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Evaluating human pressure on mangrove vegetation in Nigeria: a case study of the Niger Delta

Bashir Shehu Abubakar

WORLD MARITIME UNIVERSITY
Malmö, Sweden

EVALUATING HUMAN PRESSURE ON MANGROVE VEGETATION IN NIGERIA: A CASE STUDY OF THE NIGER DELTA

By

ABUBAKAR, BASHIR SHEHU
Nigeria

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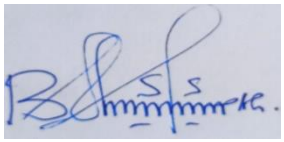
Declaration

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

(Signature): 

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Abstract

Title of Dissertation: **Evaluating Human pressure on Mangrove vegetation in Nigeria: A case study of the Niger Delta**

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Mangroves are vital to human society because they provide a variety of goods and perform essential ecological services. They help stabilize coastlines, sustain near-shore fisheries' food chains, offer residents fish and shellfish, and sequester carbon. They also provide a habitat for various fish species. In addition to providing food and shelter, they also provide the local communities with honey, medicinal benefits, and fuel.

Despite mangroves' many societal, economic, and ecological benefits, their destruction is a common practice in Nigeria's Niger Delta. Overexploitation, oil spills, and crude oil exploration are some of the anthropogenic activities contributing to this problem. These actions have disrupted coastal system stabilization in the Niger Delta region and harmed people's ability to make a living.

This study aims to examine the activities that some of the mangrove-dependent communities in a portion of the Niger Delta engage in, which exert more strain and pose more danger to the mangrove forests in these communities. Abonnema, Buguma, and Bonny are the three communities from the state of Rivers that were selected for the research. The other two localities were from the state of Bayelsa (Brass and Nemba).

Using Relative Importance Index Analysis, these areas will be used to study the importance of mangroves to the household economy and to have a broader understanding of the level of mangrove dependency in these communities. This will also enable us to know which of the mangrove ecosystem goods and services are the most important to the local resource users (the ones facing more human pressure than the rest of the ecosystem).

KEYWORDS: Niger Delta, Mangrove Forests, Mangrove goods and Services, provisioning service, human pressure on mangrove forests

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List of Abbreviations

FME	Federal Ministry of Environment
MEA	Millennium Ecosystem Assessment
NDBMG	Niger Delta Budget Monitoring Group
NDBP	Niger Delta Biodiversity Project
NDDC	Niger Delta Development Commission
NBDSAP	National Biodiversity Strategic Action Plan
NGO	Non-Governmental Organisation
NOAA	National Oceanic and Atmospheric Administration
OSGM	Ocean Sustainability Government and Management
REC	Research Ethic Committee
SPDC	Shell Petroleum Development Company
TRCC	Tropical Research and Conservation Centre
UN	United Nations
UNEP	United Nations Environmental Programme
UNEP-WCWC	United Nations Environmental Programme World Conservation Monitoring Centre
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organisation
WACA	West Africa Coastal Area Management Programme
WEFORUM	World Economic Forum
WHO	World Health Organisation
WMU	World Maritime University

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

Mangroves are a variety of tropical and subtropical plants and shrubs that have acclimated to the harsh environment between the sea and the land; their usual home is a muddy river estuary (NOAA, 2021). A mangrove ecosystem is a forest unique in its adaptation to salty water and produces substantial amounts of vegetation that supplies food for other organisms (Sandilyan & Kathiresan, 2012a). Mangrove trees essentially serve to stabilize the mud in which they grow by trapping material introduced by rivers and tides (Golam, 2013). They can provide a surface for oysters and barnacles to grow on (Minchinton & McKenzie, 2008), a habitat for insects (Abdul, 2015), and places for birds to nest (Buelow & Sheaves, 2015). Most importantly, through photosynthesis, mangroves provide energy for an ecological community of various species. As a result, the mangrove ecosystem is one of the world's most resourceful and biologically diverse (Hogarth, 2015). There are numerous ways in which mangrove forests contribute directly to the well-being of rural communities, such as: providing firewood, timber, thatching materials, poles, and furniture materials; glue; wax; glue; wax; fish; shrimp; fruits; fodder; vinegar; synthetic fibers; medicines; paper; and tourism (Golam, 2013).

However, despite all the ecosystem services (Providing service, Regulatory service, supporting service, cultural service) rendered by the Mangroves forests (MA, 2015), Climate change, natural disasters like hurricanes, and human activities, such as deforestation, pollution, and changes in freshwater management regimes all threaten these ecosystems and their inhabitants (Sarhan & Tawfik, 2018). The last two decades of the twentieth century saw a 35% decline in mangrove tree populations across the globe (MEA 2005). There is a perception among some people that mangroves are of very little significance (Dahdouh-Guebas et al. 2005). The primary policy tool needed to maintain mangrove forests' goods and services is the formation of protected areas. It is worth knowing that conservation rather than restoration of mangroves is much more cost-effective (Webber et al. 2016). In 2005, only 19 percent of mangroves were in conservation areas (Chape et al. 2005). Environmental decision-making is becoming increasingly reliant on evaluating the economic worth of ecosystem services (Vo et al. 2012).

1.2 MANGROVE ECOSYSTEM

The biological significance of mangrove forest ecosystems is as a result of the inter-tidal ecotones of estuaries couple with the dynamism of temperatures, variety of habitats, fluctuating water levels etc.; all of these traits make the mangrove ecosystem a biodiversity hotspot (Getzner & Islam, 2020). Mangrove forests offer significant and distinctive ecosystem goods and services, making them amongst the most beneficial and biologically significant ecosystems on earth (Golam, 2013). According to Field (1999), the diverse tropical plants and shrubs that make up the ecosystem of mangrove forests can be found in areas of the world with coasts, marshes, and creeks. In these regions, Mangrove are the main primary source of productivity and It is because of their presence that other organisms can thrive (Kathiresan & Brian, 2001). Alternatively, mangroves serve as the ecosystem's primary energy source and physical foundation. Mangrove fauna are unique in that they contain both marine and land-based organisms (Simon, 2013). Although mangroves only account for 0.7% of the world's forests, they can store nearly 2.5 times as much CO_2 as the world's population does annually (Golam, 2013). Mangroves are a type of vegetation that covers much coastal territory around the world, with the most significant portions being in Brazil, India, Malaysia, Nigeria, Senegal, and Venezuela (Metras, 2011).

1.3 SPECIES OF MANGROVES

A total of 80 species of True mangrove trees and shrubs are known, primarily found in intertidal regions between the high water levels of neap and spring tides, and 50–60 of those species significantly contribute to the composition of mangrove forests. Southeast Asia has the highest species diversity, containing more than two-thirds of all species, compared to Africa and the Americas, where about 10 and 15 species exist respectively (Field, 1995).

A variety of edaphic influences, such as geophysics, climatic conditions, geographic location, biogeography, geology, hydrography, and environmental influences, affect the species composition and structure of mangrove forests (AIMS, 2019). There are two categories of mangroves: mangroves associates, which are glycophytes with specific salt tolerance, and true mangroves, which are halophytes. Mangroves associates naturally occur along the landward edges of mangrove habitats, while true mangroves grow only in the intertidal areas (Chanda et al., 2015). Others classify mangroves as any ground fern, palm, tree, or shrub that grows typically in the inter-tidal zone of tropical coastal or estuary habitats and is taller than 0.5m (Polidoro et al., 2014). According to Tomlinson (2016), most of the mangrove forests on earth are made up of the genera *Avicennia, Lumnitzera, Bruguiera, Ceriops, Kandelia, Rhizophora*, and *Sonneratia*, as well as the species *Nypa fruticans* and *Laguncularia racemose*. The species compositions of the

West African mangroves are more like those in the western Atlantic. Several indigenous species include *Laguncularia racemose, Rhizophora racemose, Rhizophora mangle,* and *Rhizophora harrisonii*. In addition, *Nypa fruticans* is one of the invasive species (Emma & Neil, 2022).

