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Assessment of Multi-Dimensional Impact of Mangrove Ecosystem in Southern Part of Akwa Ibom State

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Abstract

Mangrove ecosystems constitute a vital socio-economic and ecological lifeline for coastal communities in the Niger Delta, yet they face unprecedented pressure from overexploitation and environmental degradation. This study assessed the multi-dimensional impacts of mangrove ecosystems in the southern part of Akwa Ibom State, focusing on their roles in artisanal fisheries, wood-based energy, non-timber forest products (NTFPs), and coastal protection. A mixed-methods research design was employed, combining ecological field surveys with socio-economic assessments. Using Cochran's formula, a sample of 384 respondents was proportionately drawn from three Local Government Areas (Ibeno, Eastern Obolo, and Mbo). Data were collected through structured questionnaires, Focus Group Discussions (FGDs), and systematic quadrant sampling (10m \times 10m plots) to quantify resource density. Findings revealed that the mangrove-dependent population is predominantly male (64.6%) and economically active, with the 31–45 age group (40.6%) being the most dominant. Fishing emerged as the primary livelihood (42.2%), with finfish (38.0%) and shellfish (29.2%) being the most harvested resources. The study identified a significant wood-based economy where Rhizophora racemosa and Avicennia africana are harvested for fish smoking and construction. However, educational attainment was generally low, with 25.5% having no formal education, which correlates with a high dependency on natural resources. Income levels were similarly constrained, with 69.3% of households earning less than ₦20,000 monthly, indicating widespread economic vulnerability. Ecologically, the quadrant analysis confirmed that mangroves provide critical "green infrastructure" against Atlantic storm surges, though "mangrove mining" for fuelwood threatens this protective function. The study concludes that while mangroves are central to regional food security and household stability, current extraction rates are nearing a tipping point. It recommends a transition toward "blue economy" alternatives, such as ecotourism and sustainable apiculture, and the integration of indigenous knowledge into formal conservation policies to ensure the long-term resilience of Akwa Ibom's coastal fringes.

Keywords: *Mangrove Ecosystem, Artisanal Fisheries, Livelihoods, Niger Delta, Akwa Ibom State, Socio-economic Impact, Resource Management.*

1. Introduction

Mangrove ecosystems are critical to the environmental and socio-economic fabric of coastal regions. Found primarily in tropical and subtropical intertidal zones, they provide essential ecosystem services such as coastal protection, carbon sequestration, and habitat for diverse marine and terrestrial species (Alongi, 2020). Mangroves, a unique and highly productive ecosystem, play a vital role in supporting biodiversity, maintaining coastal integrity, and providing livelihood opportunities for communities around the world. These coastal forests, consisting of salt-tolerant trees and shrubs, are crucial for the ecological balance and act as nurseries for many marine species. However, despite covering less than one percent of tropical forests worldwide, they provide disproportionately significant ecological and socio-economic functions. Globally, mangroves act as nurseries for commercially important fish and crustaceans, protect coastlines from erosion and storm surges, filter pollutants, and are critical in sequestering carbon in what is termed "blue carbon" (United Nations Environment Programme, 2023). In addition to these ecological services, mangroves are closely tied to human well-being, sustaining millions of people across the globe who depend on them for food, medicine, fuelwood, construction materials, and cultural identity (International Union for Conservation of Nature, 2024; Food and Agriculture Organization, 2024). Their conservation has therefore become an international priority, not only for biodiversity protection but also for climate change mitigation and sustainable livelihood development.

On a global scale, mangroves cover approximately 137,000 square kilometers across 123 countries, primarily in tropical and subtropical regions (Giri *et al*., 2011). They provide critical services such as carbon sequestration, shoreline protection from storm surges, and the maintenance of fishery stocks. Despite their significance, it is estimated that the world has lost over one-third of its mangrove forests due to deforestation, aquaculture, and urbanization (Valiela *et al*., 2001). This degradation not only threatens biodiversity but also the livelihoods of the millions of people who depend on mangroves for resources such as fuelwood, construction materials, and fish.

In Africa, mangrove forests play a central role in the ecological integrity of coastal regions, particularly in estuaries and deltaic systems. Nigeria holds the largest expanse of mangrove forests on the continent, concentrated within the Niger Delta region. These forests have long provided resources such as fish, crabs, periwinkles, oysters, fuelwood, poles for construction, and medicinal plants, while also acting as safety nets for marginalized communities that rely on natural resources for survival (Boyle, Akani, Gobo, and Ayotamuno, 2025).

Nigeria, home to the largest mangrove forests in Africa and the third-largest in the world, has an extensive mangrove area that stretches from Lagos in the west to the Niger Delta in the east (Ajonina *et al.,* 2008). Within the Niger Delta, The degradation of mangrove forests in Nigeria threatens not only the biodiversity of the region but also the livelihoods of the millions of people who rely on them for fishing, agriculture, and other economic activities (Numbere, 2018). More than 35% of the world's mangroves are already gone (WWF, 2017). The figure is as high as 50% in countries such as India, the Philippines and Vietnam. Globally, threats to mangrove forests and their habitats include clearing, over harvesting, over fishing, pollution, climate change and river changes through dams and irrigation. Akwa Ibom State is a hotspot of mangrove ecosystems, particularly in its southern coastal localities such as Oron, Mbo, Okobo, Uruan, Ibeno, and Eastern Obolo. The dominant mangrove species in these areas include Rhizophora racemosa and Avicennia africana, which form dense forests along tidal creeks and estuaries (Ebong et al, 2025; Abraham et al, 2025; Imoh et al, 2025). These mangroves serve as the backbone of local livelihoods supporting artisanal fishing, oyster harvesting, periwinkle gathering, boat construction, and small-scale fuelwood trade. They also hold cultural and social significance in traditional practices and festivals of riverine communities. Yet, mounting pressures from oil spills, overexploitation, climate variability, and coastal erosion are increasingly threatening the sustainability of these ecosystems. Recent reports highlight that fisher folks in Akwa Ibom South are facing declining catches, higher vulnerability to storms, and reduced income due to the combined effects of environmental degradation and fossil fuel extraction.

