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Posted Date: 20 January 2025

doi: 10.20944/preprints202501.1393.v1

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Review

Assessment of Sustainable Fishing Practices in Artisanal Fisheries in Nigeria

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Abstract: Artisanal fisheries in Nigeria constitute a critical segment of the nation's socio-economic structure, contributing significantly to food security and local livelihoods. Representing over 60% of domestic fish production, these fisheries employ traditional, small-scale methods that interact dynamically with ecological and socio-economic systems. However, the sustainability of this sector faces numerous challenges, including overfishing, environmental degradation, regulatory gaps, and socio-economic barriers. This review examines the current state of artisanal fisheries in Nigeria, emphasizing the interplay between traditional fishing practices, ecological sustainability, and socio-economic dynamics. It highlights the impacts of climate change, pollution, and competition from industrial fishing on fish stocks and livelihoods. The study advocates for sustainable practices, such as ecosystem-based management, improved governance, and community participation. Drawing on case studies and traditional knowledge, it provides actionable recommendations, including the integration of local practices into policy frameworks, the promotion of co-management systems, and capacity-building initiatives to empower fishers. In order to address these multi-dimensional challenges, the study underscores the importance of sustainable artisanal fisheries for enhancing food security, preserving biodiversity, and fostering socio-economic resilience in Nigeria.

Keywords: *Artisanal fisheries*; Sustainability; Food security; Climate change; Ecosystem-based management

1.0. Introduction

Artisanal fisheries in Nigeria represent a significant component of the country's socio-economic framework, contributing to local economies and food security. These fisheries are characterized by small-scale operations that utilize traditional fishing methods, often employing limited technology and targeting a diverse range of species. According to Zeller et al. (2023), small-scale fisheries serve as a vital informal social protection system, particularly in remote areas where alternative employment opportunities are scarce, thereby playing a crucial role in poverty alleviation and food security. This is particularly relevant in Nigeria, where over 60% of the total domestic fish output is derived from artisanal fishers, highlighting their importance in meeting local demand for fish and providing livelihoods for many families (Bamigboye & Koledoye, 2022).

The scale of artisanal fisheries in Nigeria is substantial, with numerous communities relying on these fisheries for their daily sustenance and economic activity. As noted by Ifabiyi and Adisa (2022), understanding the perceptions of fisherfolk regarding their operations is essential for enhancing fishing skills and outputs, which directly impacts local economies. Furthermore, the contribution of artisanal fisheries to local economies is often greater than that of industrial fisheries, as they generate less environmental impact while providing social benefits through job creation and community engagement (López-Angarita et al., 2018; Belhabib et al., 2017). This is echoed in the findings of Prosperi et al. (2019) who highlight the resilience of small-scale fisheries in adapting to changing

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market conditions, thereby ensuring their sustainability and the preservation of local coastal communities.

In terms of food security, artisanal fisheries are indispensable, particularly in a country like Nigeria, where fish constitutes a significant part of the diet for many households. The reliance on fish as a primary protein source underscores the need for sustainable management practices to ensure the long-term viability of these resources. The challenges faced by artisanal fisheries, including overfishing and inadequate governance, necessitate a concerted effort towards sustainable practices that can enhance both ecological health and economic stability (Sogbesan & Kwaji, 2018).

The importance of sustainability in fisheries management cannot be overstated, particularly in the context of artisanal fisheries, which are vital for the livelihoods of millions and the ecological health of aquatic ecosystems. Sustainable fishing practices are essential for ensuring the long-term viability of fish stocks, which are increasingly threatened by overfishing, habitat degradation, and climate change. According to the Food and Agriculture Organization (FAO), approximately 31.4% of commercialized fish stocks are overfished, underscoring the urgent need for effective management strategies that prioritize sustainability (Liem et al., 2018). This is particularly critical in artisanal fisheries, where fishing practices often directly impact local ecosystems and communities.

Sustainability in fisheries management encompasses a holistic approach that integrates ecological, social, and economic dimensions. As highlighted by Kolding and Zwieten (2014), the conventional management paradigm, which focuses primarily on maximizing yields, often neglects the ecological balance necessary for maintaining healthy fish populations and habitats. Instead, an ecosystem-based fisheries management (EBFM) approach is advocated, which considers the complex interactions within marine ecosystems and the socio-economic factors influencing fishing practices (Trochta et al., 2018). This approach not only aims to sustain fish stocks but also to preserve the integrity of the entire ecosystem, ensuring that fishing activities do not compromise the ecological functions that support fish populations.

Moreover, the implementation of sustainable practices is crucial for enhancing the resilience of fisheries to external pressures, such as climate change and market fluctuations. Research indicates that well-managed fisheries that adhere to sustainable practices are more likely to achieve stable yields over time, thereby providing food security and economic stability for communities reliant on fishing (Halpern et al., 2015; Bundy et al., 2016). For instance, studies have shown that fisheries with strong governance frameworks and compliance with sustainability standards tend to experience improved ecosystem health and fish stock recovery (Bundy et al., 2016). This is particularly relevant for Nigeria's artisanal fisheries, where the integration of sustainable practices can significantly enhance both ecological sustainability and community livelihoods.

Thus, the assessment of sustainable fishing practices in Nigeria's artisanal fisheries is not only timely but essential for safeguarding the livelihoods of countless individuals and ensuring food security for future generations. This review aims to provide a comprehensive evaluation of the current state of artisanal fisheries in Nigeria, focusing on sustainable practices, existing challenges, and recommendations for improvement. The primary objectives of this review are threefold: to identify and analyze current fishing practices employed by artisanal fishers, to highlight the challenges faced in implementing sustainable practices, and to propose actionable recommendations to enhance the sustainability of these fisheries.

2.0. Current State of Artisanal Fisheries in Nigeria

Artisanal fisheries in Nigeria represent a vital component of the country's economy and food security, contributing significantly to local livelihoods and cultural heritage. These fisheries are primarily characterized by small-scale, traditional fishing practices that utilize simple gear and methods. The current state of artisanal fisheries in Nigeria is influenced by various factors, including environmental changes, economic pressures, and governance challenges.

One of the most pressing issues facing artisanal fisheries in Nigeria is the impact of climate change. Research indicates that alterations in rainfall patterns, temperature, and wind conditions

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have adversely affected fishing activities, leading to a decline in fish stocks and the quality of life for fishers (Okeke-Ogbuafor et al., 2022). The vulnerability of these communities to climate change varies, with some regions experiencing more severe impacts than others. This situation is compounded by illegal, unreported, and unregulated (IUU) fishing practices, which further threaten the sustainability of fish populations (Okeke-Ogbuafor et al., 2022; Belhabib et al., 2017).

Economically, artisanal fisheries play a crucial role in Nigeria's food system, providing over 85% of domestic fish production and contributing approximately 5% to the national GDP (Sogbesan & Kwaji, 2018). The sector is essential for food security, as fish is a primary source of protein for many Nigerians, with per capita consumption reaching 14.9 kg annually (Adisa et al., 2021). However, the increasing demand for fish products has not been met by domestic production alone, leading to a reliance on imports to fill the gap (Obot, 2020; Olaoye & Ojebiyi, 2018). This imbalance highlights the need for improved management practices and capacity building within the artisanal fishing community to enhance productivity and sustainability (Boro & Agbugba, 2023).

