem-based shellfish management in Nigeria, and offering recommendations for the establishment of MPAs in the country. Establishing an MPA along Nigeria's coastline presents a number of challenges. This is largely due to region's diverse use of environmental resources for their livelihood, as well as the growing human population, which has intensified the pressure on marine and coastal resources. However, with appropriate political support, increased stakeholder engagement and institutional frameworks in place, the creation of MPAs is achievable.

The Nigerian Coastal Area

Nigeria has a coastline of approximately 853 km, bordering the Gulf of Guinea in the Atlantic Ocean. (Fig 1). It has a 200-nautical-mile Exclusive Economic Zone in accordance with the United Nations Convention on the Law of the Sea (UNCLOS) of 1982 (Hamisu, 2019). The coastline is characterized by lagoon systems to the west, extensive mangrove swamps, sandy beaches and a delta complex (Niger Delta) to the east which opens into the sea through various rivers (Zabbey *et al.*, 2019). The Niger Delta system, which spans approximately 500 km, provides a vital habitat for most of Nigeria's living resources including shellfish (Jimoh and Lemomu, 2010; Chuku *et al.*, 2022).

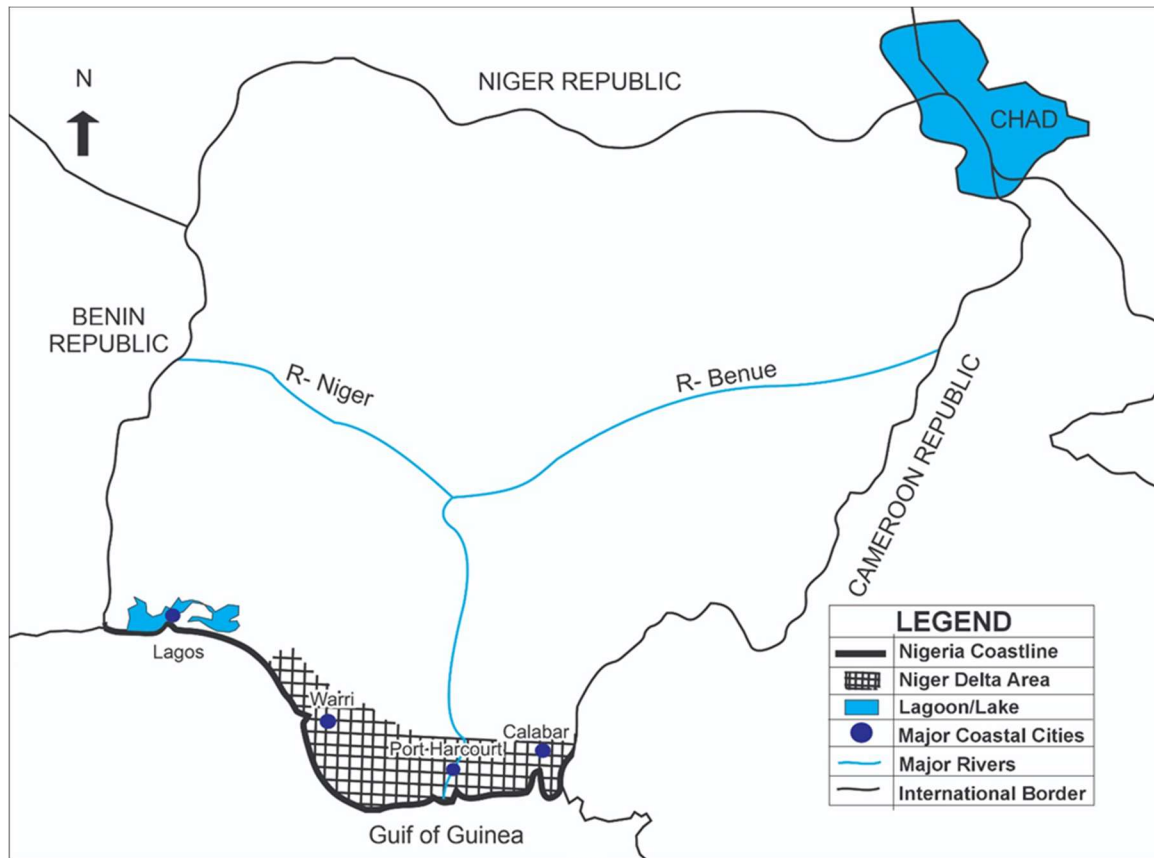


Figure 1: Map of Nigeria showing coastline. [Image source: Author]

Coastal communities in Nigeria, like those in other parts of the world, earn most of their livelihoods through fishing and trade (Adelekan and Fregene, 2015). Fishing is a dominant activity in these areas, with important finfish and shellfish resources harvested regularly. The reproductive strategies of fish are crucial for ensuring their survival. Shellfish species, in particular, depend on broadcast spawning, which makes them especially vulnerable to overfishing and natural disturbances (Moruf *et al.*, 2022).