Efforts have been made to conserve these ecosystems through various national and international initiatives. For instance, the Nigerian government has introduced policies to regulate mangrove deforestation and promote sustainable practices. However, more work is needed, particularly in integrating local communities into conservation efforts. The study is guided by the following objectives; evaluate the role of mangroves in artisanal fisheries and food security, analyze the Wood-Based Energy Economy and Construction Sector, assess the Ecotourism and Non-Timber Forest Product (NTFP) Potential and investigate the Protective Value Against Coastal Erosion and Climate Hazards

2. Literature Review

Mangrove ecosystems are one of the most productive and ecologically significant coastal environments in the world. They act as natural buffers against storm surges, support fisheries, and serve as breeding grounds for aquatic species. They also supply fuelwood, timber, medicinal plants, and non-timber forest products that sustain rural livelihoods. Despite the importance of mangroves to coastal communities in Southern Akwa Ibom State, the ecosystem faces increasing pressures that jeopardize its ecological integrity and the economic wellbeing of the people. Hence, the literature were reviewed on order of set objectives.

The mangrove forests of Southern Akwa Ibom State are among the most carbon-dense and biologically diverse ecosystems in Africa. Beyond their botanical significance, they constitute a "socio-economic lifeline" for millions. As Spalding et al. (2024) observe, nearly 20 million people globally depend on mangroves for their primary protein and income. In the context of the Nigerian Niger Delta, this dependence is even more acute due to the lack of alternative industrial employment outside the oil sector. This study evaluates the multi-sectoral impacts of these ecosystems across four key dimensions: fisheries, energy, non-timber products, and coastal protection.

2.2 Evaluation of Mangroves in Artisanal Fisheries and Food Security

In the Southern part of Akwa Ibom State, the mangrove ecosystem functions as the primary architect of regional food security. Mallick (2021) posits that mangroves are "biological supermarkets," serving as critical breeding and nursery grounds for a vast array of finfish, shrimps, crabs, and mollusks. This biological productivity is rooted in the unique morphology of mangrove species found in the region. The intricate prop-root systems of *Rhizophora racemosa* (red mangrove) and the specialized, upward-growing pneumatophores of *Avicennia germinans* (white mangrove) provide a dense, submerged structural complexity. This "lattice" of roots acts as a sanctuary, shielding juvenile marine life from larger predators and the turbulent currents of the Atlantic, effectively ensuring the survival of the next generation of aquatic biomass.

For the artisanal fishers of Ibeno and Eastern Obolo, this biological function translates directly into quantifiable economic output. Akotun (2025) highlights that the geography of the local fishing industry is entirely dependent on the forest's layout; fishing gears, such as cast nets, basket traps, and longlines, are strategically deployed within the sheltered mangrove creeks. Furthermore, landing sites (locally known as *beach* or *wharf*) are almost exclusively situated at the mouths of these estuaries to facilitate immediate access to the "nursery" zones.

The impact of these fisheries extends far beyond the coastline. They do not merely provide a local protein source for coastal families; they anchor a massive regional trade network. High-value species such as the Atlantic mud crab and various prawns are processed—often using mangrove wood—and supplied to major inland markets across Akwa Ibom, Abia, and as far as Northern Nigeria. This creates a multi-sectoral chain of income involving fishers, processors, transporters, and retailers.

However, this heavy reliance represents a significant "double-edged sword." Saunders et al. (2006) argue that while mangroves are robust support systems, they are not invincible. Intense anthropogenic pressures—specifically overfishing, the use of destructive gear, and habitat conversion for urban or industrial expansion—threaten to collapse the very "nursery" that sustains the regional food chain. In Southern Akwa Ibom, where oil-related pollution also interacts with these stressors, the degradation of the mangrove fringe could lead to a permanent decline in fish recruitment, triggering a cascading crisis of protein scarcity and economic displacement for tens of thousands of households

2.3 Analysis of the Wood-Based Energy Economy and Construction Sector

The extraction and utilization of mangrove timber represent a fundamental pillar of the daily socio-economic architecture in Akwa Ibom's coastal fringes. Bimrah (2022) documents that mangrove wood, particularly from the *Rhizophora* genus, is the preferred material for local industry due to its exceptionally high caloric value and its natural resistance to rot and insect infestation in high-salinity environments. In the fish-processing sector—which serves as the economic backbone for Southern Akwa Ibom—mangrove fuelwood is the primary, and often exclusive, energy source used for smoking fish. This preservation method is a critical link in the value chain; without the consistent, high-intensity heat provided by this specific wood, the shelf-life of the daily catch would be reduced to a matter of hours in the tropical heat. This would lead to massive post-harvest losses, stripping coastal women—who dominate the processing and middleman sectors—of their primary livelihood.

Beyond its role as a thermal energy source, the regional construction sector relies heavily on the structural integrity of mangrove poles. These are utilized extensively for scaffolding in modern building projects and as the primary framework for traditional stilt housing and "fishing camps" (*nka*) found across the Ibeno and Mbo coastlines. Tasneem (2024) categorizes this utilization into two distinct tiers: subsistence-oriented (local consumption for housing and domestic cooking) and commercial-driven (large-scale harvesting for sale in urban centers). Notably, the rapid urban expansion and rising energy costs in cities like Uyo and Eket have spiked the demand for mangrove-derived charcoal and construction poles, transforming what was once a localized activity into a lucrative, albeit unregulated, trade.