The governance of artisanal fisheries in Nigeria is often inadequate, with many fishers operating without formal regulations or support systems (Júnior et al., 2016). This lack of oversight can lead to overexploitation of resources and conflicts between artisanal and industrial fishing sectors. Studies suggest that enhancing governance frameworks and involving local communities in decision-making processes are critical for the sustainable management of fisheries (Kinyua et al., 2022). Furthermore, the integration of traditional knowledge and practices into modern management strategies could improve the resilience of these fisheries against external pressures, including climate change and market fluctuations (Anyanwu et al., 2022; Nwabeze & Erie, 2013).

In terms of socio-economic dynamics, artisanal fisheries are not only a source of income but also a cultural cornerstone for many communities. The transmission of fishing traditions and practices is vital for maintaining cultural identity (Derdabi & Aksissou, 2021). However, the sector faces challenges related to gender roles and the organization of fishers, which can affect their ability to compete and thrive in the market (Adetoyinbo & Otter, 2020). Addressing these challenges through targeted training and support initiatives can empower fishers and enhance their economic outcomes (Sogbesan & Kwaji, 2018).

2.1. Description of Artisanal Fishing Practices

Artisanal fishing in Nigeria employs a variety of traditional methods and tools that reflect the local ecological conditions and cultural practices of fishing communities. These practices are crucial for sustaining livelihoods and ensuring food security in many regions of the country. The methods and tools used in artisanal fishing are diverse, ranging from simple hand-operated gear to more complex systems, all of which are adapted to the specific environments in which they are used.

One of the most common methods of artisanal fishing in Nigeria is the use of nets, including gill nets, cast nets, and seine nets. Gill nets are particularly prevalent, as they are effective for catching fish by entangling them in the mesh (Ibrahim et al., 2010). Cast nets, which are thrown by hand and sink to capture fish, are also widely used, especially in shallow waters (Ibrahim et al., 2010). Additionally, seine nets, which are drawn through the water to encircle fish, are employed in various water bodies, including rivers and coastal areas (Ibrahim et al., 2010). These nets are typically made from locally sourced materials, and their design can vary based on the target species and fishing conditions.

In addition to nets, hook and line fishing is a traditional method that remains popular among artisanal fishers. This method involves using baited hooks to catch fish, and it is often employed in both freshwater and marine environments (Ibrahim et al., 2010). The simplicity of this technique makes it accessible to many fishers, and it allows for selective fishing, which can help reduce bycatch (Sogbesan & Kwaji, 2018).

Artisanal fishers also engage in traditional practices such as fish farming, which involves the cultivation of fish in controlled environments like ponds and lakes. This practice has gained traction as a means to supplement wild catch and meet the growing demand for fish in Nigeria (Olaoye &

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Ojebiyi, 2018). However, the majority of fish production still comes from capture fisheries, with artisanal fisheries accounting for over 82% of the total domestic fish output (Tyohemba, 2023).

Preservation techniques are integral to artisanal fishing, particularly due to the perishable nature of fish. Smoking is the most common method used for preserving fish in Nigeria, as it enhances flavor and extends shelf life (Ogundana, 2023). Other methods include drying, salting, and refrigeration, though smoking remains the most affordable and widely adopted technique among local communities (Abeni, 2015). These preservation methods not only reduce post-harvest losses but also add value to the fish products, making them more marketable (Adeyeye et al., 2015).

2.2. *Economic Significance of Artisanal Fisheries*

In terms of fish production, artisanal fisheries are responsible for approximately 81.9% of the total domestic fish supply in Nigeria, which translates to about 1.2 million metric tonnes annually (Omitoyin & Tosan, 2012; Roland, 2019). This substantial contribution underscores the importance of artisanal fisheries in meeting the protein needs of the population, as fish is a primary source of animal protein for many Nigerians (Adewale, 2024). Despite this high level of production, Nigeria remains the largest importer of fish in Africa, indicating a significant gap between local production and consumption needs (Falola et al., 2022).

Employment is another critical aspect of the artisanal fisheries sector. It is estimated that artisanal fisheries provide direct employment to about 1 million fishers and indirectly support approximately 5.8 million people in related sectors such as processing, marketing, and distribution (Roland, 2019; Boro & Agbugba, 2023). This makes the fisheries sector a vital source of livelihood for many rural communities, particularly in coastal and riverine areas where alternative employment opportunities may be limited (Sogbesan & Kwaji, 2018). The economic activities generated by artisanal fisheries extend beyond fishing, contributing to local economies through the sale of fish and fish products, which in turn supports local markets and businesses (Olaoye & Ojebiyi, 2018).

The economic significance of artisanal fisheries extends to its contribution to the national Gross Domestic Product (GDP). Estimates suggest that the fisheries sector contributes around 4% to 5.4% of Nigeria's total GDP (Omitoyin & Tosan, 2012; Adewale, 2024; Sogbesan & Kwaji, 2018). This contribution is particularly important given the country's ongoing challenges with food security and poverty alleviation. The income generated from artisanal fisheries not only supports the livelihoods of fishers but also enhances food availability and nutritional security for the broader population (Omitoyin & Tosan, 2012; Falola et al., 2022).

Moreover, artisanal fisheries are integral to the cultural identity and social fabric of many communities in Nigeria. They provide not only a source of income but also a means of preserving traditional fishing practices and cultural heritage (Sogbesan & Kwaji, 2018). The sustainability of this sector is therefore essential not only for economic reasons but also for maintaining the cultural and social structures of fishing communities.

2.3. *Challenges Faced by Artisanal Fishers*

Artisanal fishers in Nigeria face a myriad of challenges that threaten their livelihoods and the sustainability of fish stocks. Among these challenges, overfishing, pollution, and competition from industrial fishing are particularly significant.

Overfishing is a critical issue affecting artisanal fisheries in Nigeria. The increasing demand for fish, coupled with unsustainable fishing practices, has led to the depletion of fish stocks. Artisanal fishers often rely on traditional methods that may not be effective in managing fish populations, resulting in overexploitation of certain species (Sumaila & Tai, 2020; Sogbesan & Kwaji, 2018). The lack of adherence to fisheries regulations further worsen this problem, as many fishers operate without proper licenses or compliance with sustainable practices (Sogbesan & Kwaji, 2018). The consequences of overfishing are dire, leading to reduced catches and threatening the food security of communities that depend on fish as a primary source of protein (Falola et al., 2022).

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Pollution is another significant challenge faced by artisanal fishers. The contamination of water bodies through industrial activities, particularly oil spills and chemical runoff, has severely impacted fish habitats and populations (Omonibeke et al., 2024; Nkodo et al., 2023). Heavy metals and other pollutants from artisanal refining processes have been found to accumulate in aquatic environments, posing health risks to both fish and humans (Omonibeke et al., 2024; Ikezam et al., 2021). Studies indicate that the presence of pollutants such as lead and mercury in water bodies can lead to declines in fish populations and affect the quality of fish caught by artisanal fishers (Uzomah et al., 2021; Omonibeke et al., 2024). This pollution not only diminishes fish stocks but also affects the health and livelihoods of fishing communities, as contaminated fish can pose serious health risks to consumers (Uzomah et al., 2021; Nkodo et al., 2023).

Competition from industrial fishing poses a significant threat to artisanal fishers in Nigeria. Industrial fishing operations, which often employ advanced technologies and larger vessels, can deplete fish stocks more rapidly than artisanal methods (Song et al., 2020). This competition can lead to conflicts over fishing grounds and resources, as industrial fishers may encroach on areas traditionally fished by artisanal communities (Song et al., 2020). Furthermore, the economic power of industrial fishing companies often allows them to dominate markets, making it difficult for artisanal fishers to compete effectively (Falola et al., 2022; Song et al., 2020). The reliance on imported fish due to the inability of local production to meet demand further complicates the situation, as it undermines the economic viability of artisanal fisheries (Falola et al., 2022; Nkodo et al., 2023).