Countries	*Acrostichum aureum*	*Avicennia gerninans*	*Conocarpus erectus*	*Laguncularia racemose*	*Nypa fruticans*	*Rhizophora harrisonii*	*Rhizophora Mangle*	*Rhizophora Racemose*	*Total Species*
Nigeria	x	x	x	x	x	x	x	x	8
Benin	x	x	x	x	-	-	x	x	6
Togo	-	x	x	-	-	-	-	x	3
Ghana	x	x	x	x	x	x	-	x	7
Cotedl voire	x	x	x	x	-	-	-	x	5
Liberia	x	x	x	-	-	x	x	x	6
Sierra Leone	-	x	x	x	-	x	x	x	6
Guinea	x	x	x	x	-	x	x	x	7
Guinea Bissau	-	x	x	x	-	x	x	x	6
Gambia	x	x	x	x	-	x	x	x	7
Senegal	x	x	x	x	-	x	x	x	7

Table 1 *above shows the distribution of Mangrove species across West African States; where* ***(x)*** *from the table represents present of a specific species while* ***(-)*** *represent absent of a species (Christopher & Charles W., 2018).*

In Nigeria, only six (6) true species of mangrove plants from three of the world's most recognizable families are found:

- **Rhizophoraceae:** (*Rhizophora racemosa, Rhizophora harrisonii*, and *Rhizophoramangle*)
- **Avicenniaceae:** (*Avicennia germinans*)
- **Combretacceae:** (*Conocarpus erectus* and *Laguncularia racemosa*)

There are many Mangrove associates such as: the mangrove sedge (*Paspalum vaginatum*), mangrove fern (*Acrostichum aureum*), date palm (*phoenix reclinata*), and the invasive nipa palm (*Nypa futicans*) in the Niger Delta, out of which screw pine leaves are used in making mats (Zabbey et al., 2019).

1.4 MANGROVE ECOSYSTEM GOODS AND SERVICES

The circumstances and processes by which natural ecosystems and organisms sustain and fulfill human life are known as ecosystem services. They preserve biodiversity and produce ecosystem goods like fish, fodder, wood, biomass fuels, natural fiber, numerous medications, industrial products, and their precursors (Gretchen, 1997). Mangrove ecosystems in tropical coastal locations function as nurseries for scores of fish species and as nesting grounds for some mammals, ants, reptiles, fish, and birds alike (Marina & Sylvie, 2021). There are a wide variety of ecosystem services provided by mangrove forests. Their role in providing ecosystem services (ES) to local and regional coastal communities, as well as improving those communities' livelihoods, cannot be overstated. Mangrove forests ecosystem services are categorized into Four forms:

- Provision Ecosystem Services 'PES' (e.g., Horney, wood, and timber)
- Supportive Ecosystem Services 'SES' (e.g., Habitats as a nursery for fish species and breeding)
- Regulatory Ecosystem Services 'RES' (e.g., Erosion control and protection from floods and storms)
- Cultural Ecosystem Service ‘CES’ (e.g., Spiritual, Aesthetic, Educational and Recreational)

In addition, ecosystem services such as regulating nutrient and carbon cycles and providing cultural ecosystem services are of great global importance (M. Brander et al., 2012; Getzner & Islam, 2020; MA, 2015).

1.4.1 EXAMPLE OF GOODS AND SERVICES OF MANGROVE FORESTS

1. Coastal protection

By reducing the force of waves, mangrove forests also help prevent the shoreline and inhabited areas (Brinkman et al., 1997, Quartel et al., 2007). However, several coastal habitats are in danger due to climate change-related sea level swings (Alongi, 2008; Cohen et al., 2016). According to Rossetti and colleagues in 2008 and 2012, the swings may impact the distribution of mangrove habitats along coastlines and the relocation of all interdependent coastal ecosystems (IPCC, 2001). Sea level rise, in addition to having a negative impact on mangroves, also poses a severe danger to intertidal wetlands, salt marsh habitats, and adjacent ecosystems (Cohen et al., 2016; Nicholls & Tol, 2006). These unfavorable circumstances can alter mangrove zonation and movement from the shoreline to the landward side of maritime zones (Gilman et al., 2006). Storm surges also contribute to the decline of the ecosystem and the shrinking of mangrove areas

following sea level rise, and their combined impacts may speed up the landward migration of the mangroves (Ellison, 2000). Floods may result in the demise of mangroves and accompanying flora and related habitats due to land restrictions and vertical rises in water levels ((Jagtap & Nagle, 2007). Therefore, it is imperative to consider the mangrove belt's vulnerability to the effects of climate change and relevant occurrences, which negatively influence coastal habitats (Bijlsma, 1997). In addition, the filtration process by the mangrove roots prevents sediment from reaching seagrass meadows and the coral reefs; this serves as a suitable means for preserving the marine ecosystem. Around 2.4 billion people live within 100 kilometers of the coast, according to the UN Ocean Conference in 2017. As a result, mangroves are a valuable resource for communities at risk of flooding and other natural disasters due to sea level rise and other effects of global warming (Simon, 2013; Weforum, 2019).

2. *Carbon sinks*

Gases known as greenhouse gases (GHGs) are essentially blamed for the planet's warming and the subsequent climate change, and the most common greenhouse gas is carbon dioxide (Bartoli et al., 2020). Coastal forests mitigate this climate change by removing atmospheric carbon dioxide and storing it in the plant's biomass and the surrounding soil (Getzner & Islam, 2020). According to SOFIA (2022), carbon sink is typically described as carbon's organic absorption and storage by vegetated coastal ecosystems (salt marshes, seagrass meadows, and mangroves). As these plants grow, they absorb atmospheric carbon dioxide through the process of photosynthesis and also by capturing carbon-rich particles from other sources and using them as building blocks for their leaves, roots, and branches, hence the storage (Candy, 2018). Mangroves and salt marshes' carbon extraction from the atmosphere is at ten times the rate of tropical forests and store five times as much carbon per acre as tropical forests (Simon, 2013). Furthermore, when mangroves die, their roots, branches, and leaves often become covered by soil submerged in tidal water, slowing down the breakdown process, thereby storing more carbon and generating a carbon sink in the soil (Weforum, 2019).

3. *Social economic aspects*

Many coastal residents who live in mangrove forests rely on the resources provided by mangroves to make a living. However, deforestation threatens the forest's long-term viability because the trees are harvested for wood chips, charcoal, and pulp; while these occur, anglers exploit the forest to collect fish, crabs, and shellfish for financial gain (Simon, 2013; Weforum, 2019).

Furthermore, according to Bandaranayake (1998), mangrove trees are also commonly used as animal feed, and the local communities collect plant extracts for medicinal purposes.

4. *Ecotourism*

The preservation of mangroves can be encouraged by sustainable tourism, which can generate money for the residents. Activities such as sports fishing, kayaking, and bird-watching tours can take place in the forests, mainly located close to coral reefs or sandy beaches. Keeping tourist numbers under control is essential for preserving the fragile ecosystem of the forested areas. Ecotourism, if maintained at sustainable levels, would provide an ideal desire to protect mangroves rather than their clearing for mass land for tourism developments (Simon, 2013; Weforum, 2019).

5. *Mangrove ecosystems*

A mangrove ecosystem supports a variety of marine life, including fish, crabs, shrimp, mollusks, and mammals such as sea turtle, monkeys, antelopes and manatees. The trees serve as homes for nesting, breeding, and migrating birds (Onyena & Sam, 2020). Additionally, it serves as an ideal breeding ground for a wide variety of species due to their ability to filter sediments and provide nutrients from above and below the water's surface (Candy, 2018). This ecosystem contributes to; the enhancement of coastal fisheries, the promotion of tourism, the protection of coastlines (including protection of shorelines and seashores, maintenance of coastal and shoreline substrate, and safeguards of host communities from waves and severe weather conditions), and the prevention of natural calamities such floods, intense storms, sea level rise (Huxham et al., 2015; Barbier, 2016) However, the eradication of mangrove forests for various human needs threatens the existence of a wide range of species because of the destruction of the natural form of the ecosystem. We have lost enormous biodiversity worldwide due to anthropogenic activities and climate change effect consequently, putting many plant and animal species in jeopardy (Weforum, 2019).

1.5 THE NIGERIAN COASTAL ZONE'S GEOLOGY AND GEOMORPHOLOGY

Coastal zone is the area where land and sea meet, is defined by the shoreline; this land-sea interface is a complex management area because so many different activities, responsibilities, and interests are at play. Ocean resources can be found in the coastal zone, which is also a source of income for local populations and a habitat for rare species of plants and animals (P.C.