However, the socio-economic benefits of this extraction are increasingly overshadowed by ecological reality. Hamza (2024) warns that this "wood-based economy" is frequently characterized by unsustainable harvesting patterns. In several coastal belts across West Africa, the absence of a structured forest management policy has led to what is termed "mangrove mining." This phenomenon occurs when forests are cleared at a rate far exceeding their natural regeneration cycle. Such overexploitation does not merely degrade the environment; it threatens the long-term stability of the local energy supply and the physical security of the communities that depend on these forests. In Southern Akwa Ibom, the depletion of mature mangrove stands forces harvesters deeper into the creeks, increasing the cost of wood and, by extension, the price of processed food, thereby creating a cycle of economic and environmental instability.

2.4 Assessment of Ecotourism and Non-Timber Forest Product (NTFP) Potential

While fisheries and timber represent the most visible "outputs" of the ecosystem, the multidimensional impact of mangroves in Southern Akwa Ibom encompasses a vast and diverse array of Non-Timber Forest Products (NTFPs). These resources often serve as the "invisible" economy of the wetlands, providing critical safety nets for the most vulnerable members of coastal society. Ogeh (2016), in an empirical study of mangrove utilization patterns within the Niger Delta, demonstrated that community members derive significant household income from a wide spectrum of forest-based activities. His data revealed a diverse livelihood portfolio: while logging accounted for only 5.3% of direct engagement, fuelwood gathering represented 18.3%, and specialized activities like medicinal plant collection accounted for 2.7%. Most significantly, Ogeh's research found that the mean annual earnings from the marketing of various mangrove resources reached approximately N2,920,514.51 (approximately US$19,470.00 at the time of study) per household in certain high-intensity clusters. This valuation positions the mangrove forest not merely as a local resource, but as a high-value macro-economic asset for the state.

In Southern Akwa Ibom, particularly around the fringes of Mbo and Eastern Obolo, there is burgeoning potential for "blue economy" alternative livelihoods that could shift the regional paradigm away from extractive industries. Primary among these are apiculture (beekeeping) and ecotourism. Mangrove honey is regarded globally as a high-value medicinal and culinary product due to its unique mineral content. As Dahdouh-Guebas et al. (2000) observed in comparative Kenyan coastal studies, such "integrated" livelihood activities provide a sustainable economic bridge, allowing communities to generate significant revenue while actively preserving the forest canopy. By leveraging the pristine, scenic beauty of the St. Nicholas and Qua Iboe River estuaries, the region possesses the foundational requirements for ecotourism modules—such as guided creek tours and bird-watching—that can provide stable income without the ecological cost of felling a single tree (Mbuotidem et al, 2026).

Furthermore, the diversification of the NTFP sector offers specific opportunities for gender-inclusive economic growth. Hamza (2024) identifies the extraction of tannins from mangrove bark for leather treatment and traditional dyeing as an under-utilized secondary sector. Historically used in localized artisanal crafts, the industrial-scale revitalization of tannin extraction could empower coastal women by creating a value-added manufacturing niche. These NTFPs do not only provide supplementary income; they function as critical buffers during periods of economic stress, such as seasonal fishing bans or fluctuations in the oil labor market, thereby enhancing the overall socio-economic resilience of Southern Akwa Ibom's coastal populations.

2.5 Investigation of Protective Value Against Coastal Erosion and Climate Hazards

The most critical, yet often unquantified, dimension of mangrove impact is its role as "green infrastructure." Owuor (2024) emphasizes that mangroves provide shoreline stabilization and erosion control. In regions like Mbo and Ibeno, which face the brunt of Atlantic storm surges, the mangrove fringe acts as a flexible barrier that absorbs wave energy.

This protective service has direct livelihood implications. When mangroves are intact, coastal assets—homes, boats, and nets—are shielded from destruction. Conversely, the removal of these forests leads to rapid coastal recession. As Saunders et al. (2006) discuss, the rising sea levels associated with global climate change make these "natural sea walls" more valuable than ever. The cost of building artificial groins or concrete embankments to protect Akwa Ibom's coastline would be prohibitive; thus, the mangrove ecosystem provides a multi-billion naira "insurance policy" against climate-induced poverty and displacement.

The mangrove ecosystem of Southern Akwa Ibom State is a complex, multi-sectoral asset that provides food, energy, medicine, and physical protection. However, as the research of Ogeh (2016) and Spalding et al. (2024) suggests, the current level of dependence is nearing a tipping point of overexploitation. To ensure these forests continue to support livelihoods, there must be a transition toward "valuation" where the ecological services (like erosion control) are weighed against short-term gains (like timber logging).

3. Materials and Methods

3.1 Study Area

The coastal region of southern Akwa Ibom State is situated in the Niger Delta region of Nigeria, extending approximately between 4°30′N and 4°50′N latitude and 7°30′E and 8°15′E longitude (Udo, 2019). The region borders the Atlantic Ocean to the south and comprises several coastal and riverine Local Government Areas (LGAs), including Ibeno, Mbo, Eastern Obolo, Oron, and Ikot Abasi. These areas are characterized by extensive river networks, estuaries, and mangrove swamps that define the Niger Delta's unique geomorphology (Akpan and Ekong, 2021). The coastal area is strategically positioned, playing a significant role in Nigeria's maritime trade, oil and gas exploration, and fisheries industry. The region is part of the Cross River-Kwa Ibo basin, an important estuarine environment that serves as a breeding ground for marine biodiversity (Ekanem *et al*., 2022).