3.0. Sustainability Practices in Artisanal Fisheries

Sustainability practices in artisanal fisheries in Nigeria are critical for ensuring the long-term viability of fish stocks and the livelihoods of local communities. Artisanal fisheries, which account for a significant portion of Nigeria's fish production, face numerous challenges that hinder sustainable practices. These challenges include low compliance with fisheries regulations, inadequate knowledge of sustainable practices among fishers, and socio-economic factors that influence fishing activities.

Research indicates that there is low adherence to sustainable fisheries practices among artisanal fishers in Nigeria, which threatens the sustainability of inland fisheries resources (Sogbesan & Kwaji, 2018). This lack of compliance is often linked to insufficient training and awareness regarding sustainable fishing methods. For instance, John and Adisa (2022) emphasize the importance of understanding fisherfolks' perceptions of their local fishing operations, suggesting that enhanced knowledge could lead to better adherence to sustainable practices. Moreover, the socio-economic characteristics of fishers, such as education level and access to resources, significantly influence their fishing practices and compliance with sustainability measures (Anyanwu et al., 2022).

The Nigerian artisanal fisheries sector is also characterized by a significant gap between fish production and demand. Despite producing approximately 800,000 metric tonnes of fish annually, the country faces a shortfall of about 1.3 million metric tonnes to meet its national demand of approximately 2.1 million metric tonnes (Osuji, 2024; Issa et al., 2022). This shortfall underscores the urgent need for sustainable management practices that can enhance fish production while ensuring the conservation of aquatic ecosystems. The implementation of effective fisheries management strategies, such as ecosystem-based approaches and the establishment of Marine Protected Areas (MPAs), has been recognized as vital for promoting sustainability in fisheries (Agbeja, 2017).

Furthermore, the role of local knowledge and traditional practices in managing fishery resources cannot be overlooked. Artisanal fishers often possess valuable insights into local ecosystems and sustainable practices that can contribute to the conservation of marine resources (Zahra & Masruroh, 2021). By integrating these traditional practices with modern sustainability frameworks, there is potential for improving the resilience of artisanal fisheries against environmental and economic pressures.

3.1. *Definition and Principles of Sustainable Fishing*

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Sustainability in the context of fisheries refers to the management and utilization of fish resources in a manner that maintains their populations and the health of aquatic ecosystems over time. This concept is crucial for ecological balance, as it ensures that fish stocks are not depleted faster than they can replenish, thereby supporting biodiversity and the overall health of marine and freshwater environments. Sustainable fishing practices are designed to minimize environmental impact, promote the recovery of overexploited stocks, and maintain the integrity of aquatic ecosystems, which are essential for the livelihoods of communities that depend on these resources (Asche et al., 2018).

The principles of sustainable fishing encompass several key aspects. Firstly, it involves the adoption of practices that ensure fish populations are harvested at levels that do not compromise their ability to reproduce and thrive. This is often measured through the concept of Maximum Sustainable Yield (MSY), which aims to find the balance between fish catch and population growth (Irvine et al., 2018). Secondly, sustainable fishing practices emphasize the importance of ecosystem-based management, which considers the interconnections between different species and their habitats. For instance, maintaining trophic diversity and ecological balance is vital for the resilience of fish populations and the ecosystems they inhabit (Ouattara et al., 2024).

Moreover, sustainability in fisheries also incorporates socio-economic dimensions, recognizing that fishing communities rely on these resources for their livelihoods. Effective fisheries management must therefore address the needs of these communities while ensuring that ecological integrity is preserved (Imbwae et al., 2023). This includes engaging local fishers in decision-making processes and promoting practices that enhance their economic resilience without compromising environmental health (Nwabeze & Erie, 2013).

The importance of sustainable fishing extends beyond ecological balance; it is also critical for food security. Fish is a primary source of protein for billions of people worldwide, and unsustainable practices threaten the availability of this vital resource (Bernhardt & O'Connor, 2021). Furthermore, sustainable fisheries contribute to the economic stability of coastal and inland communities, fostering livelihoods and supporting local economies (Sogbesan & Kwaji, 2018). As such, the implementation of sustainable fishing practices is not only an environmental imperative but also a socio-economic necessity.

3.2. *Overview of Sustainable Practices Currently Employed*

Sustainable practices in artisanal fisheries in Nigeria are vital for ensuring the long-term viability of fish stocks and the health of aquatic ecosystems. Several strategies have been successfully implemented, including selective fishing, seasonal closures, habitat conservation, and community engagement in fisheries management. Each of these practices contributes to the sustainability of fisheries while supporting the livelihoods of local communities.

Selective Fishing: Selective fishing practices are designed to minimize bycatch and target specific species or sizes of fish. This method is particularly important in Nigeria, where overfishing and the capture of juvenile fish have led to declines in several species. Research indicates that implementing size limits and encouraging the use of selective gear can significantly improve the sustainability of fish stocks (Nwabeze & Erie, 2013). For instance, the use of nets with larger mesh sizes allows smaller, juvenile fish to escape, thereby promoting their growth and reproductive success. This practice not only supports the recovery of overexploited stocks but also enhances the overall health of marine ecosystems (Eriegha, 2024).

Seasonal Closures: Seasonal closures are another critical practice employed in the management of artisanal fisheries. These closures restrict fishing during specific periods, often coinciding with spawning seasons, to protect vulnerable fish populations. In Nigeria, seasonal closures have not been fully implemented to safeguard spawning aggregations, which are crucial for replenishing fish stocks (Nwabeze & Erie, 2013). Studies show that such closures can lead to increased fish abundance and size, ultimately benefiting fishers through improved catches in subsequent seasons (Boro & Agbugba,

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2023). The effectiveness of seasonal closures relies heavily on compliance and enforcement, which remain challenges in many regions (Ogbeibu, 2023).

Habitat Conservation: Habitat conservation is essential for sustaining fish populations and maintaining ecological balance. In Nigeria, the degradation of aquatic habitats due to pollution, overfishing, and coastal development poses significant threats to fishery resources (Hurtado, 2024). Efforts to conserve critical habitats, such as mangroves and wetlands, are vital for supporting biodiversity and providing nursery grounds for many fish species (Omitoyin & Tosan, 2012). Community-based management approaches that involve local fishers in conservation efforts have shown promise in promoting sustainable practices and fostering stewardship of marine resources (Obot, 2020). For example, initiatives aimed at restoring mangrove ecosystems have been linked to improved fish populations and enhanced resilience of coastal communities (Sadauki, 2023).

Community Engagement and Education: Engaging local communities in fisheries management is crucial for the success of sustainable practices. Research highlights the importance of understanding fisherfolks' perceptions of their local fisheries and management strategies (John & Adisa, 2022). By involving fishers in decision-making processes and providing education on sustainable practices, stakeholders can foster a sense of ownership and responsibility towards resource management (Nwabeze & Erie, 2013). This participatory approach not only enhances compliance with regulations but also empowers communities to adopt sustainable fishing practices that align with their socio-economic needs (Kinyua et al., 2022).

3.3. *Case studies of Successful Sustainable Practices in Nigeria*

In Nigeria, several case studies illustrate the successful implementation of sustainable practices in artisanal fisheries, leading to improved fish stocks and community benefits. These examples highlight the effectiveness of various strategies, including community-based management, selective fishing, and habitat restoration.