& G.O., 2011). The Nigerian shoreline stretches for about 853 km (from west to east), starting from the Seme border in Badagri to Ikang in Cross River State, gradually falling into the Atlantic Ocean. It is situated between latitudes 4°10′ to 6°20′N and longitudes 2°45′ to 8°32′E on the West Coast of Africa. The Exclusive Economic Zone, which can stretch up to 370 km (200 nautical miles) in length, has a surface size of 210,900 km2 compared to the 6500 km2 marine area of the coastline (Admin,2021)

Fig 1. Above shows the Nigerian Coastline, the distance it covers and all the coastal states eastward from west i.e. from Lagos to Cross River States. ***Courtesy: (Worldometer, 2022)***

Southern Nigeria's geography is low lying, with altitudes between 2 and 4 meters above mean sea level. It extends inland for around 15 kilometers (km) in Lagos, 150 kilometers (km) in the Niger Delta, and 25 kilometers (km) east of the Niger Delta (Adeaga, 2014)

Among the 36 states that comprise the federation, the Nigerian coastal zone consists of nine states: **Lagos, Ogun, Ondo, Edo, Delta, Bayelsa, Rivers, Akwa-Ibom and Cross River** (P.C. & G.O., 2011). It is believed that 25% of the country's population lives in these coastal states (WACA, 2019; P.C & G.O., 2011). Based on variations in morphological, vegetative, and beach-type attributes, the Nigerian coastal zone consists of four major geographic areas: the barrier

lagoon coast, the transgressive mud coast, the Niger Delta, and the strand coast, which runs from west to east (WACA, 2019; P.C & G.O., 2011).

1.5.1 Morphological Division of Nigerian coastline

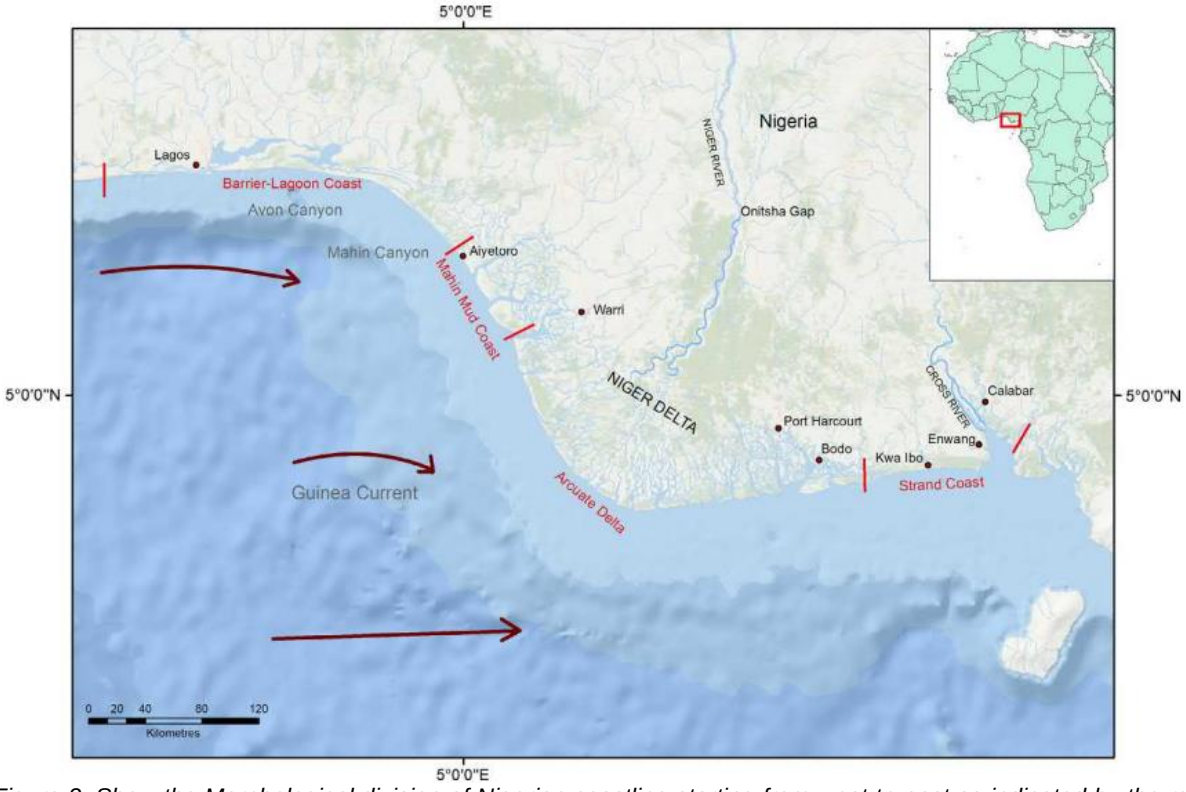

*Figure 2. Show the Morphological division of Nigerian coastline starting from west to east as indicated by the redline drawn along the cost as in figure 2 above; the Barrier-Lagoon, Mahin Mud coast, Acurate Delta and the strand coast**Courtesy: (Zabbey et al., 2019)***

1.5.1.1 ***The Coastal Complex of the Barrier-Lagoon***

The barrier-lagoon coast extends eastward for roughly 200 km from the Benin/Nigeria border to the west. The beaches along the shore in this area are medium-grained and only slightly well-sorted. With a typical tidal range of under 1.1 meters, this shoreline has a high energy level (i.e., the coast is micro-tidal). Typically, beach features are high and have well-developed berm complexes. Coconut and palm trees make up most of the scanty coastal vegetation. Typically, mangroves are not present (Ibe, 1988; Adeaga, 2014; Zabbey et al., 2019).

1.5.1.2 ***The transgressive mud coast of Mahin***

This mud beach stretches for roughly 75 km eastward from the barrier-lagoon coast's eastern edge, ending at the Benin River on the western flank of the Niger Delta. The majority of the silt on the mud beach is medium to coarse, poorly sorted, finely skewed, and plantykurtic to leptokurtic.

Mangroves are typically the dominant coastal vegetation here, but in places where either erosion or human activity has damaged the mangroves, the coast has become dominated by the hardy grass Paspalum vaginatum, which coexists with strands of stunted red mangrove and clumps of the fern Acrostichum aureum (H. Jesse, 1988; Adeaga, 2014).

1.5.1.3 ***The Arcuate Delta***

The Niger Delta, an arcuate delta, extends about 450 kilometers eastward from the Benin River to the mouth of the Imo River, where it empties into the Atlantic Ocean (Dada et al., 2018). As a result of the multiple river mouths and tidal inlets that cross the Nigerian coastline, the various beach ridge barrier islands flourish best here. The barrier islands are located off the coastline, about 5 to 35 kilometers in length and 2 to 10 kilometers in width. Island height varies but is usually around 2 meters above mean sea level due to sand ridges. The fine to magnificent, relatively well-sorted sand on the mostly level beaches measures roughly 150 meters in width. Microtidal seas and swells batter the barrier islands, making them particularly vulnerable (1.2 to 2 m tidal range). A mangrove swamp system predominates the creeks on the sides and behind the beach faces, while the beach ridges behind the faces are covered with lush rainforest trees and bushes (Ibe, 1988; Sexton & Murday, 1994; Adeaga, 2014; Zabbey et al., 2019).

1.5.1.4 ***The Strand Coast***

The strand coast, Nigeria's fourth geomorphic unit, extends 85 kilometers east from the Imo River to the Cross River Estuary near the Nigerian/Cameroonian border. From fine to magnificent, moderately well-sorted sand dominates the beaches in this area, which range in width from 50 to 75 meters. Tides in this area range between two and three meters (i.e., the coastline here is mesotidal.). Kwa Ibo River is the only significant snag in the uninterrupted horizon of the strand beach. The landscape appears to be covered with a variety of plants. Mangrove forests line the coast of the Cross River Estuary (Ibe, 1988; Awosika & Folorunsho, 2009).

1.6 THE NIGER DELTA

Map of the Niger-Delta Region in Southern Nigeria

Figure 3. This shows all the Nigerian States within the coast of the country that together form what is call the Niger Delta States as not all the State at coastline belong to this group. ***Courtesy: (Ebhuoma et al., 2020)***

In the southern region of Nigeria, on the Atlantic coast, between 40°2 and 60°2 north of the equator, and 50°2 east of the Greenwich meridian, lies the Niger Delta; this region lies in Nigeria's south-south geopolitical zone (Adekola & Mitchell, 2011). It covers an area of 211,000km^2 and it is made up of 853km long of coastlines surrounded by Mangroves (UNEP, 2011). The region is home to various habitats and a plethora of natural resources. Mangrove forests play a significant role in this regard. In addition, the Niger Delta is Nigeria's region that generates most of the country's annual revenue. This is made possible by the region's vast supplies of crude oil and natural gas. Despite this, oil and gas (O&G) exploration has had a significant negative impact on the environment of the Niger Delta. The activity has destroyed habitats, cause the extinction of plant and animal species, and the destruction of the means of subsistence for several resource users; the majority of whom make their living from farming and fishing (UNEP,2011).