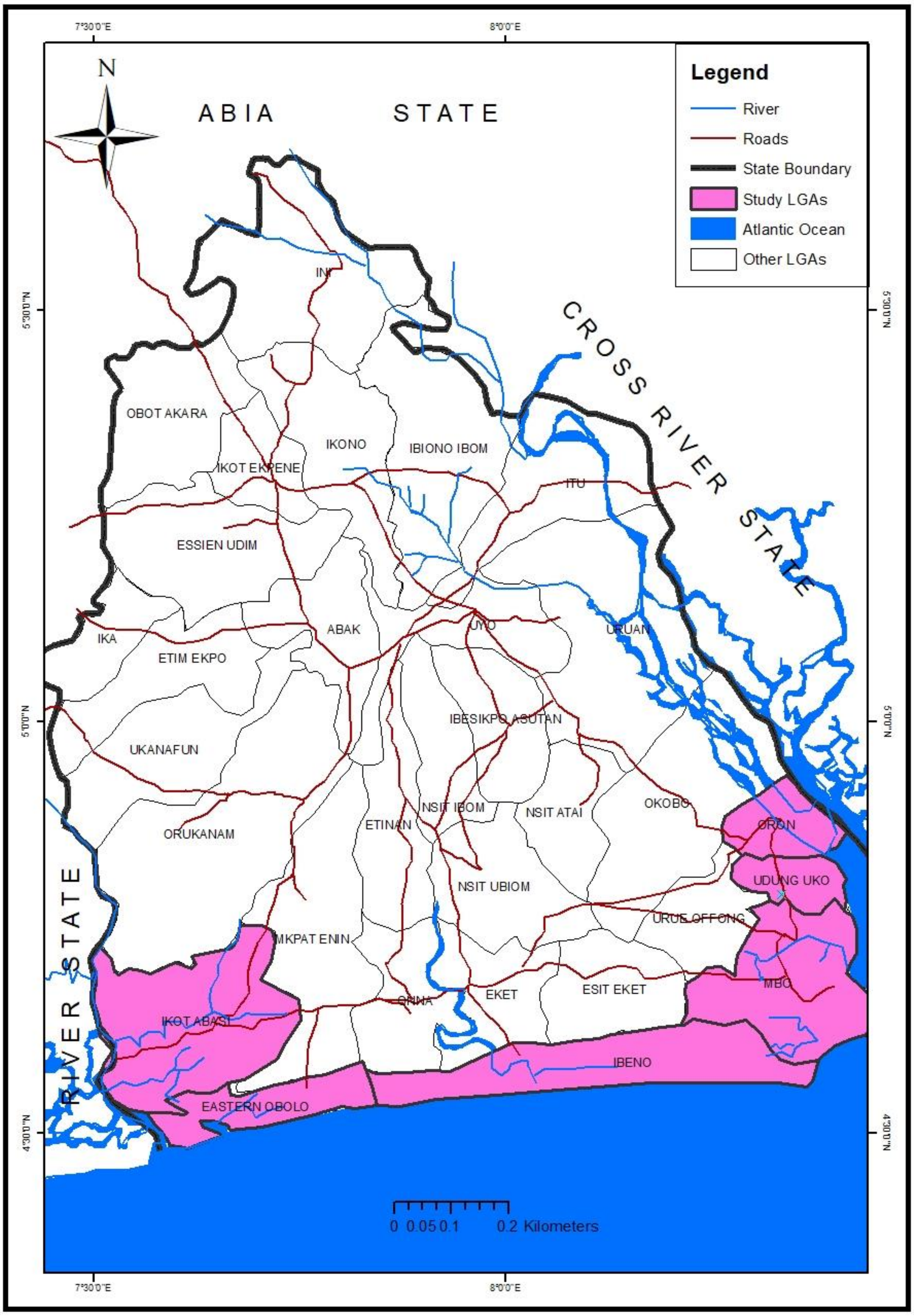

Figure 1.1: Map of Akwa Ibom Study Area (Cross River Central)

Source: Compiled by Researcher from resources in the GIS Lab - University of Uyo.

Coastal communities in the southern zone of Akwa Ibom derive direct livelihoods from mangrove ecosystems through small-scale fisheries (fishers use creeks and estuaries for harvesting juvenile and adult finfish and shellfish), wood extraction (fuelwood, craft wood and posts), collection of palm products (Raphia, nipa where present), and limited smallholder agriculture and salt production in adjacent areas such as palm oil production and subsistence farming. (Udoh, 2022). Fishing also contribute to their major livelihood, with traditional canoe-based and artisanal fishing being predominant (Nwankwo and Essien, 2020). Agriculture and Oil Industry, the ExxonMobil oil terminal in Ibeno has significantly shaped the area's economy. Despite these activities, socio-economic pressures due to overharvesting, conversion for aquaculture, urban expansion, sand filling, and impacts from oil and gas activities have been documented as principal drivers of mangrove loss and degradation in the Niger Delta and Akwa Ibom, with consequent declines in fisheries productivity and shoreline stability Nwilo, and Badejo,(2005).

3.2 Materials

The study adopted a mixed-methods research design, combining ecological field surveys with socio-economic assessments. To quantify the availability and distribution of non-timber mangrove resources (NTFPs), a systematic quadrant sampling technique was employed. This allowed for an objective assessment of species density and resource availability across different coastal localities.

A multi-stage sampling procedure was employed to ensure a representative distribution across the three study areas. Purposively, the Local Government Areas (Ibeno, Eastern Obolo, and Mbo) were selected based on their high mangrove density and the prevalence of forest-edge communities. Within each LGA, communities were stratified into three groups based on their primary economic activity: fishing-dominant, wood-processing-dominant, and NTFP/trading-dominant. Considering the sample size determination, using Cochran's (1977) formula for large populations, a sample size of 384 respondents was determined and the questionnaires were distributed proportionately across the three LGAs (approximately 128 per LGA) to ensure balanced geographic representation.

The primary instrument for data collection was a structured questionnaire, supplemented by Focus Group Discussions (FGDs). Questionnaires were divided into sections covering socio-demographic characteristics (age, gender, years of residence), types of mangrove utilization (fisheries, fuelwood, NTFPs), and perceived impacts on coastal protection. The instrument was pre-tested in a pilot study to ensure the questions were culturally and technically appropriate for the coastal dwellers of Southern Akwa Ibom.