1. Community-Based Fisheries Management in Jebba Lake Basin: One notable case study is the implementation of community-based fisheries management practices in the Jebba Lake Basin. This initiative involved local fishers in decision-making processes regarding fishing regulations and sustainable practices. By empowering the community, the project aimed to enhance compliance with sustainable fishing practices, such as selective fishing and seasonal closures. Research indicates that this participatory approach has led to increased fish stocks and improved livelihoods for local fishers (Nwabeze & Erie, 2013). The success of this initiative demonstrates the importance of involving local communities in fisheries management, as their knowledge and commitment are crucial for sustainable practices.

2. Selective Fishing Practices in the Niger Delta: Another successful example is the adoption of selective fishing practices in the Niger Delta region. Fishers have begun to implement size limits and use gear that minimizes bycatch, which has resulted in healthier fish populations. Studies show that these practices have led to a significant increase in the abundance of target species (Ogunji, 2023). The improved fish stocks have not only benefited the ecosystem but also enhanced the economic stability of fishing communities, as they can rely on more consistent and sustainable catches.

3. Habitat Restoration Initiatives: Habitat restoration efforts, particularly in mangrove ecosystems, have also shown positive outcomes for fish stocks and community livelihoods. In regions where mangroves have been restored, there has been a noticeable increase in fish populations, as these habitats serve as critical nursery grounds for many species. Community involvement in these restoration projects has fostered a sense of ownership and responsibility, leading to better protection of these vital ecosystems. The restoration of mangroves has not only improved fish stocks but has also provided additional benefits, such as enhanced coastal protection and increased biodiversity.

4. Aquaculture Development in Nigeria: The growth of aquaculture in Nigeria represents another successful case of sustainable practices. With Nigeria becoming the second-largest aquaculture producer in Africa, initiatives focused on sustainable fish farming practices have led to increased fish production and reduced pressure on wild fish stocks (Ogunji, 2023). The promotion of

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environmentally friendly aquaculture techniques, such as integrated multi-trophic aquaculture (IMTA), has contributed to the sustainability of fish farming while providing economic opportunities for local communities. This development has helped to bridge the gap between fish demand and supply, ensuring food security for the growing population.

5. The Fadama Project: The Fadama Project, a government initiative aimed at improving agricultural productivity, has also positively impacted artisanal fisheries. By providing training and resources to fishers, the project has promoted sustainable fishing practices and improved fish production levels (Olaoye & Ojebiyi, 2018). The integration of sustainable practices into the project has led to increased fish stocks and enhanced livelihoods for participating communities, demonstrating the effectiveness of targeted interventions in promoting sustainability.

4.0. Barriers to Sustainable Fishing Practices in Nigeria

The artisanal fisheries sector in Nigeria faces numerous barriers to implementing sustainable practices, which significantly undermine the potential for ecological and economic sustainability. These barriers can be categorized into regulatory, environmental, socio-economic, and governance challenges.

Regulatory Challenges: One of the primary barriers to sustainable practices in Nigeria's artisanal fisheries is the low adherence to existing fisheries regulations. Many artisanal fishers do not comply with sustainable fishing practices, which threatens the sustainability of inland fisheries resources (Sogbesan & Kwaji, 2018). The ineffectiveness of regulatory frameworks has led to widespread overfishing, resulting in a decline in fish stocks and changes in species composition (Olopade et al., 2017). Furthermore, the failure to observe closed seasons and the use of destructive fishing methods exacerbate the situation, leading to unsustainable exploitation of fish resources (Eriegha, 2024). This regulatory failure is compounded by weak enforcement mechanisms, which allow unsustainable practices to persist unchecked (Olopade et al., 2017).

Environmental Challenges: Environmental degradation, including climate change, poses significant threats to the sustainability of artisanal fisheries in Nigeria. Changes in climate patterns affect fish populations and their habitats, leading to decreased catches and increased competition for dwindling resources (Aderinola et al., 2021). Additionally, anthropogenic activities, such as pollution and habitat destruction, further threaten the ecological balance necessary for sustainable fisheries (Adewale, 2024). The combined pressures from both artisanal and industrial fishing activities intensify these environmental challenges, leading to conflicts over resource use and sustainability (Marengo et al., 2015).

Socio-Economic Challenges: The socio-economic context of artisanal fishers also presents barriers to sustainable practices. Many fishers operate under conditions of poverty, which limits their ability to invest in sustainable technologies or practices (Awujola, 2023). The reliance on artisanal fisheries as a primary source of livelihood means that economic pressures often drive fishers to prioritize short-term gains over long-term sustainability (Belhabib et al., 2017). Additionally, the lack of access to training and resources to adopt sustainable practices further perpetuates this cycle of unsustainability (Nwabeze & Erie, 2013). The perception of fishers regarding the importance of sustainable practices is often influenced by their immediate economic needs, which can lead to resistance against regulatory measures aimed at promoting sustainability (John & Adisa, 2022).

Governance Challenges: Effective governance is crucial for the sustainability of fisheries, yet many artisanal fishers in Nigeria perceive governance structures as inadequate or ineffective (Kinyua et al., 2022). The lack of engagement between fishers and management authorities hampers the development of policies that are both practical and beneficial to local communities (Kiruba-Sankar et al., 2021). Moreover, the marginalization of artisanal fisheries in broader economic and environmental policies further complicates efforts to promote sustainable practices (Ali, 2023). The need for inclusive governance that considers the voices of local fishers is essential for the successful implementation of sustainable fisheries management strategies (Kinyua et al., 2022; Kiruba-Sankar et al., 2021).

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4.1. *Socioeconomic Factors Influencing Fishing Practices*

The socioeconomic factors influencing fishing practices in Nigeria, particularly in the context of artisanal fisheries, are deeply intertwined with issues of poverty, lack of education, and economic pressures. These factors collectively hinder the adoption of sustainable fishing practices, which are crucial for the long-term viability of fisheries and the livelihoods of fishing communities.

Poverty as a Barrier to Sustainable Practices: Poverty remains a significant challenge for artisanal fishers in Nigeria, limiting their ability to invest in sustainable fishing technologies and practices. Many fishers operate under conditions of extreme financial constraint, which compels them to prioritize immediate economic returns over long-term sustainability (Sogbesan & Kwaji, 2018). The reliance on artisanal fisheries as a primary source of income often leads to overfishing and the use of destructive fishing methods, as fishers seek to maximize short-term gains to meet their basic needs (Nwabeze & Erie, 2013). Furthermore, poverty restricts access to alternative livelihood opportunities, perpetuating a cycle of dependency on unsustainable fishing practices (Ashley-Dejo & Adelaja, 2022). The economic pressures associated with poverty can lead to a disregard for regulations aimed at promoting sustainability, as compliance may be viewed as an unaffordable luxury (Sogbesan & Kwaji, 2018).

Lack of Education and Awareness: The lack of education among artisanal fishers significantly impacts their understanding of sustainable fishing practices. Many fishers have limited knowledge of the ecological principles that underpin sustainable fisheries management, which hinders their ability to implement effective conservation measures (John & Adisa, 2022). Educational deficits can result in a lack of awareness regarding the long-term benefits of sustainable practices, such as the importance of maintaining fish stocks and protecting aquatic ecosystems (Andries et al., 2022). Studies have shown that enhancing education and training for fishers can lead to improved fishing practices and greater adherence to sustainability principles (Nwabeze & Erie, 2013). However, the existing educational infrastructure in many rural areas of Nigeria is inadequate, further exacerbating the challenges faced by fishers (Andries et al., 2022).