As one of the largest arcuate river deltas in the world, the Niger Delta takes up half of the nation's coastline. There are 21 significant inlets in the Delta, which divide the shoreline into several barrier islands. Barrier islands are usually 15 to 20 km long and 3 to 5 km wide. The western part of the Delta has more formed barriers than the eastern part (Sexton & Murday, 1994).

Several things determine the amount of rainfall in the Niger Delta, such as the region's hilly topography and the continent's latitude. The annual rainfall in the area is between 3,000 and 4,500 mm and has an average temperature of 27 degrees Celsius. March through October is the wet season, with November through February being dry (World Bank, 1995; Okonkwo et al., 2015). The Niger River originates in the highlands of southeastern Guinea, not far from its border with Sierra Leone. It then flows in a crescent shape from Mali, through Niger to its border with Benin,

and finally into Nigeria, where it pours into the Gulf of Guinea via a massive delta of the Niger Delta. (Asanebi, 2016).

There is a crucial distinction between the Niger Delta and the "South-South Zone," which includes the states of **Akwa Ibom, Bayelsa, Cross River, Delta, Edo, and Rivers**, which are distinct geographical areas. A geopolitical location in which Nigeria's south-south zone is a part, the Niger Delta is home to the country's largest oil-producing region. As an oil-rich region, it has been the focus of international controversy over environmental and human rights violations, kleptocracy, and environmental pollution (NDBMG, 2022). A large amount of hydrocarbon deposit exists in the delta region. About 80% of Nigeria's export earnings come from crude oil produced in the delta region, which currently produces approximately 2 million barrels daily. The Nigerian oil industry ranks among the top ten oil producers in the world (and is a member of OPEC). Among the essential resources in the Niger Delta are the third-largest mangrove forest in the world, West and Central Africa's most extensive freshwater swamp forests, and Nigeria's last remaining primary forest, which harbors a high concentration of biodiversity and several endemism centers, as well as a vast supply of nonrenewable resources (Peterside & Ogon, 2001)

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1.7 COMPOSITION OF MANGROVE SPECIES IN THE NIGER DELTA

According to ITA et al., (2005) the swamp in the Niger Delta, thoroughly interrelates with the creeks and rivers, contributing significantly to the nutrients and organic matter used by the mangrove ecosystem for nourishment; to boost their biomass, the primary producers use this abundant nutrient resource. The three most prevalent mangroves found in Niger Delta are the red (Rhizophora racemosa), black (Laguncularia racemosa), and white (Avicennia germinans). However, other species of mangroves can also be found within the forest (Numbere, 2018).

As such Akpovwovwo & Gbadegesin, (2021) narrated that the tallest mangroves species in the Niger Delta region is the red mangroves (Rhizophora mangle). It could reach a height of 25 meters, with blunt tips and long leaves that are broad and 12 centimeters long. Its most distinctive features are the "prop roots" and "drop roots" that grow from the branches of the red mangrove. Propagules, or seedlings, are about 15 centimeters long and cigar-shaped (Numbere, 2019). Small ballpoint pen-like vertical root shoots called pneumatophores categorize the black mangrove (Avicenia germninans), which can be found near the red mangroves. Located at the upper tide line, compact clusters of all these shots of root allow mangroves to acquire oxygen from the air (ITA et al., 2005). On the higher ground, just above rising water marks and behind the red and black mangroves, the white mangroves (Languncularia racemosa) can be found. In

addition to being succulent and thick, its leaves are rounded at both ends and are the same color. When looking at the roots, you'll see a system similar to most terrestrial plants (Numbere, 2019).

1.8 GOODS AND SERVICES OF MANGROVE ECOSYSTEM IN THE NIGER DELTA

Protected by estuaries, lagoons, and creeks, the mangrove environment of the Niger Delta is home to a wide variety of plant life that has adapted to survive in low-oxygen, salty soil (Omogoriola et al., 2012). More than 70% of Nigeria's about 10,000 km2 of mangroves (NDBP, 2012) and over 35% of total West African cover may be found in the Niger Delta's lower tidal floodplain, where there are also more than 20 significant estuaries and 7,700 km2 of mangrove forests (UNEP-WCWC, 2006; Omogoriola et al., 2012).

In the Niger Delta region, mangrove ecosystems play a vital ecological function while providing a wide range of services for human well-being. The services rendered are economic, environmental, and social benefits, which are all interconnected (Akanni et al., 2018). For example, the indigenous people use mangroves for various purposes, such as firewood and building materials, as well as medicinal and food-related products (Numbere, 2018). Mangrove forests are harvested for their timber used for both civil construction processes (boat creation, house construction, and bridges), and due to their high energy content, the woods are used as fuel (Zabbey et al., 2019).

However, in the Mangroves forests of Nigeria and many other African Nations, many species of mammals, birds, and reptiles are being hunted unsustainably for meal, skin, and cultural beliefs. Mangrove ecosystems are as well vital to the survival of the marine benthic population because of the organic substances and nutrient flow they provide (Das et al. 1997). Commonly in the Niger Delta, mangrove ecosystems provide ideal breeding grounds for much fish, shrimp, crabs, and other shellfish and are also utilized for fish farming (ITA et al., 2005). Accordingg to Bandaranayake (1998) findings various mangrove species in Nigeria have been used for cultural purposes and medicinally. Some of the mangroves' ecological and environmental benefits are the hydrological cycle, carbon fixation, sediment control, and storm buffering (Gilbert and Janssen 1998). Removing wastewater containing heavy metals is an important role that mangroves play. Heavy metals in mangrove soil can be stored in inaccessible forms (Tam and Wong 1996). Poles and tanning material are just some of the mangrove's reported economic benefits, as Blasco et al. (1996) reported.

1.9 THREATS TO MANGROVE ECOSYSTEM IN NIGERIA

The mangrove ecosystem is important in a wide variety of ways; by supplying local populations with food, medicine, construction materials, wood for fuel, as well as acting as a habitat for commercial and non-commercial species of fish while establishing coastal protection against storm surges, and acting as a storage facility for carbon, known as "blue carbon" (Ghosh S, 2015; Veettil et al., 2019). However, despite all the great goods and services the mangrove forests offer, they are fast decreasing due to the conversion of land for agricultural purposes, the urban development of coastal areas, pollution by the coastal industries, and overharvesting of the mangrove resources. According to some projections, one-fourth of the world's mangrove forests have disappeared over the last 40 years. This has significantly affected many species of birds, fish, mammals, and insects. It has also resulted in enormous losses for the vast numbers of people who frequently use and rely heavily on mangroves in the world's tropical regions (UNEP-WCMC, 2020).

Many people around the globe, including Nigeria, continue to consider wetland areas as valueless or rather wastelands; as a result, the wetland areas tend to be destroyed or altered to serve other purposes (Adekola et al. 2012). In most cases, the loss of mangroves results from over-exploitation, cutting, and pollution (Saenger et al. 1983). However, in some areas, the loss of mangroves results from natural factors such as coastal erosion, persistent inundation, and elevated salinization, all of which are associated with sea level rise (Saenger et al. 1983; Blasco et al. 1996).

Corcoran et al. (2007) stated that Nigeria's mangroves have declined by 26 percent in recent years. Which is as a result of multiple factors, both natural and human-made, contributing to Nigeria's diminishing mangrove forests; Population growth, fast urban settlement, oil exploration & exploitation, industrial waste contamination, unchecked ploughing for crop yields, overgrazing, timber production, land reclamation, roads construction, dam creation, and other infrastructure projects are all examples of anthropogenic influences (Uluocha and Okeke 2004). Wetland reclamation projects taking place in the Niger Delta and south of Lagos have increased dramatically due to rising demand for beachfront real estate, growing population search for shelter, with limited land available (Adekola et al. 2012). Climate change, marine and coastal erosion, subsidence, ocean water intrusion, invasion by non-native biota, desertification, anddroughts are all-natural issues (Lamond et al., 2019)

Based on a survey of relevant research and accounts from experts in the field, the top four causes of Mangrove ecosystem degradation in the Niger Delta are Exploitation of oil and gas, reclamation of wetland for construction of homes and other infrastructure, dredging, and the spread of alien

species of plants like the Nypa palm (Godstime et al., 2007). Oil and gas exploitation poses the greatest danger to this environment; unfortunately, Nigeria's mangrove forests continue to be one of the most vulnerable wetland types in the country (Paulinus & Aju, 2021).