Importance of Shellfish

Shellfish play a vital role in aquatic ecosystems by providing habitat and food for other species while improving water quality through their filter-feeding activities (Vaughn and Hoellein, 2018; Zhao and Wu, 2024). As filter feeders, they help improve water quality by removing suspended particles and excess nutrients, promoting healthier aquatic environments and supporting biodiversity (Newell, 2004). This activity not only improves water quality but also aids in nutrient cycling by linking benthic and pelagic environments, which in turn enhances the productivity of coastal ecosystems (Lowery *et al.*, 2007). Additionally, in the process of feeding, shellfish accumulate marine biotoxins, chemical contaminants, and pathogenic microorganisms such as bacteria and viruses. Consequently, they help to remove harmful substances from the water further enhancing the overall ecosystem health status (Hegaret *et al.*, 2009; Fababegoli *et al.*, 2018). Improved water quality affords a more suitable environment for the growth of vegetation, such as mangroves, which are crucial for the survival of various life forms (Raihan, 2023).

Furthermore, shellfish such as clams, oysters, and mussels, are often found in aquatic habitats known as shellfish beds (Lowery *et al.*, 2007). The nooks and crannies of shellfish beds provide habitats for invertebrates and juvenile fish, which, in turn, serve as vital food sources for predatory fish and other marine species (Heinonen and Auster, 2012). Also, shellfish beds contribute to reducing the impacts of climate change by stabilizing sediments, which helps protect shorelines from erosion and storms (Griffith and Gobler, 2020).

Shellfish are among the largest sources of animal protein in the world (FAO, 2016). Important shellfish species such as shrimp, prawns, crayfish, lobster, and crab are valuable sources of nutritious food for humans. They provide essential dietary protein and fats to consumers in many countries around the world (Moruf *et al.*, 2020; Lawal-Are *et al.*, 2021). Furthermore, they contain appreciable quantities of essential amino acids and minerals which are important to humans (Venugopal and Gopakumar, 2017; Moruf *et al.*, 2021). Additionally, some shellfish such as marine mussels have also been demonstrated to be promising sources of bioactive compounds that can be exploited for other uses in different industries (Grienke *et al.*, 2014). Generally, shellfish are crucial to human well-being, particularly in coastal communities where they serve food and provide as a source of livelihood (Ferreira and Bricker, 2016). The shellfish industry supports livelihoods through fishing, processing, and related sectors, making it an integral part of coastal economies (Allison, 2011; Olivier *et al.*, 2013).

Shellfish Conservation in Nigeria

In Nigeria, efforts to conserve marine and coastal ecosystems are driven by environmental policies and regulations enforced by the National Environmental Standards and Regulations Enforcement Agency (NESREA) and initiatives by non-governmental organizations (Okeke *et al.*, 2022; Umukoro and Omozue, 2024). These efforts are aimed at protecting and conserving natural ecosystems by promoting sustainable environmental practices. However, these efforts face significant limitations, including inadequate enforcement, lack of funding, limited community involvement, and insufficient scientific data to guide conservation strategies (Agbeja, 2012; Ekpo and Essien-Ibok, 2013; Moruf, 2020). Additionally, illegal fishing and habitat destruction threaten conservation efforts by damaging vital ecosystems and endangering the livelihoods of coastal communities (Amos and Peter, 2018). Overcoming these limitations requires stronger government commitment, local community participation, and more comprehensive research to inform sustainable management practices.

Nigeria is a signatory to the Ramsar Convention, which recognizes shellfish ecosystems as a type of Ramsar wetland (Orie, 2019). While this agreement could support recovery plans for critical ecosystems, Nigeria has yet to integrate it into its domestic legal framework. As a result, there is no legal basis for implementing the Ramsar Convention to protect marine biodiversity and coastal resources (Edo, 2023). To address this gap, Nigeria must establish Marine Protected Areas (MPAs) to safeguard its marine ecosystems and resources. MPAs help regulate human activities within designated zones, limiting destructive practices and promoting the sustainability of marine resources (Cicin-Sain and Belfiore, 2005).