Economic Pressures and Market Dynamics: Economic pressures, including fluctuating fish prices and competition from industrial fishing operations, further complicate the situation for artisanal fishers. The need to remain competitive in a market that often favors larger, industrial operations can drive fishers to engage in overfishing and other unsustainable practices (Frawley et al., 2019). Additionally, the demand for fish in local and international markets can create incentives for fishers to prioritize quantity over quality, leading to practices that deplete fish stocks (Johnson et al., 2020). The economic landscape is often characterized by a lack of access to financial resources, which limits fishers' ability to invest in sustainable practices or diversify their income sources (Ashley-Dejo & Adelaja, 2022). Consequently, economic pressures can lead to a short-term focus that undermines the long-term sustainability of fisheries (Sogbesan & Kwaji, 2018).

4.2. *Cultural Perceptions and Attitudes Towards Sustainability*

Cultural perceptions and attitudes towards sustainability play a significant role in shaping fishing behaviors within Nigeria's artisanal fisheries. Traditional beliefs and practices, which have been passed down through generations, influence how fishing communities interact with their environment and manage their resources.

Traditional Beliefs and Practices: In many Nigerian fishing communities, traditional beliefs are deeply rooted in local culture and often dictate the methods and practices employed in fishing. These beliefs can promote sustainable practices or contribute to unsustainable behaviors. For instance, some communities adhere to traditional fishing practices that emphasize respect for nature and the need to maintain ecological balance. Such practices may include seasonal fishing restrictions, which align with the natural breeding cycles of fish species, thereby promoting sustainability (Temple et al., 2017). However, as modern pressures and economic incentives increase, these traditional practices may be overlooked in favor of more lucrative, yet unsustainable, fishing methods.

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Cultural Attitudes Towards Sustainability: Cultural attitudes towards sustainability are shaped by the community's historical relationship with their environment. Many artisanal fishers possess a wealth of indigenous knowledge regarding local ecosystems, which informs their fishing practices. This knowledge encompasses an understanding of fish behavior, breeding patterns, and the ecological impacts of overfishing. However, the transition to modern fishing techniques and the influence of external markets can erode this traditional knowledge, leading to practices that are detrimental to sustainability. The challenge lies in reconciling traditional practices with contemporary sustainability goals, ensuring that local knowledge is not lost but rather integrated into modern fisheries management strategies (Coy et al., 2014).

Economic Pressures and Cultural Resistance: Economic pressures often clash with traditional beliefs, creating a complex dynamic that influences fishing behaviors. As fishers face increasing competition from industrial fishing operations and market demands, there is a tendency to prioritize short-term economic gains over long-term sustainability. This shift can lead to the abandonment of traditional practices that are inherently sustainable. Moreover, the perception that modern fishing methods are more efficient can undermine the value of traditional knowledge, leading to a cultural shift away from sustainable practices (Schiller & Bailey, 2021). Conversely, there is a growing recognition among some fishing communities of the importance of sustainability, driven by the realization that overfishing and environmental degradation threaten their livelihoods. This awareness has prompted some fishers to advocate for the preservation of traditional practices that align with sustainable fishing, highlighting the potential for cultural beliefs to evolve in response to contemporary challenges (Rumagia et al., 2020).

4.3. Regulatory Challenges and Enforcement Issues

The effectiveness of existing regulations and the challenges in enforcement within Nigeria's artisanal fisheries sector are critical issues that significantly impact the sustainability of fishery resources. Despite the establishment of various regulatory frameworks aimed at promoting sustainable fishing practices, enforcement remains a significant hurdle due to several interrelated factors.

Effectiveness of Existing Regulations: Nigeria has implemented a range of regulations intended to manage its artisanal fisheries, including laws that govern fishing seasons, gear restrictions, and catch limits. However, the effectiveness of these regulations is often undermined by inadequate enforcement mechanisms. For instance, Kwaji et al. (2020) highlight that poor implementation of sanctions by authorities has led to increased non-compliance with fishing regulations in regions such as Lakes Geriyo and Ribadu. This lack of enforcement creates an environment where illegal fishing practices can thrive, as the risks associated with violations are perceived to be low. Moreover, the existing regulations often fail to address the specific needs and practices of local fishing communities. Many fishers operate with limited awareness of the regulations due to high illiteracy rates and insufficient outreach efforts by regulatory bodies. This gap in communication further worsen the challenges of compliance, as fishers may not fully understand the implications of the regulations or the importance of sustainable practices.

Challenges in Enforcement: The challenges in enforcing fishing regulations in Nigeria's artisanal fisheries are multifaceted. One significant issue is the lack of resources allocated to regulatory agencies tasked with monitoring and enforcing compliance. Many enforcement bodies are understaffed and lack the necessary infrastructure to effectively oversee fishing activities. This inadequacy leads to sporadic enforcement efforts that are often insufficient to deter illegal fishing practices. Additionally, the socio-economic context in which artisanal fishers operate complicates enforcement efforts. Many fishers are driven by economic necessity, which can lead them to prioritize immediate financial gains over compliance with regulations. This economic pressure is further compounded by competition from industrial fishing operations that may not adhere to sustainable practices, thereby creating an uneven playing field for artisanal fishers. The perception of regulatory penalties also plays a role in compliance.

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5.0. Impact of Climate Change on Artisanal Fisheries in Nigeria

Climate change poses significant challenges to artisanal fisheries in Nigeria, affecting both the ecological and socio-economic dimensions of this vital sector. However, the impacts of climate change are not uniformly distributed across different types of fisheries. Inland fisheries, which often involve women, are particularly vulnerable compared to marine fisheries, which are predominantly male-dominated (Okeke-Ogbuafor et al., 2022). This disparity is intensified by the greater focus of West African countries on marine fisheries, leading to insufficient support for inland fishing communities (Okeke-Ogbuafor et al., 2022).

The ecological impacts of climate change on fisheries include alterations in fish species distribution, habitat changes, and shifts in productivity. These changes can lead to a decline in fish stocks, which directly threatens food security and the livelihoods of fishing communities (Omitoyin & Tosan, 2012; Mustapha, 2013). For instance, climate change is expected to modify the distribution of fish species, affecting their breeding and recruitment patterns, which are critical for maintaining sustainable fish populations (Mustapha, 2013). Additionally, the cumulative effects of climate change can disrupt food-web processes, leading to species invasions and the spread of vector-borne diseases that further threaten fish populations (Mustapha, 2013; Muringai et al., 2022).

Effective fisheries management is essential to mitigate these impacts. Research indicates that adaptive management strategies, which account for shifting fish distributions and productivity, are crucial for sustaining artisanal fisheries under climate change (Free et al., 2019; Gaines et al., 2018). However, many countries, including Nigeria, lack the necessary monitoring and scientific capacity to implement these adaptive measures effectively (Free et al., 2019; Gaines et al., 2018). The integration of ecosystem-based approaches into fisheries management can enhance resilience by considering all drivers affecting coastal fisheries production (Fogarty et al., 2021; Holsman et al., 2020). Such approaches not only address immediate ecological challenges but also promote long-term sustainability by fostering adaptive capacity among fishing communities (Fogarty et al., 2021; Holsman et al., 2020).