The data generated from the 384 respondents were analyzed using frequencies, percentages, and mean scores were used to evaluate the role of mangroves in food security and the energy sector.

To obtain the data presented in Table 4.2, the following field protocols were observed:

1. **Selection of Plots:** At each study location, three representative sampling stations were established along the intertidal zone.
2. **Quadrat Dimension:** A standard 10m×10m (100m^2) quadrat was used for larger woody NTFPs, while sub-quadrats of 1m×1m were nested within to count smaller mollusks and seedlings.
3. **Data Collection:** Within each quadrant, all identifiable non-timber resources were recorded. This included: (i) **Faunal Resources:** Counting the density of Periwinkles (*Tympanotonus fuscatus*), Mudskippers (*Periophthalmus* spp.), and Atlantic Mud Crabs. (ii) **Floral Resources:** Identifying medicinal plants, fruit-bearing species, and seedlings of *Rhizophora racemosa* and *Avicennia africana*.
4. **Frequency and Density Calculation:** The resource density was calculated using the formula:

   Density=Total number of quadrants sampledTotal number of individuals of a species

In summary, percentages and mean values were used to rank the prevalence of specific non-timber resources at each location, which are subsequently detailed in the results section.

4. Result and Findings

Table 1 Socio-demographic Characteristics

Characteristics	Frequency	Percentage (%)
1. Age		
18–30	68	17.7
31–45	156	40.6
46–60	112	29.2
61 and above	48	12.5
Total	**384**	**100**
2. Gender		
Male	248	64.6
Female	136	35.4
Total	**384**	**100**

3. Marital Status		
Single	72	18.8
Married	256	66.7
Divorced	24	6.3
Widow/Widower	32	8.3
Total	**384**	**100**
4. Occupation		
Fisherman	162	42.2
Trader	96	25
Farmer	82	21.4
Civil servant	44	11.5
Total	**384**	**100**
5. Educational Level		
No formal education	98	25.5
Primary	134	34.9
Secondary	108	28.1
Tertiary	44	11.5
Total	**384**	**100**
6. Monthly Household Income		
< 10,000	124	32.3
10,000–20,000	142	37
21,000–30,000	78	20.3
≥ 40,000	40	10.4
Total	**384**	**100**

Source: Field data (2025).

The age structure of respondents across the sampled villages shows dominance of the economically productive population in Table 4.1. Respondents aged 31–45 years accounted for 146 respondents (38.0%), making this the most dominant age group. This was followed by the 46–60 years category with 112 respondents (29.2%). Respondents aged 18–30 years constituted 86 respondents (22.4%). The least represented group was 61 years and above, with 40 respondents (10.4%). The dominance of the 31–60 years age group indicates that mangrove-related livelihoods are largely sustained by active and productive individuals. The concentration of these age groups in advantaged villages reflects stronger livelihood opportunities that retain active labour. The age distribution shows that the majority of respondents fall within the economically active age group of 31–45 years (40.6%) and 46–60 years (29.2%). This indicates that mangrove-related livelihoods are predominantly sustained by adults in their productive years. Similar age structures have been reported in coastal and fishing communities in Nigeria and other developing countries, where middle-aged populations dominate natural resource-based occupations due to their physical capacity and experience (Allison and Ellis, 2001; Adekola *et al.,* 2015). The relatively lower proportion of youths (18–30 years) may suggest rural–urban migration in search of alternative livelihoods, a trend commonly observed in coastal regions (FAO, 2018).

Gender distribution across villages indicates male dominance numbered 236 (61.5%), while the Female respondents accounted for 148 (38.5%). Male respondents dominated in fishing-oriented villages such as Ukpenekang, Idung Assang, Esin Offot, and Iko Town, where they constituted over 65% of respondents. Female participation was relatively higher in Ibaka, Enwang, and Okobo Ebughu, where women were more engaged in fish processing, trading, and non-timber resource collection. This reflects traditional gender roles in coastal communities, where men dominate extractive activities while women engage in post-harvest and supplementary livelihood activities. Gender composition reveals a male-dominated sample (64.6%), reflecting the gendered nature of mangrove-based livelihoods, particularly fishing and wood harvesting. This finding aligns with previous studies that identify men as the primary actors in extractive activities, while women are more involved in processing, trading, and household-level utilization of mangrove products (Glaser, 2003; Chukwuone *et* *al*., 2012). However, the substantial proportion of female respondents (35.4%) underscores the important but often underrepresented role of women in coastal livelihood systems. The marital status distribution shows a predominance of married respondents of 254 (66.1%) followed by 78 (20.3%) Single respondents and 32 (8.3%) Widow/Widower then Divorced 20 (5.2%). Married respondents were particularly dominant in advantaged villages, where stable mangrove-related incomes support household formation. High marriage rates suggest that mangrove-based livelihoods provide social and economic stability for households in the study area. Marital status data indicate that a large majority of respondents are married (66.7%), suggesting relatively stable household structures. Married households often have higher livelihood responsibilities, which may increase dependence on natural resources for income and subsistence (Ellis, 2000). Widows, widowers, and divorced individuals together account for 14.6%, a group that may be particularly vulnerable to livelihood shocks and environmental degradation, as reported in other mangrove-dependent communities (Badola *et al*., 2012).