1.10 GOVERNANCE AND MANAGEMENT OF MANGROVE FOREST IN NIGERIA

Mangrove forests, when managed effectively, have several advantages, including the maintenance of biological diversity, the preservation of the environment, the promotion of social justice and community growth, and the instalment of a sense of accountability in those who have a stake in the forest (FAO, 1994). As such, to have an effective management system, legislation (including enforcement of rules of Law) must be in place and be followed (Van Lavieren et al., 2012). Legislation mandating sustainable resource control typically includes guidelines and policies outlining how that legislation will take effect at different tiers of government (Feka, 2015). Several international policies, including the Convention on Biological Diversity (CBD), the Ramsar Convention on Wetlands (Ramsar), and the UNEP Global Program of Action for the Protection of the Marine Environment from Land-Based Activities, all of which Nigeria is a signatory. Despite several of these and other regulatory frameworks aimed at protecting Niger Delta ecology (Ebeku 2004; Ugochukwu and Ertel 2008), damaging actions nevertheless occur. Perhaps it is surprising that potential consequences to a vital ecosystem prove challenging despite the legal framework for protection and conservation. The political-economic forces may be to blame, according to Blaikie (1985). Undeniably, the economy of Nigeria relies heavily on crude oil from the delta; consequently, all administrative, political, and economic precautions are taken to ensure that exploration and production operations are protected from undesirable interference (Ebeku 2004). Thus, informal institutions truncate the effectiveness of formal and legal institutions. Thus, it is necessary to examine the political aspects of the transformation of the wetlands in the Niger Delta (Bryant and Bailey 1997; Forsyth 2004; Robbins 2004).

A better method of conserving mangroves and other coastal resources and ensuring their sustainable use is implementing an integrated coastal area management process that incorporates logical policy development, environmental regulations, and coordinated action through restoration and environmental awareness campaigns. (Chua and Scura 1992). In order to accomplish this, in-depth knowledge must be acquired of the wetland's ecosystem services and the dangers to which it is vulnerable. Unfortunately, while this region is blessed with many natural resources, the best available information focuses on its abundant crude oil and gas reserves. Therefore, as much as we understand the big picture regarding wetland ecosystem

services, change drivers, and subsequent impacts, more localized information is needed to formulate a sustainable strategic plan (Boavida 1999; Ostrom et al. 2007).

1.11 THE RESEARCH AIMS AND OBJECTIVES

This research will assess the value of the mangrove ecosystem's goods and services to the people of Abonnema, Buguma, Bonny, Brass, and Nembe, as well as the factors that affect these forests in the states of Rivers and Bayelsa, home to the largest mangrove areas in the Niger Delta region.

Research questions specific to the topic:

1. In what ways does mangrove vegetation affect the lives of the local communities?
2. What are the effects of human activity on Mangroves?
3. What government policies and regulations are in place for managing and protecting Mangrove vegetation in the Niger Delta?

As a result of the subject's nature, primary data will be gathered from local communities directly to learn the most recent information regarding resource utilization and ecosystem degradation in the mangrove forests. This will allow us to assess the driving forces behind resource over-usage and the obstacles that prevent the proper management of the mangrove ecosystem in the Niger Delta region. Therefore, this suggests that the information gathered will only be utilized to carry out this study. A comprehensive data collection process is essential to the quality and reliability of a study.

Specifically, a two-part study question will assess the value of the goods and services provided by mangrove ecosystems to local resource consumers. As a first step, we will analyze how mangroves rank in relevance to household income compared to alternative sources of income. This will provide a broader framework for assessing the reliance on mangroves in the immediate area. The second step is gauging local consumers' value placed on various components of the mangrove ecosystem. The final step will be to find out how resource users feel about reforestation and how they feel about getting involved. That will help the study's overarching goal of better understanding the mangroves' significance and the urgency of starting a conservation and rehabilitation project.

CHAPTER 2

2.0 MATERIALS AND METHODS

The Research began with formulating research questions pertinent to the subject area, followed by identifying relevant literature based on the construction of guidelines and searching for articles relevant to the keywords: Evaluating Human pressure on Mangroves vegetation in Niger Delta. A comprehensive literature assessment in the preceding chapter was carried out to identify the gaps and prompted the need to address the research questions generated. Therefore, this Section of the research will approach to discuss: the study area, research framework, research-ethics, collection of data, formation of the survey questionnaire and interviews, and data analysis methods adopted to process the collected data to address the research questions; and limitations of this research.

2.1 STUDY AREA

The demand for resources by humans from Mangrove vegetation must be effectively managed and regulated. Otherwise, some of the Mangrove forests that have not already suffered damage by oil spillage in the Niger Delta region may be disturbed due to other excessive human activities as the population in Nigeria's coastal communities rises (Numbere, 2021). As such, five rural mangrove-dependent communities in the Niger Delta region that are little or not affected by oil spillages were identified; three in River State (Abonnema, Buguma, and Bonny) and two in Bayelsa (Brass and Nembe). These areas will be used to study the importance of mangroves to the household economy in relation to other livelihoods and to have a broader understanding of the level of mangrove dependency in these communities. This will also enable us to know which of the mangrove ecosystem goods and services are the most important to the local resource users (the ones facing more human pressure than the rest of the ecosystem).

2.2 RESEARCH ETHICS

Data collection from human participants is a common focus of social science research. This naturally prompts ethical concerns regarding how researchers ought to approach data subjects. Developing an ethical approach to research planning and execution appears to be receiving more attention, and the research community is getting more sophisticated in addressing such concerns (Paul, 2010). As a result, the WMU Ethics Committee rigorously reviewed and scrutinized the survey questionnaire to verify its compliance with the highest ethical standards before it gained the go-ahead for use. The survey participants' privacy and rights are protected by ensuring their

anonymity, confidentiality, data protection, and the ability to withdraw from the survey anytime. Participation and contribution were explicitly stated to be voluntary and free of charge. All data collected and used for this study will be destroyed after the dissertation is submitted, with no changes made.

2.3 COLLECTION OF DATA

In order to get the most up-to-date information on human pressure exacted on the Mangrove ecosystem of the selected coastal communities, we need original data collected from the community dwellers directly. Hence, we can better understand which is the most needed of all the Mangrove ecosystem services; which might be under serious threat if not properly managed and regulated. According to Igwenagu (2016) and Alvesson & Sköldberg (2017), the data gathered for this research was obtained particularly for this purpose. The quality and reliability of research are directly related to the method used to collect data. In this regard, the researcher designed a comprehensive survey questionnaire using the study questions in order to gather first-hand, accurate, and high-quality information comprehensively. Using qualitative analysis methodologies, Cho & Lee (2014) claim that researchers can gain deeper insight into their findings. Wilkinson & Birmingham (2003) think survey questionnaires are ideal for collecting large volumes of data, protecting participants' privacy, and aiding in the analysis of surveys.

2.4 FORMATION OF THE SURVEY QUESTIONNAIRE

The semi-structured questionnaire was used to gather data so as to determine the goods and services provided by the mangrove ecosystem that are most important to the local resource users, i.e., the people who rely on the natural reserve for their livelihood. Participants in this study included resource users from the communities of Abonnema (n=20), Bonny (20), Buguma (20), Brass (20), and Nemba (n=20). The total sample size was 100. A random sample of respondents was selected from residents of these communities with the assistance of some locals. Snowball sampling was used to select the participants, which means that the researcher first contacts were only those who are relevant to the study's topic and then uses these contacts to contact others (Bryman, 2012).

The Initial questions (6 & 7) of the questionnaire were created to understand the importance of mangrove forests in relation to other sources of income. Then, questions about the importance and use of mangrove ecosystem goods and services to the selected communities were addressed in sections 8 & 9. The researcher decided to use Rönnbäck et al. (2007) as a basis for the classification system, which was then refined with input from local experts. According to the

questionnaire, there were three types of ecosystem services: provisioning, cultural, and regulating (storm protection). However, Mengist et al. (2020) assert that measurement of the benefits of regulatory ecosystem services to human safety is difficult and complex. Therefore, the researcher excluded other types of regulatory services. A question labeled "others" allowed respondents to list additional ecosystem services of any kind that they were familiar with and not listed on the questionnaire.