Moreover, socio-economic adaptations are necessary for communities reliant on artisanal fisheries. Strategies such as livelihood diversification, changes in fishing gear, and targeting new species have been adopted by fishery-dependent populations to cope with the fluctuating resources due to climate change (Muringai et al., 2022; Lancker et al., 2019). However, the low adherence to sustainable practices among artisanal fishers poses a significant barrier to effective management and conservation efforts (Sogbesan & Kwaji, 2018). Therefore, there is an urgent need for policy reforms that prioritize climate change adaptation in fisheries management, ensuring that local communities are engaged in the decision-making processes that affect their livelihoods (Cisneros-Mata et al., 2019).

5.1. Overview of Climate Change Effects on Fisheries

Climate change significantly impacts fish populations and habitats in Nigeria, presenting challenges that threaten both biodiversity and the livelihoods of communities dependent on fisheries. The effects of climate change manifest through various mechanisms, including alterations in temperature, precipitation patterns, and the frequency of extreme weather events, which collectively disrupt aquatic ecosystems and fish populations.

One of the primary impacts of climate change on fisheries in Nigeria is the alteration of fish habitats. Rising temperatures can lead to changes in water temperature and stratification, which affect the distribution and breeding patterns of fish species (Mustapha, 2013; Omitoyin & Tosan, 2012). For instance, warmer waters may favor certain species over others, leading to shifts in community composition and potentially resulting in the decline of less adaptable species (Mustapha, 2013). Additionally, changes in precipitation can influence freshwater systems, affecting the flow and quality of water in rivers and lakes, which are crucial habitats for many fish species (Mustapha, 2013; OLU et al., 2023).

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Furthermore, climate change exacerbates existing environmental stressors such as pollution, overfishing, and habitat degradation. These combined pressures can lead to reduced fish populations and diminished biodiversity (OLU et al., 2023). For example, the introduction of invasive species, often facilitated by changing climatic conditions, can further threaten native fish populations by competing for resources or introducing diseases (Mustapha, 2013; OLU et al., 2023). The cumulative effects of these stressors may result in significant declines in fish stocks, which are critical for food security and economic stability in many coastal and inland communities (Mustapha, 2013; OLU et al., 2023).

The socio-economic implications of these ecological changes are profound. Artisanal fisheries, which account for a significant portion of Nigeria's fish production, are particularly vulnerable to climate change impacts. These fisheries provide livelihoods for millions of people, and any decline in fish stocks can lead to increased poverty and food insecurity among fishing communities (Omitoyin & Tosan, 2012; OLU et al., 2023). Moreover, the adaptive capacity of these communities is often limited by factors such as lack of access to information, financial resources, and training on sustainable practices (Arimi, 2013; Onyeneke et al., 2019; Onada & Solomon, 2016).

Adaptation strategies are essential to mitigate the impacts of climate change on fisheries. Research indicates that enhancing the adaptive capacity of fish farmers through training and awareness programs can significantly improve their resilience to climate change (Arimi, 2013; Onyeneke et al., 2019). Implementing effective fisheries management practices that consider climate variability is also crucial. Such practices include establishing adaptive management frameworks that can respond to changing environmental conditions and promoting sustainable fishing practices to ensure the long-term viability of fish populations (Gaines et al., 2018; Onada & Solomon, 2016).

5.2. *Adaptation Strategies Employed by Artisanal Fishers*

Artisanal fishers in Nigeria are increasingly adapting to the challenges posed by climate change through a variety of strategies aimed at enhancing their resilience and sustaining their livelihoods. These adaptations are essential as fishing communities face significant threats from changing environmental conditions, including altered weather patterns, rising sea levels, and increased frequency of extreme weather events.

One prominent adaptation strategy employed by artisanal fishers is the diversification of livelihoods. Many fishers are shifting towards alternative sources of income, such as aquaculture, fish processing, and other agricultural activities, to reduce their reliance on fishing alone (Aderinola et al., 2021). This diversification not only provides financial security but also allows communities to buffer against the volatility of fish stocks impacted by climate change. Research indicates that communities that engage in multiple income-generating activities are better positioned to withstand the adverse effects of climate variability (Aderinola et al., 2021; Adelekan & Fregene, 2014).

Additionally, the use of weather information and forecasting has emerged as a critical adaptation tool. Fishers are increasingly utilizing weather forecasts to make informed decisions about fishing activities, which helps them avoid dangerous conditions and optimize their catch (Okeke-Ogbuafor et al., 2022). This proactive approach is particularly important in regions where traditional knowledge may no longer suffice due to the unpredictability of climate impacts. By integrating scientific weather data with local knowledge, fishers can enhance their resilience to climate-related disruptions (Okeke-Ogbuafor et al., 2022).

Community engagement and the establishment of formal networks are also vital for enhancing adaptive capacity. Collaborative efforts among fishers, local governments, and non-governmental organizations facilitate the sharing of resources, knowledge, and best practices for climate adaptation (Adelekan & Fregene, 2014). These networks can provide training and support for sustainable fishing practices, which are crucial for maintaining fish populations and habitats in the face of environmental changes (Adelekan & Fregene, 2014).

Moreover, some communities are adopting innovative fishing techniques and technologies that are more resilient to climate impacts. For example, the use of improved fishing gear and practices

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that minimize bycatch and reduce habitat destruction can help sustain fish populations (Aderinola et al., 2021). These practices not only contribute to ecological sustainability but also enhance the economic viability of fishing operations.

In response to flooding and other climate-related risks, many fishing communities are also investing in infrastructure improvements, such as building more resilient fishing boats and enhancing storage facilities for their catch (Omoyinmi et al., 2023). These investments are aimed at mitigating the impacts of extreme weather events and ensuring that fishers can continue their activities even under challenging conditions.

5.3. Role of Local Knowledge in Climate Resilience

Indigenous knowledge plays a crucial role in enhancing climate resilience among communities in Nigeria, particularly in the context of artisanal fisheries and agriculture. This knowledge, developed over generations through close interactions with the environment, provides valuable insights into local ecosystems, weather patterns, and sustainable resource management practices. By integrating indigenous knowledge into climate adaptation strategies, communities can better navigate the challenges posed by climate change.

One of the primary benefits of indigenous knowledge is its ability to inform local practices that enhance resilience to climate variability. For instance, traditional fishing practices and seasonal calendars developed by local fishers allow them to anticipate changes in fish behavior and availability, thereby optimizing their catch (Olaniyan & Govender, 2023; Ajani et al., 2013). Such knowledge is often based on long-term observations of environmental changes, making it comparable to scientific data in terms of its relevance and applicability (Ajani et al., 2013). This local expertise is particularly important in regions where scientific resources and infrastructure may be lacking, enabling communities to adapt effectively to changing conditions.

Moreover, indigenous knowledge systems often encompass a holistic understanding of the interconnections between various environmental factors. This perspective is essential for developing adaptive strategies that consider the broader ecological context, including the impacts of climate change on biodiversity and ecosystem services (Yongabi, 2023; Brugnach et al., 2014). For example, traditional practices such as rotational fishing and the use of specific gear types can help sustain fish populations and protect habitats, contributing to the overall health of aquatic ecosystems (Olaniyan & Govender, 2023; Ajani et al., 2013).

The integration of indigenous knowledge into formal climate adaptation frameworks can also foster community engagement and ownership of adaptation strategies. When local communities are involved in the decision-making processes that affect their livelihoods, they are more likely to adopt and sustain these strategies (Tunde & Ajadi, 2019; Brugnach et al., 2014). This participatory approach not only enhances the effectiveness of adaptation measures but also empowers communities to advocate for their needs and priorities in broader climate policy discussions.