Occupational structure reveals livelihood specialization of 172 respondents (44.8%) fishing followed by 98 respondents (25.5%), 76 respondents (19.8%), and 38 respondents (9.9%) in trading, Farming and Civil service respectively. Fishing dominated in Ukpenekang, Idung Assang, Esin Offot, and Iko Town, accounting for over 55% of respondents in these villages. Farming was more common in other villages. This means that proximity to mangrove ecosystems strongly influences occupational choice, with fishing emerging as the dominant livelihood where mangrove resources are abundant. Occupation patterns further highlight the central role of mangrove ecosystems in sustaining livelihoods. Fishing is the dominant occupation (42.2%), followed by trading (25.0%) and farming (21.4%). This occupational structure confirms the economic importance of mangrove ecosystems as breeding and nursery grounds for fish and other aquatic resources (Alongi, 2014). Similar dominance of fishing livelihoods has been documented in coastal areas of the Niger Delta and other parts of West Africa (Ajonina *et al*., 2008; Nwankwoala *et al*., 2019). The presence of traders also reflects value-chain activities linked to fisheries and mangrove products. Educational attainment varied across villages as Primary education has 142 respondents (37.0%) seconded by Secondary education with about 126 respondents (32.8%). while Number with no formal education gave a (19.3%) and 10.9% respondents with Tertiary education. This indicates that Tertiary education was more common in Ukpenekang, Idung Assang, and Iko Town, while no formal education was higher in other villages. By interpretation lower educational attainment reinforces dependence on natural-resource-based livelihoods, particularly mangrove ecosystems. Educational attainment among respondents is generally low to moderate, with most having primary (34.9%) or secondary education (28.1%), while only 11.5% attained tertiary education. A significant proportion (25.5%) has no formal education. Low educational levels are characteristic of many rural coastal communities and are often associated with limited livelihood diversification and high reliance on natural resources (Béné *et al*., 2010). This pattern suggests potential constraints in adopting alternative income sources or sustainable resource management practices that require technical knowledge. Household Income distribution highlights economic disparities showing 27.1% for < ₦10,000, ₦10,000–₦20,000 (35.9%), ₦21,000–₦30,000 (21.4%) and ₦40,000 and above (15.6%) respectively for income derived. The higher income categories were concentrated in villages, particularly Ukpenekang and Idung Assang. This means that mangrove-based livelihoods significantly enhance income levels in villages with strong market access and productive ecosystems. This implies that income distribution indicates generally low household income levels, with the majority earning between ₦10,000–20,000 (37.0%) and less than ₦10,000 (32.3%) monthly. Only 10.4% earn ₦40,000 or more. These findings point to widespread economic vulnerability and poverty, which have been widely reported in mangrove-dependent and small-scale fishing communities (Allison *et al.,* 2009; FAO, 2020). Low income levels often intensify pressure on mangrove resources, as households depend heavily on readily accessible natural assets to meet daily needs.

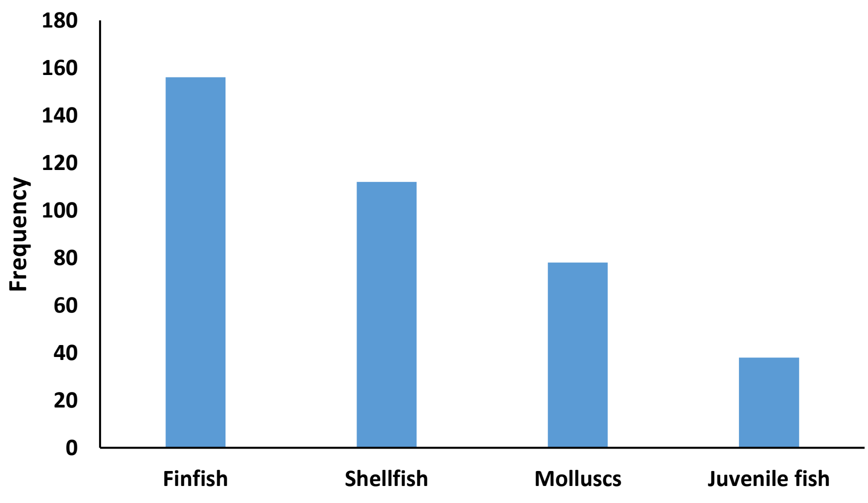

Figure 1: Fisheries Resources Obtained

Source: Field data (2025)

Finfish constituted the most harvested resource (38.0%; 146 respondents) and dominated in open-water and estuarine villages such as Idung Assang, Ukpenekang, and Esin Offot. Shellfish harvesting (29.2%; 112 respondents) was particularly common in mudflat and creek-side villages like Okobo Ebughu, Udesi, and Esuk Enwang, where periwinkles and crabs thrive. Molluscs (20.3%; 78 respondents) were moderately harvested across several villages, especially those with shallow mangrove swamps, serving as both food and income sources. Juvenile fish harvesting (12.5%; 48 respondents) was least reported but is environmentally significant, occurring mainly in high-pressure fishing villages, indicating potential overexploitation and future stock decline.

Table 2 Non Timber Resources at sampled Locations using Quadrant

Village	Periwinkles (m²)	Density (/m²)	Frequency (%)	Oysters (m²)	Density (/m²)	Frequency (%)	Crabs (m²)	Density (/m²)	Frequency (%)	Honey (m²)	Density (/m²)	Frequency (%)
Ufa Ewa	42.5	6.2	85	38	5.8	80	31	4.5	75	12	1.8	60
Esuk Okopedi	38	5.5	80	35	5	75	28	4.2	70	10.5	1.6	55
Ikot Ukpok	45	6.5	88	40	5.9	82	33	4.8	78	13	1.9	62
Ibaka	28	4	65	25	3.8	60	21	3.2	58	8	1.3	50
Ubotuong	40	5.8	82	36	5.2	78	30	4.3	73	11.5	1.7	58
Esuk Ewang	30	4.5	68	27	4	63	23	3.5	60	9	1.4	52
Obianga	22	3.8	60	20	3.5	55	18	2.8	52	7	1.1	48
Essin Offot	35	5	78	32	4.5	73	27	3.9	68	10	1.6	55
Inua Abasi	50	7	90	45	6.5	85	38	5.2	80	14	2.1	65
Usung	48	6.8	88	42	6	82	35	4.9	77	13.5	2	63