2.4.1 Relative Importance Index Analysis

The relative importance index is used in this research project to rate, according to their relative significance, the benefits obtained from the mangrove forests by the residents of the surrounding communities. Using Likert-type scales to rank the Mangrove ecosystem services according to their relative importance, the index analysis is a valuable tool in determining the essential benefits derived from the Mangrove forests' goods and services and helps rank them in order of importance (Jeng et al., 2018). According to the survey questionnaire, respondents were asked to rate the importance of Mangrove goods and services according to their impact on their lives by scoring 1 to 3 on a Likert's Scale, with '1' representing "not important," '2' representing "important," and '3' representing "very important." In order to determine the relative ranking of the services, the scores were then transformed into a relative importance index (RII) based on the following formula:

$$RII = \frac{\sum W}{H * N} \qquad \text{equation (1)}$$

Where: “W” is the weight given to each item by the respondents on Likert’s scale point from 1 to 3 as explained above, “H” is the highest weight from the Likert’s scale point, which in this case is “3” and “N” is the total number of the respondent in a community that is “20” in this study (Aheto et al., 2016).

$$RII = \frac{3n3+2n2+1n1}{3x20} \qquad \text{equation (2)}$$

Where “n” is the frequency with which the respondents choose any of the degrees of scale points from the Likert as their choice. Table 2 below shows the five key levels ranges of the Relative index to ascertain from the calculated value to show how vital the resource is to respondents; the closer to 1 the calculated is, the more important it is, based on perception of the respondents.

RII VALUE RANGE	IMPORTANCE LEVEL	
0.8 ≤ RII ≤ 1.0	HIGH	H
0.6 ≤ RII ≤ 0.8	HIGH – MEDIUM	H-M
0.4 ≤ RII ≤ 0.6	MEDIUM	M
0.2 ≤ RII ≤ 0.4	MEDIUM – LOW	M-L
0.0 ≤ RII ≤ 0.2	LOW	L

Table 2 contains the five key levels are derived from RI values, as described by Akadiri, (2011)

2.5 INTERVIEWS

The term "interview" refers to a type of conversation that is not normally associated with casual small talk. As an alternative to more traditional methods of research, they've been employed to compile extensive data on a wide range of subjects over time. It also shows the importance of the research topic and is by far quite resource intensive, requires information to be elicited on a one-to-one basis and is more insightful (Wilkinson, D., & Birmingham, 2003).

In addition to the survey and questionnaire used to gather data on respondents' perceptions of the value placed on ecosystem goods and services personally, two key personnel were interviewed. The key personnel are scholars; one from the University of Port-Harcourt in Rivers State (Respondent A), and the other is a female lecturer from Federal University, Otuoke in Bayelsa State (Respondent B). The first interview was held on the 2nd of August, 2022, for 19minutes 15seconds and the second was held on the 4th of April, 2022, for 3minutes 45seconds. The interviews consisted of thematic questions about the Mangrove forest ecosystem in the Niger Delta, its conservation, benefits to the community dwellers, and mainly the management policy in place. The information obtained during these interviews was used to analyze the questionnaires' data and answer the second research question on management and policy.

The goal was to back up the survey findings with expert opinions and obtain information from persons with hands-on experience after an appropriate choice of focused interviewees.

2.6 Research Limitation

There are unquestionably constraints on all types of research. Price and Murnan (2004) describe a research constraint as an uncontrollable institutional bias that may affect the results of a study, while a delimitation is an ostensibly controlled systematic bias imposed on purpose by the researcher. It is something outside of the researcher's control that could potentially influence and

impact the results, design of the study, and its conclusions; Theofanidis & Fountouki (2018) called it an unwanted limitation; Simon (2011) called it a possible vulnerability. As such, this research met its design limitation as the intended interviewee from the ministry of environment and other related Agencies did not respond, and all effort to reach them was unsuccessful. As a result, I was only opportune to have an audio interview with two persons from Academia due to time constraints; one from the University of Port Harcourt in Rivers State (RESPONDENT A) and the other from Federal university, otuoke in Bayelsa State (RESPONDENT B). Therefore, I used the questionnaire as a guide to asking them questions during the session.

CHAPTER 3

3.0 RESULTS

Results from the questionnaires are shown below to determine which ecosystem goods and services are most valued by local resource users within the given setting. Based on the content of the questionnaires, the analysis was divided into two sections: demographic and relative importance index analysis. As such, the collected data was used to paint a picture of the regions' overall demographics; next, the significance of mangroves concerning other economic activities will be discussed; finally, the goods and services provided by mangrove ecosystems will be evaluated. Each question's details were presented and organized in a way that corresponded with the research questions, the results were described in detail, and the explanation was explained at length.

3.1 An overview of the demographics and socioeconomics of the communities.

In all the communities studied, mangroves were an essential source of livelihood, such as fuelwood, and were heavily relied upon for many other sources. Averagely over 40% of the respondents fell into the age range of 31 to 40 years old, and they were primarily male (70%, 65%, 80%, 60%, and 65% in Abonnema, Buguma, Bonny, Brass, and Nembe, respectively). In all the villages, an average of 73% of the respondents only had a secondary school diploma, 5% had completed their primary education, 20% had completed their university education, and 3% had completed some other formal education. (Table 2). Most respondents were natives of the communities where they lived and had lived there their entire lives, while on the average12% were settlers who had lived in the corresponding communities for approximately 20 years. Most respondents' primary jobs were farming, fishing, and trading, which accounted for 50% of all responses.

3.1.1 Representation of the respondents' age group

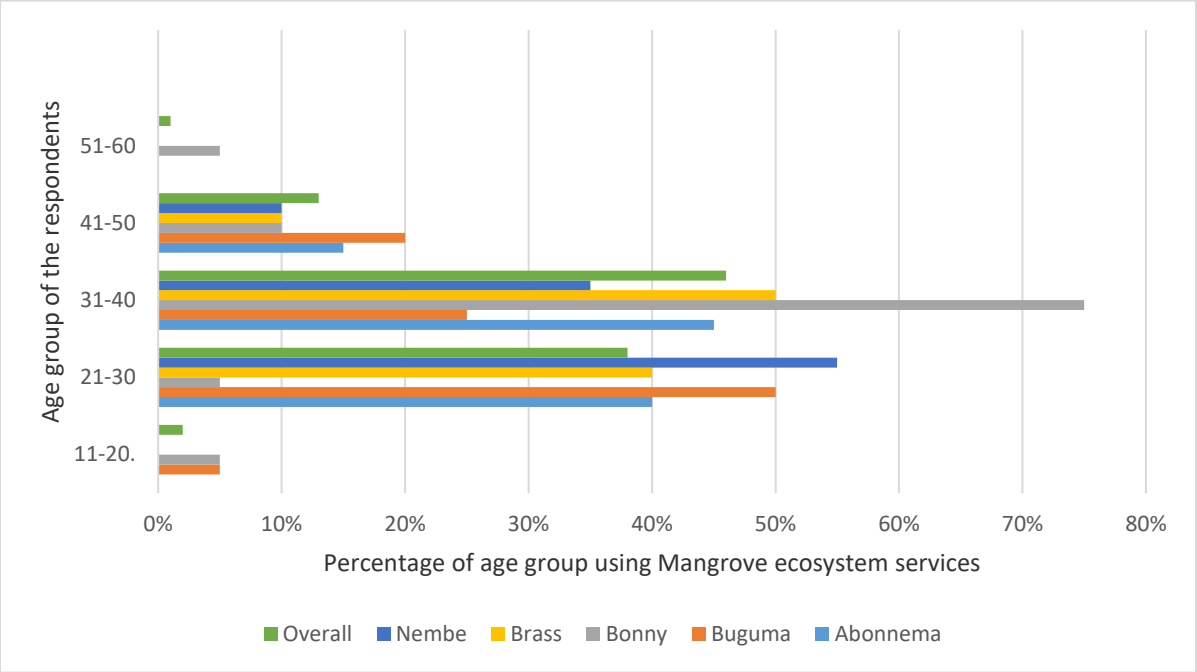

Figure 4. the graphical representation of the age group of the respondents in percentage

Based on the overall percentage of respondents between 21-30 and 31-40, Figure 4 shows that 84% were between 21-30 and 31-40. With 75% of respondents between 31-40 coming from the Bonny community and only 5% are within the 21-30 age group, while in the 21-30 age group, Nembe has 55% of respondents and 35% found within the 31-40 age group. The Brass community reported 50% of respondents in the 31-40 age group and 40% of respondents in the 21-30 age group, while Buguma has most of its respondents in the 21-30 age group with 50% and 25% of them in the 31-40 age group. Finally, Abonnema respondents did not have much variation between the 21-30 age group and the 31-40 age group, with 40% and 45%, respectively.