The marine environment in Nigeria faces significant threats from overfishing, habitat destruction, and pollution (Zabbey *et al.*, 2019; Akangbe *et al.*, 2024). These pressures negatively impact marine organisms, including shellfish, which accumulate pollutants that can impair their reproductive health and reduce their populations (Jacob *et al.*, 2024; Akangbe *et al.*, 2024).

Marine Protected Areas

The establishment of Marine Protected Areas (MPAs) offers a comprehensive approach to conservation by protecting entire ecosystems, rather than solely regulating specific species or harvesting techniques (Leenhardt *et al.*, 2015). This strategy focuses on maintaining biodiversity and the overall health of marine habitats by allowing ecosystems to function naturally, without continuous human interference. Consequently, MPAs help ensure the long-term sustainability of shellfish resources and other marine life. As one of the most widely used tools for marine conservation (Spalding and Hale, 2016), MPAs are valued for their documented ecological and socioeconomic benefits, particularly when effectively located and managed.

MPAs play a crucial role in the restoration and protection of ecosystems and marine species (Jameson *et al.*, 2002; Ban *et al.*, 2017). They enhance various ecosystem services, including increased fisheries productivity, recreational opportunities, and coastal protection (Spalding and Hale, 2016; Paltriguera *et al.*, 2018). Additionally, MPAs help safeguard ecosystems that perform critical functions such as carbon storage, improved water quality, and coastal defense against erosion (Laffoley *et al.*, 2019).

Furthermore, MPAs have demonstrated effectiveness in enhancing the conservation of shellfish species, particularly in regions facing challenges like overfishing and habitat degradation (Buxton *et al.*, 2004). This can be attributed to the reduced human activity and fishing pressure that MPAs provide within protected zones, allowing shellfish populations to recover and thrive (Laffoley *et al.*, 2019). In contrast, shellfish populations outside of MPAs often face declines due to ongoing exploitation and various environmental stressors. While MPAs offer significant conservation benefits, their effectiveness depends on factors such as proper enforcement, the size of the protected area, and the overall health of the surrounding ecosystem (Sanchirico *et al.*, 2013; Leenhardt *et al.*, 2015).

Establishing a MPA is distinct from other sustainable shellfish management practices. This is because it incorporates a social dimension to sustainable fishing by designating specific zones where human activities are either restricted or entirely prohibited (Pomeroy *et al.*, 2007). Additionally, it emphasizes protecting entire ecosystems rather than solely regulating shellfish harvesting, which primarily impacts populations. MPAs offer a better effort at preventing habitat degradation and overfishing, making it a unique approach in the broader strategy of sustainable marine resource management (Selig and Bruno, 2010; Yunanto *et al.*, 2018). Instituting MPAs in the protection of marine biodiversity and local management of coastal and marine resources have been recognized as highly effective worldwide (Bennett and Dearden, 2014).

The effectiveness of Marine Protected Areas (MPAs) in conserving shellfish is demonstrated by the positive changes observed in shellfish populations over time (Moland *et al.*, 2021). Research shows that shellfish populations within MPAs experience increases in both abundance and biomass, primarily due to reduced human exploitation and habitat protection (Zupan *et al.*, 2018; Magris, 2021). Sustaining this population growth can aid the recovery of overexploited species, enhance reproductive success, and promote healthier ecosystems. However, the long-term success of MPAs in strengthening shellfish populations depends on several factors, including adequate enforcement, the size of the protected areas, the duration of protection, and effective management strategies to mitigate threats such as illegal harvesting (Roberts *et al.*, 2019; Bennett and Dearden, 2014).

Challenges with MPA Establishment in Nigeria

Since the late 19th century, Nigeria has established protected areas. The first forest reserve was created in 1899, and since then there has been a rapid increase in the number and size of protected areas, which are primarily inland (Abdulaziz *et al.*, 2015). However, there are no established marine protected areas despite the economic and ecological importance of the marine ecosystem (Dan-Woniowe, 2020). The establishment of MPAs in Nigeria face numerous challenges, some of which includes:

1. **Inadequate Regulatory Frameworks.**

Nigeria lacks a well-structured and effectively enforced legal framework for MPAs. Existing marine conservation laws are fragmented, with overlapping provisions that makes implementation difficult (Obidimma *et al.*, 2023). The absence of a proper regulatory framework makes it challenging to establish clear guidelines for the designation of MPAs in Nigeria. Without a robust legal framework, conservation efforts remain disjointed. There are strong legal frameworks at international level to support the sustainability of MPAs. What is needed is to consolidate the numerous Nigerian marine protection laws into a unified and comprehensive legal framework. Currently, there are no specific legal document dedicated to creating MPAs in Nigeria.