Village	Medicinal Plants (m²)	Density (/m²)	Frequency (%)	Fuelwood Resi	Density (/m²)	Frequency (%)	Raffia (m²)	Density (/m²)	Frequency (%)	Mangrove Fruits (m²)	Density (/m²)	Frequency (%)
Ufa Ewa	18	2.5	70	40	6	85	25	3.5	65	35	5	80
Esuk Okopedi	16	2.2	65	38	5.5	80	22	3.2	60	32	4.5	75
Ikot Ukpok	19	2.6	72	42	6.2	87	26	3.6	67	36	5.2	82
Ibaka	12	1.8	55	30	4.5	65	18	2.5	50	24	3.5	60
Ubotuong	17	2.3	68	39	5.8	82	23	3.3	62	33	4.8	78
Esuk Ewang	13	2	60	32	4.8	70	20	2.8	55	25	3.8	65
Obianga	10	1.5	50	25	3.8	60	15	2.2	45	20	3	55
Essin Offot	15	2.1	65	36	5.2	80	21	3	60	30	4.2	72
Inua Abasi	21	3	75	44	6.5	90	28	3.9	70	40	5.5	85
Usung	20	2.8	73	41	6	88	27	3.7	68	38	5.2	82

Source: Field data (2025)

The sampled mangrove swamp forests across ten villages of Ufa Ewa, Esuk Okopedi, Ikot Ukpok, Ibaka, Ubotuong, Esuk Ewang, Obianga, Essin Offot, Inua Abasi, and Usung shown in Table 2 revealed varied distribution of non-timber resources, including periwinkles, oysters, crabs, honey, medicinal plants, fuelwood residues, raffia, and mangrove fruits. Periwinkles, oysters, and crabs exhibited considerable variability in area coverage, density, and frequency of occurrence. Villages such as Inua Abasi, Usung, and Ikot Ukpok had the highest periwinkle coverage (48–50m²) with densities ranging from 6.5 to 7 individuals per m² and frequencies above 88%. Similarly, oyster and crab densities were highest in these villages, reflecting productive intertidal habitats suitable for benthic faunal communities. In contrast, villages like Obianga and Ibaka had lower values for area coverage, density, and frequency, indicating either higher anthropogenic pressure or less suitable ecological conditions for these species. Honey and medicinal plants were distributed in moderate coverage and frequency, with the highest values observed in villages with relatively intact tree canopies, such as Inua Abasi, Ikot Ukpok, and Usung. The density of honey-producing hives and medicinal plants was lower than faunal resources, reflecting the scattered nature of these resources and dependence on specific tree species.

Fuelwood residues were extensive in villages with greater tree cover, including Ufa Ewa, Inua Abasi, and Usung, suggesting active utilization of mangrove trees for domestic energy. The presence of fuelwood residues corresponds with areas of high tree density and highlights local dependence on mangrove wood. Raffia palms and mangrove fruits showed relatively even distribution across most villages, with slightly higher density and frequency in areas with intact mangrove stands. Villages such as Inua Abasi and Usung recorded coverage of 27–28m² for raffia and 38–40m² for mangrove fruits, indicating abundant availability of these resources for craft, food, and other livelihood activities. In view of these, the table indicates a heterogeneous pattern of non-timber resource distribution across the villages. Villages with intact or moderately disturbed mangrove forests support higher densities and frequencies of both faunal and floral resources, while villages under higher human pressure or environmental stress show reduced availability.

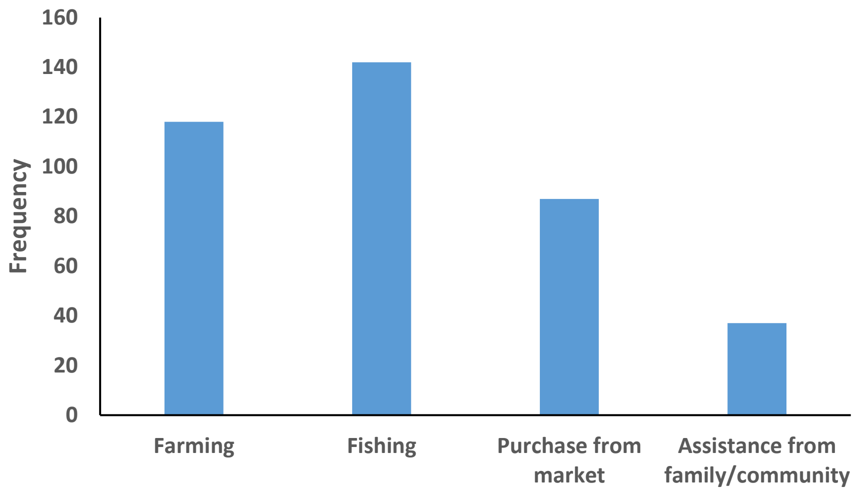

Figure 2: Main Source of Household Food

Source: Field data (2025).

Fishing was the main source of food for 38.0% of households, followed by farming at 32.3%. Market purchases accounted for 18.8% in Figure 2, while 10.9% relied on assistance from family or community, indicating mixed food sourcing strategies. This implies that, fishing remains the primary food source for most households, underscoring the centrality of mangrove-supported fisheries to food security, especially in riverine and coastal settlements.