3.1.2 Native and Settlers Ratio

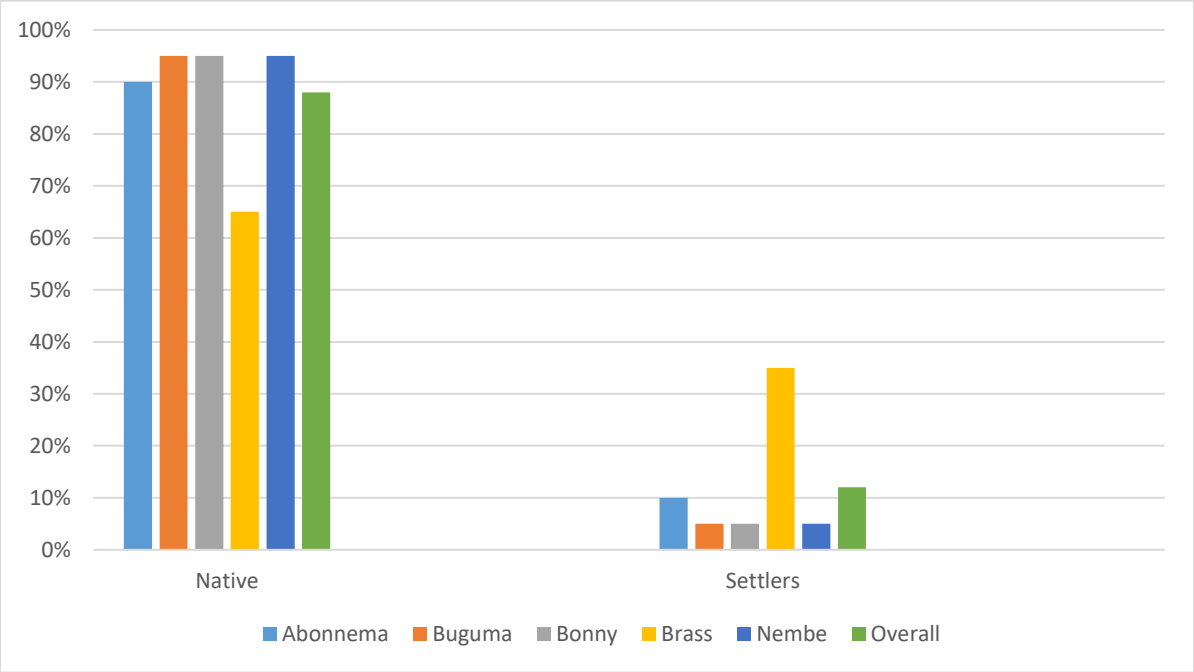

Fig 5 shows the percentage ratio of indigenous populace and settlers in the coastal communities.

Mostly, the respondents are the natives of the coastal communities with few settlers, especially in Buguma. Bonny and Nembe with 95% natives to 5% settlers' ratio each, while Abonname has about 90% native dwellers; the scarcity of settlers in these coastal communities might be related to communal conflict; which is very common within the region or lack of business and employment opportunities. Only Brass has a more significant percentage of settlers with 35%, and the percentage of natives is 65%; this can be related to business viability and peaceful coexistence. The large number of native people who make their homes in this area is evidence that the communities here are rich in culture and have preserved their traditional means of subsistence and methods of conducting business from generation to generation. Moreover, because there were no settlers, there was no foreign culture or language; there was no opportunity for assimilation or a watering down of their traditional practices. Many people in this area place a high value on the cultural significance of the Mangrove forests' environmental services, which include things like traditional medicine. As a result, many individuals view wetlands as a positive source of satisfaction that is inextricably linked to important cultural, social, ethical, religious, and spiritual beliefs (James et al., 2013).

3.1.3 Gender roles in harnessing Mangrove ecosystem services

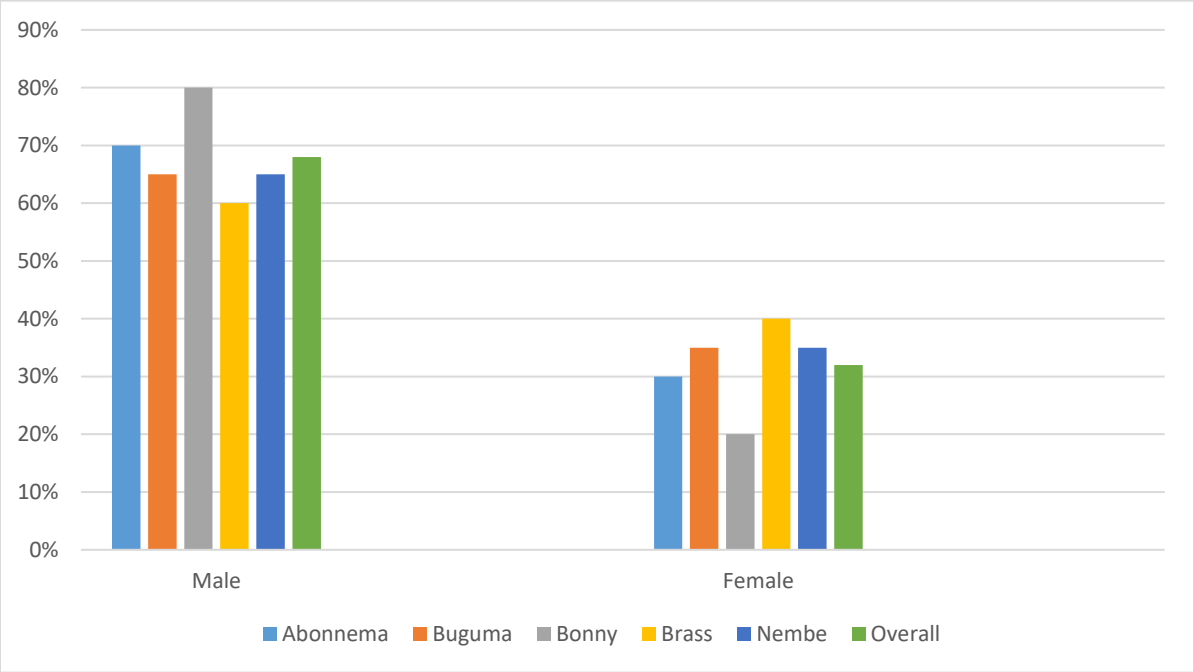

Fig 6 indicates the percentage distribution in the ratio of male to female within the five communities

The representation above in Fig 5 shows the percentage participation of the female gender in tapping from the goods and services provided by the Mangrove ecosystem services. The highest participation is seen in the Brass community in the form of 40% while there is equal participation in percentage in both Buguma and Nembe (35%) and the minor record is seen in Bonny community with 20% participation. Millennium Ecosystem Assessment (MA) (2005) notes that humans benefit significantly from mangroves' many ecosystem services. These services can be classified into four categories:

- provisioning services (food, water, timber, and fiber)
- regulating services that affect climate, floods, disease, wastes, and water quality
- supporting services (soil formation, photosynthesis, and nutrient recycling)
- cultural services (recreational, aesthetic, and spiritual)

However, some of the services are naturally more inclined to the male gender than the female gender and vice versa; for example, a study conducted in the Solomon Islands found that men were more knowledgeable and more engaged in the acquisition of mangrove ecosystem services than women (Warren-Rhodes et al., 2011). However, researchers in Western Sydney, Australia, did not uncover any substantial differences between the sexes regarding their views on

ecosystem services (Pinto and Maheshwari, 2015). Research conducted in Kenya by Rönnbäck et al. (2007) indicated that males were better knowledgeable of mangrove ecosystem services than females, except for culturally exploited resources such as mollusks, fodder, and bark for dye manufacture. Survey results from the Iberian Peninsula in southwestern Europe found that women were more able to understand an ecosystem's potential to deliver services, including regulatory and provisioning services (Martn-López et al., 2012). According to a number of studies, women are more likely than males to be aware of the medicinal potential of plants (Al-Assaf et al., 2014, Daz-Reviriego et al., 2016). Similarly, human capital analysis revealed that according to their expertise in folk medicine, women were somewhat, on average, more likely than men to value mangroves in terms of if medicinal properties. In addition to being more likely to recognize the therapeutic value of mangroves, women also provided more specific information about the preparation and administration of mangrove medicines. This lends credence to the previously cited case studies showing that women, on average, possess more excellent knowledge than males about the medicinal benefits of plants (Yang et al., 2018).