Furthermore, the recognition of indigenous knowledge in climate adaptation efforts can help bridge the gap between traditional practices and scientific approaches. Collaborative frameworks that combine indigenous knowledge with scientific research can lead to more comprehensive and effective adaptation strategies (Hiwasaki et al., 2014; Mutasa, 2015). For instance, integrating local weather forecasting methods with modern meteorological data can improve the accuracy of climate predictions and enhance the preparedness of fishing communities for extreme weather events (Hiwasaki et al., 2014; Tunde & Ajadi, 2019).

6.0. Community Engagement and Stakeholder Involvement

Community engagement and stakeholder involvement are crucial components in the management and sustainability of artisanal fisheries in Nigeria. However, the governance of these fisheries often lacks the necessary participatory frameworks that include diverse stakeholder voices, which is essential for effective management and sustainability.

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Artisanal fisheries in Nigeria are a vital source of income and nutrition, accounting for over 82% of the country's fish production and providing livelihoods for millions of people (Tyohemba, 2023; Aderinola et al., 2021). Despite their importance, these fisheries face numerous challenges, including competition from industrial fishing practices and the impacts of climate change (Teh & Pauly, 2018; Belhabib et al., 2019). Effective stakeholder engagement is essential to address these challenges, as it fosters collaboration among fishers, government agencies, and other stakeholders, ensuring that management practices are inclusive and equitable (Wilson, 2023; Okafor-Yarwood et al., 2022). For instance, participatory governance frameworks can help balance the interests of various groups, thereby promoting sustainable fishing practices that protect both the environment and the livelihoods of local communities (Okafor-Yarwood et al., 2022).

The integration of local ecological knowledge into fisheries management is another critical aspect of community engagement. Local fishers possess invaluable insights into the ecosystems they depend on, which can inform sustainable practices and enhance resilience against environmental changes (Rasalato et al., 2010). By incorporating these perspectives into management strategies, authorities can develop more effective policies that reflect the realities of artisanal fishing communities (Morales & Martin, 2018). This approach not only empowers local fishers but also fosters a sense of ownership and responsibility towards the sustainability of their resources.

Moreover, the socio-economic dynamics of artisanal fisheries necessitate targeted interventions that address the unique challenges faced by different stakeholder groups, particularly marginalized populations such as women and youth (Bamigboye & Koledoye, 2022; ODİOKO & BECER, 2022). Engaging these groups in decision-making processes can lead to more equitable resource distribution and improved outcomes for community development (Bamigboye & Koledoye, 2022). For example, initiatives aimed at enhancing the capacity of youth in artisanal fishing can significantly contribute to local economies while ensuring the sustainability of fish stocks (Bamigboye & Koledoye, 2022; Awujola, 2023).

6.1. *Importance of Community-Based Management Approaches*

Community-based management approaches in artisanal fisheries in Nigeria offer numerous benefits that enhance sustainability, improve livelihoods, and foster social cohesion. Involving local communities in fisheries management is essential for addressing the unique challenges faced by these communities, including overfishing, habitat degradation, and socio-economic disparities.

One of the primary benefits of community-based management is the incorporation of local ecological knowledge into decision-making processes. Local fishers possess valuable insights regarding fish behavior, seasonal patterns, and ecosystem changes, which can significantly inform sustainable management practices (Leite & Gasalla, 2013). By integrating this knowledge, management strategies can be tailored to the specific ecological and socio-economic contexts of the communities, leading to more effective conservation outcomes (Purcell & Pomeroy, 2015). This participatory approach not only enhances the relevance of management measures but also fosters a sense of ownership among community members, which is crucial for compliance and long-term sustainability (Cohen & Foale, 2013).

Furthermore, community-based management can improve the resilience of fisheries by promoting adaptive management practices that respond to changing environmental conditions and socio-economic pressures. For instance, studies have shown that periodically harvested marine reserves, when managed by local communities, can lead to increased fish stocks and improved yields (Cohen & Foale, 2013; Goetze et al., 2017). This adaptive capacity is particularly important in the face of climate change, where traditional management practices may no longer suffice (Purcell & Pomeroy, 2015). By empowering communities to manage their resources, they can implement innovative solutions that reflect their unique circumstances and challenges.

In addition to ecological benefits, community-based management approaches can enhance the socio-economic well-being of local populations. By involving communities in the management process, there is a greater likelihood of equitable resource distribution and improved livelihoods

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(Nwabeze & Erie, 2013). For example, community-managed fisheries often prioritize local needs, ensuring that fish resources contribute to food security and economic stability (Simmance et al., 2022). This is particularly relevant in Nigeria, where artisanal fisheries provide livelihoods for millions and are integral to the food systems of coastal communities (Nwosu et al., 2010).

Moreover, community engagement in fisheries management can strengthen social cohesion and governance structures within communities. Collaborative management fosters trust and communication among stakeholders, which is essential for resolving conflicts and ensuring compliance with management regulations (Elegbede et al., 2023). By building local governance capacities, communities can better advocate for their interests and engage with external stakeholders, including government agencies and NGOs, to secure additional support and resources for sustainable fisheries management (Oloruntuyi et al., 2023).

6.2. Role of Local Institutions and Governance in Sustainability

Local governance structures play a pivotal role in supporting sustainable practices in Nigeria's artisanal fisheries. These governance frameworks can enhance the management of fisheries resources by fostering community participation, integrating local knowledge, and ensuring equitable resource distribution. The effectiveness of local governance in promoting sustainability is contingent upon its ability to engage stakeholders, facilitate collaboration, and adapt to the unique socio-ecological contexts of artisanal fisheries.

One of the primary advantages of local governance is its capacity to incorporate local ecological knowledge into fisheries management. Local fishers possess invaluable insights regarding fish populations, seasonal variations, and ecosystem dynamics, which can significantly inform sustainable management practices (Okafor-Yarwood et al., 2022). By recognizing and integrating this knowledge into decision-making processes, local governance structures can develop management strategies that are more aligned with the realities of the fishing communities. This participatory approach not only enhances the relevance of management measures but also fosters a sense of ownership among community members, which is crucial for compliance and the long-term sustainability of fisheries (Aguilera et al., 2015).

Moreover, local governance can facilitate adaptive management practices that respond to changing environmental conditions and socio-economic pressures. For instance, community-based management systems have been shown to improve resilience in fisheries by allowing local stakeholders to adjust their practices based on real-time observations and experiences (Okafor-Yarwood et al., 2022). This adaptability is particularly important in the context of climate change, where traditional management approaches may no longer suffice (Marengo et al., 2015). By empowering communities to manage their resources, local governance can promote innovative solutions that reflect the specific challenges faced by artisanal fishers.

Equitable resource distribution is another critical aspect of local governance that supports sustainability. Effective governance structures can ensure that the benefits derived from fisheries resources are shared fairly among community members, thereby reducing conflicts and promoting social cohesion (Kyvelou & Ierapetritis, 2020). This is particularly relevant in Nigeria, where artisanal fisheries provide livelihoods for millions and are integral to food security in coastal communities (Rocklin et al., 2011). By prioritizing the needs of local fishers and ensuring their voices are heard in decision-making processes, local governance can help to mitigate the socio-economic disparities that often arise in resource management contexts (Bennett et al., 2019).

Furthermore, local governance can enhance collaboration among various stakeholders, including government agencies, NGOs, and the private sector. By fostering partnerships and facilitating dialogue, local governance structures can create synergies that enhance the effectiveness of fisheries management initiatives (Albouy et al., 2010). For example, collaborative governance approaches that involve multiple stakeholders can lead to the development of comprehensive management plans that address both ecological and socio-economic objectives (Cinti et al., 2014). This collaborative framework not only strengthens the governance of fisheries but also builds trust and

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communication among stakeholders, which is essential for resolving conflicts and ensuring compliance with management regulations (Frawley et al., 2019).