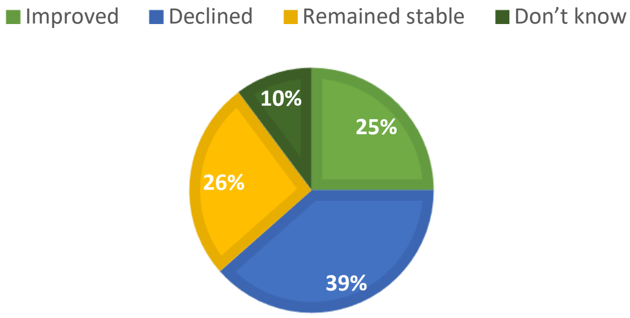

Figure 3: Change in Household Food Security

Source: Field data (2025).

Food security trends reveal concern in Figure 3, as 35.4% reported a decline in food security, while 27.1% observed improvement, 22.4% reported stability, and 15.1% were uncertain. This means that more than one-third of respondents reported a decline in food security, indicating growing vulnerability among mangrove-dependent households. This trend is consistent with declining fisheries yields and environmental stressors.

Table 3: Regression Model Summary

					Change Statistics					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.957[a]	0.916	0.622	25.80839	0.916	3.115	7	2	0.264	1.683

a. Predictors: (Constant), Mangrove_Fruits, Raffia, Fuelwood_Residues, Honey, Crabs, Periwinkles , Oysters

b. Dependent Variable: Livelihood

Source: Field data (2025).

The multiple regression model was used to examine the influence of selected mangrove resources (mangrove fruits, raffia, fuelwood residues, honey, crabs, periwinkles, and oysters) on livelihood outcomes in the study area. The results of the model summary indicate a very strong positive relationship between the predictor variables and livelihood, as reflected by a high multiple correlation coefficient (R = 0.957). The coefficient of determination (R^2 = 0.916) shows that 91.6% of the variation in livelihood is explained by the combined effects of the mangrove resource variables included in the model. This suggests that mangrove-derived resources play a substantial role in shaping livelihood conditions within the study communities. After adjusting for the number of predictors and sample size, the adjusted R^2 value dropped to 0.622, indicating that 62.2% of the variation in livelihood remains explainable when model complexity is taken into account. Although lower, this adjusted value still reflects a reasonably strong explanatory power given the limited degrees of freedom.

The standard error of the estimate (±25.81) indicates the average deviation of observed livelihood values from those predicted by the model, suggesting a moderate level of prediction accuracy. The change statistics show that the model produced an F-change value of 3.115 with degrees of freedom ($df_1 = 7$, $df_2 = 2$). However, the associated significance value (Sig. F Change = 0.264) is greater than the 0.05 threshold, implying that the overall model is not statistically significant at the 95% confidence level. This lack of statistical significance may be attributed to the very small residual degrees of freedom, which limits the robustness and inferential strength of the regression results. The Durbin–Watson statistic of 1.683 is close to the ideal value of 2.0, indicating no serious autocorrelation problem in the residuals and confirming that the assumption of independence of errors is reasonably satisfied.

Figure 4: Mangrove status of Herbs, saplings and young Nypa palm

Source: Field data (2025).

5. Conclusion

The study provides compelling evidence of a rapid landscape transformation within the coastal belt of Southern Akwa Ibom State. The persistent expansion of built-up areas, coupled with a continuous decline in mangrove and freshwater swamp ecosystems, indicates that anthropogenic activities—driven by urbanization and industrial oil-related pressures—remain the dominant drivers of change. While urban development contributes to the state's socio-economic growth, its current trajectory poses significant environmental risks, specifically wetland degradation, hydrological instability, and the erosion of vital ecosystem services.

The decline of the mangrove swamp forest is of particular concern due to its multi-sectoral role in coastal protection, biodiversity conservation, carbon sequestration, and primary livelihood support. Similarly, the reduction of freshwater swamps undermines natural flood regulation and water quality, increasing the vulnerability of communities in Ibeno and Mbo to climate-related hazards. Structurally, the mangroves are undergoing a transition characterized by uneven tree cover and the aggressive invasion of *Nypa fruticans*, which hinders the regeneration of native species like *Rhizophora*.

Furthermore, the study concludes that while mangrove resources are indispensable to the socio-economic well-being of coastal households, they are currently subjected to unsustainable overexploitation. The high dependence on these resources, combined with weak policy enforcement, creates a precarious balance. However, the high level of conservation awareness and the resilience of indigenous management practices among the people of Eastern Obolo provide a strong foundation for future governance. Ultimately, the study finds that livelihoods are not tied to a single resource but to a diversified combination of mangrove uses. Therefore, ensuring long-term environmental security requires an integrated approach that balances ecological protection with livelihood diversification.

6. Recommendations

To mitigate further degradation and enhance the resilience of the Southern Akwa Ibom coastal ecosystem, the study recommends the following:

i. Community-based mangrove conservation and restoration programs should be strengthened. This includes regulating fuelwood harvesting and incentivizing the replanting of native mangrove species, particularly *Rhizophora racemosa* and *Avicennia* species, in villages identified with poor natural regeneration.

ii. Targeted biological or manual control measures for *Nypa fruticans* should be implemented in heavily invaded areas. Reducing *Nypa* density will create the necessary space for native saplings to establish, thereby improving long-term forest resilience and ecosystem service delivery.

iii. Local indigenous knowledge and community by-laws should be integrated into formal state conservation policies. Government agencies should provide the necessary technical assistance, monitoring tools, and legal enforcement to curb illegal logging and unsustainable "mangrove mining."

iv. To reduce the direct extractive pressure on the forest, sustainable alternative livelihood options must be promoted. These include transitioning from wild-caught fisheries to integrated mangrove-friendly fish farming and promoting alternative household energy sources (e.g., LPG or solar-powered drying kilns) to reduce the reliance on mangrove wood for fish smoking.

v. The Akwa Ibom State government should incorporate continuous geospatial monitoring into its urban planning frameworks. This will allow for informed, data-driven decision-making to prevent the unchecked encroachment of built-up areas into sensitive wetland and mangrove zones.

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