2. **Limited Stakeholder Engagement.**

MPAs are most effective when they incorporate the perspectives and participation of diverse stakeholders, including local communities, government agencies and non-governmental organizations (White *et al.*, 2022). In establishing one, stakeholder involvement is required; however, in Nigeria, such engagement is limited. This often leads to resistance from local communities that rely on marine resources for their livelihoods (Umana, 2002). The absence of a participatory approach often exacerbates conflicts and influence their support or opposition to conservation initiatives (Okeke *et al.*, 2022).

3. **Lack of enforcement and monitoring.**

Lack of enforcement and monitoring poses a significant challenge to the establishment of MPAs in Nigeria. Even when MPAs are designated, the absence of effective enforcement mechanisms will allow illegal fishing, habitat destruction and other harmful activities to persist. Also, weak institutional frameworks hinder the ability of regulatory agencies to conduct regular patrols and ensure compliance. It is important to strengthen environmental protection agencies such as NESREA and NIMASA in Nigeria for the

efficient monitoring and enforcement of environmental laws (Umana, 2002). When strong institutions are in place, the establishment and subsequent monitoring of MPAs become more attainable.

4. Conflicting Economic Interests.

Economic activities such as oil exploration, coastal development, and large-scale commercial fishing frequently conflict with marine conservation efforts. Crude oil is the most valuable resource in the Niger Delta and a major contributor to Nigeria's economy, with the country heavily reliant on oil exports. The rapid expansion of oil exploration and exploitation, both onshore and offshore, has been linked to significant ecological and environmental degradation, often attributed to oil companies by local communities (Umana, 2002). Oil spills, habitat destruction, and industrial pollution pose substantial threats to proposed Marine Protected Areas (MPAs), compromising their effectiveness. Consequently, achieving a balance between economic development and marine conservation remains a critical challenge in Nigeria.

5. Lack of Awareness and Political will

Public awareness of the benefits of Marine Protected Areas (MPAs) in Nigeria remains generally low. Many policymakers and coastal communities lack a comprehensive understanding of the ecological and economic advantages associated with marine conservation. Furthermore, the political will to enforce conservation policies is weak, as short-term economic interests often overshadow long-term sustainability goals. Okeke *et al.* (2022) reported that political challenges present the most significant barriers to MPA implementation in the Niger Delta.

Conclusion

Marine Protected Areas hold significant promise for ensuring the long-term sustainability of the Nigerian coastal environmental resources including shellfish species. By providing designated spaces where human activities are regulated or prohibited, MPAs can enhance shellfish populations and promote biodiversity. MPAs facilitate the recovery of overexploited species by allowing for natural reproductive processes and habitat restoration. For MPAs to be effective in Nigeria, they must be well-enforced and supported by local communities. The efficiency of MPAs in shellfish conservation can be assessed by observing changes in shellfish abundance and diversity. Their success relies on comprehensive management, enforcement of regulations, and community engagement, which are important for achieving long-term ecological benefits.

Recommendations

To promote the sustainable use of Nigeria's marine resources, the federal ministry of marine and blue economy should:

- I. Act in line with the provisions and obligations of international conventions, such as the United Nations Convention on the Law of the Sea (UNCLOS) and the Convention on Biodiversity (CBD), to which Nigeria is a party, in establishing Marine Protected Areas by State Parties.
- II. Consolidate Nigerian laws on marine protection for the efficient management of the marine environment and its biodiversity.
- III. Implement a community management strategy for the establishment and management of Marine Protected Areas (MPAs). This strategy should encourage collaboration among

agencies such as the Nigerian Maritime Administration and Safety Agency (NIMASA) and the Nigerian Institute for Oceanography and Marine Research (NIOMR), as well as local communities and Non-Governmental Organizations (NGOs). This inclusive approach will engage all stakeholders in decision-making processes, leveraging local knowledge to develop sustainable practices that align with the unique socio-cultural contexts of the communities.

- IV. Conduct continuous research to understand the long-term impacts of Marine Protected Areas (MPAs) on shellfish populations and marine ecosystems. Monitoring ecological dynamics, species recovery, and habitat health will provide insights into MPA effectiveness, while integrating socio-economic assessments can help balance conservation goals with local livelihoods.

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