7.0. Policy Recommendations

Formulation and implementation of effective policies that address the ecological and socio-economic aspects of artisanal fisheries are pertinent to achieving sustainable and socially beneficial exploitation of fisheries resources. Nigeria's small-scale fisheries is controlled by national and state laws and policies that are based on core principles of the Federal Republic of Nigeria's 1999 Constitution, which was most recently revised in 2010 (Akintola et al., 2024). The Federal Department of Fisheries (FDF) is responsible for developing Nigeria's fisheries to attain sustainable optimization of fish production, resource utilization and conservation (FDF, 2015). Traditional management policies are also in use, with an emphasis on addressing issues of resource allocation or gear use (Olopade et al., 2017).

The traditional, community-based institutions were determined to be the de facto means of managing the local fisheries resources. To date, they have preserved the resources that these communities rely on for their livelihood by using a variety of traditional management methods(Madakan et al., 2015). These management methods are enforced by fishermen, traditional heads or local authorities. However, all of these regulations have been ineffective in ensuring sustainable practices and conservation of the fisheries resources. This can be attributed to the non-compliance of fishers to the regulatory provisions (Sogbesan & Kwaji, 2018), outdated laws and policies that do not reflect the current realities of the sector, lack of comprehensive data on the artisanal fisheries sector which makes it difficult to assess compliance and identify areas for improvement, and weak enforcement and monitoring strategies (Bolarinwa et al., 2016; Olopade et al., 2017; Sogbesan & Kwaji, 2018).

In some cases, the guidelines have been endorsed but not yet implemented, such as the FAO Voluntary Guidelines for Small-Scale Fisheries (Akintola et al., 2024). The successful implementation of these policies, developed and enforced by fishing communities, various government agencies, research institutions, and law enforcement bodies, requires the active involvement of all stakeholders, including government officials, environmental organizations, and members of the fisheries sector.

7.1. Suggestions for Improving Regulatory Frameworks

The current artisanal fisheries regulations and management techniques need to be improved and better adapted to the needs of the sector in order to guarantee adherence and to promote the sustainability of artisanal fisheries in Nigeria. One of the drawbacks of existing policies is the lack of cohesion between the implementing bodies and the key actors of artisanal fisheries, which are the fisherfolks (Moses-Oke & Erhun, 2022). One of the ways to tackle this is to introduce co-management systems involving both government and local fishing communities in the decision-making process to improve compliance and management. Co-management ensures that regulations are more contextualized and that communities are empowered to manage their resources responsibly.

Regulatory frameworks for fisheries must be based on current, reliable data in order to maximize their efficacy. More efficient regulatory actions will be possible with improved data collection on fishing efforts, catch volumes, and evaluations of fish stocks. This can be achieved through citizen science initiatives, such as establishing local data collection stations or registries where fishers can document their catches. Additionally, fostering collaboration between research institutions and local authorities can facilitate ongoing assessments and ensure that regulations are grounded in evidence-based practices.

The existing regulations are also hindered by inadequate enforcement due to limited resources and oversight (Fakoya & Akintola, 2018). To ensure compliance, it is imperative to:

- Strengthen the capacity of local enforcement agencies and fisheries officers.

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- Implement advanced surveillance and monitoring systems, such as utilizing modern technologies like satellite tracking for real-time observation of fishing activities.
- Foster collaboration with coastal patrols and marine law enforcement to deter illegal, unreported, and unregulated (IUU) fishing.

7.2. Importance of Integrating Traditional Knowledge into Policy Formulation

Indigenous knowledge (IK) or traditional knowledge (TK) represents the collective wisdom that has developed within communities over generations (Raymond-Yakoubian et al., 2017). While often rooted in cultural practices, TK/IK has frequently incorporated elements from external sources through processes of technological adaptation and knowledge exchange (Akintola & Fakoya, 2017). Traditional knowledge held by artisanal fishers in Nigeria is often overlooked in formal regulatory frameworks, yet this local knowledge is invaluable for understanding seasonal fish migration patterns, breeding cycles, and environmental changes Integrating this knowledge into formal policy formulation can significantly enhance sustainability.

Many traditional fishing communities adhere to informal regulations rooted in cultural beliefs or ecological observations that often align with sustainability principles. For example, the Bwatiye, an ethnic group primarily residing along the River Benue, have historically implemented various traditional fisheries management practices within their villages. Common strategies include access restrictions through closed seasons and areas, as well as limitations on gear types, often imposed on non-local fishers (Madakan et al., 2015). These practices can be formalized into policy by collaborating with local elders and community leaders to document traditional practices, and incorporating these practices into national regulations, thus recognizing and formalizing community-based management systems. The possible implication of this is the strengthening of the cultural legitimacy of regulations, increasing the likelihood of compliance. Local fishers are more likely to follow policies that reflect their own values and observations.

7.3. Recommendations for Enhancing Community Participation

1. Foster the establishment of recognized community-based committees and unions of local fishers, elders, women, and youth representatives to ensure inclusive participation in fisheries management. These committees should be formally recognized by regulatory bodies.

2. Implement community-based approaches to Monitoring, Control, and Surveillance (MCS) to empower fisherfolk to actively participate in fisheries management. This participatory approach fosters enhanced compliance with regulations and promotes sustainable fishing practices.

3. Adopt co-management systems where local communities have a significant voice in crafting regulations and are key stakeholders in the decision-making process.

4. Women play a pivotal role in artisanal fisheries, particularly in processing and marketing fish. However, they are frequently excluded from decision-making processes. To enhance their participation, it is crucial to encourage women's involvement in fisheries committees and decision-making bodies, and provide targeted training for women on sustainable fisheries practices and business skills to empower them to actively participate in fisheries governance.

5. Training programs should be provided for local fishers, educating them on sustainable fishing techniques, fisheries management concepts, climate change impacts and how to adapt traditional practices to mitigate its effects on fish stocks and ecosystems.

6. Incentivize compliance by providing financial support for sustainable fishing gear or techniques, and reward communities that demonstrate effective resource management.

Conclusion

Artisanal fisheries in Nigeria play an important role in ensuring food security, supporting livelihoods, and contributing to the nation's socio-economic stability. However, the sector faces significant challenges, including overfishing, environmental degradation, climate change, and

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inadequate governance. These challenges threaten the sustainability of fish stocks and the resilience of fishing communities.

This study underscores the urgent need to adopt sustainable fishing practices and implement effective management strategies. Integrating ecosystem-based approaches, strengthening governance frameworks, and promoting community-based management are pivotal for addressing these challenges. Additionally, leveraging traditional knowledge and fostering community participation can enhance compliance with regulations and drive more inclusive and effective policies.

The findings highlight the importance of addressing socio-economic barriers, such as poverty and limited access to education, which hinder the adoption of sustainable practices. Enhancing capacity-building initiatives, providing financial incentives for sustainable technologies, and supporting alternative livelihoods can help artisanal fishers navigate economic and environmental pressures.

Ultimately, achieving sustainability in Nigeria's artisanal fisheries requires a multi-stakeholder approach that balances ecological conservation with socio-economic development. By encouraging collaboration among fishers, policymakers, researchers, and local communities, it is possible to safeguard the future of this vital sector, ensuring its contributions to food security, biodiversity, and economic resilience for generations to come.

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