Another factor is tree harvesting, which is both a significant source of revenue and a potential threat to West-Central Africa's mangrove ecosystems. The current method of harvesting used by women, on the other hand, differs from that used by men in that it involves a larger working area closer to home and more extensive seasonal cutting of young trees. This contributes to the deterioration of the mangrove ecosystem, an impact compounded by men's harvesting techniques, which involve less frequent, smaller-scale removal of more giant trees (Feka et al., 2011).

3.1.4 Level of Education

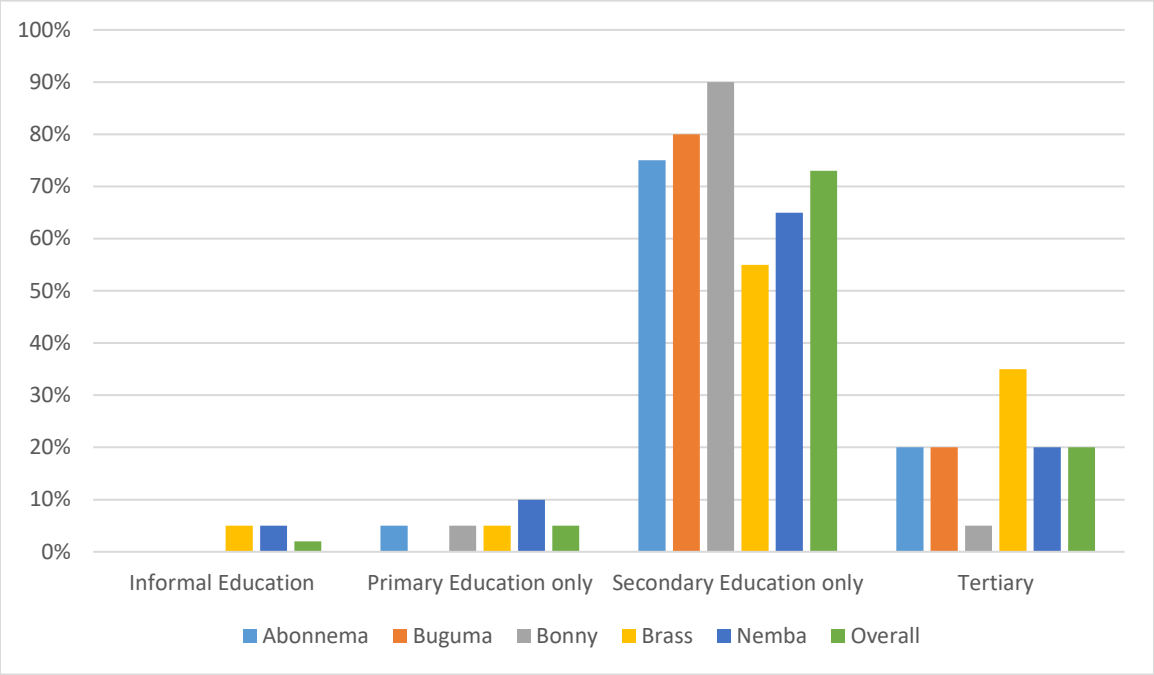

Fig 7 is the representation of the Educational Level of the respondents where secondary is the highest.

Based on the chart above, most respondents in all the communities have secondary as their highest level of education, with Bonny and Buguma communities having the highest rate. On the contrary, the Brass community has the top tertiary education level. The implication is that most of these communities' dwellers might be low-income earners as there is a relationship between low educational level and low income or unemployment. According to research conducted by Applegate, Chiem, and Sanders (2014), in several states across the United States, higher levels of adult education are inversely related to the likelihood of unemployment. There was also no correlation between those with college degrees or above and the jobless rate. According to the results, the unemployment rate is much lower among people who have completed high school (Applegate et al., 2014). Mpendulo and Mang'unyi (2018) also created a set of relationships among variables and discovered that education level positively correlated with unemployment and was the most influential factor in determining joblessness.

Consequently, the dwellers have to engage in multiple activities to make ends meet hence the pressure demand on the mangrove forest for all sustenance, which, if not adequately regulated or done sustainably, might cause a severe threat to the ecosystem.

3.1.5 Means of Livelihood of the Coastal community dwellers.

Variable	**Category**	**Abonnema (*n* = 20)** *Response in %*	**Buguma (*n* = 20)** *Response in %*	**Bonny (*n* = 20)** *Response in %*	**Brass (*n* = 20)** *Response in %*	**Nembe (*n* = 20)** *Response in %*	**Overall (n=100)** *Response in %*
Main Occupation	Fishing	20	21	23	23	21	22
	Aquaculture	7	2	10	16	2	7
	Farming	27	21	15	9	10	16
	User of Mangrove Resources	7	25	4	7	16	12
	Canoe/Boat Transporters	16	14	10	2	12	11
	Civil Servants	4	-	19	16	18	11
	Sand Mining	7	2	10	2	4	5
	Trading	12	15	9	25	17	16

Table 3 shows in percentage the different occupations of the community dwellers from which they earn a living.

Based on the questionnaire responses, the respondents are engaged in various livelihoods, with fishing activities taking the lead by an average of 22% in all communities. Farming and trading take second place with 16% each, and User Mangrove Resources take third place with 12%; this is the percentage of those dwellers that strictly depends on the resources as the source of income, e.g., herbal medicine sellers, honey tappers, firewood sellers, Etc. However, Buguma, in comparison, is the community with the highest percentage of using Mangrove resources, according to the survey. There are more Civil servants in Bonny, and it is one of the communities leading in fishing activities with 19% and 23%, respectively. In terms of farming, the respondent from the Abonnema community has the highest percentage (27%), and a more significant number

of them are in the fishery (20%) with the highest number of canoe/boat Transporters (16%), which might be linked to transporting goods and service to the farmland and Mangrove forest. Amongst the occupations, Sand Mining is the least the respondents engaged in, followed by Aquaculture.

3.2 Frequency of visitation to Mangrove Forest by the respondents.

The frequency with which resource users visited the mangroves is depicted in Figure 4. Most responders (or their family members) frequented the mangroves regularly, with daily, weekly, or monthly visits being the norm. This indicates how pressured the Mangrove ecosystem might be undergoing due to the demand for its goods and services by humans, with the highest daily visitation recorded in Bonny and Abonnema communities. Though recorded the least in daily visitation, Buguma has the highest weekly visitation of 75% as shown in Fig 4 below.

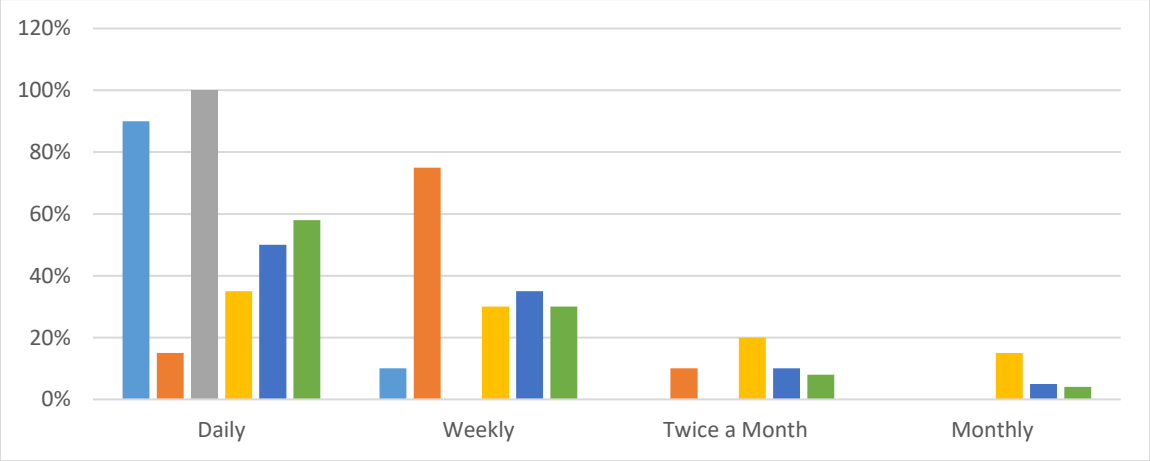

Fig 8. Frequency of visitation to Mangrove Forests.

Mangrove forests are vital not only because of their unique features in and of themselves but also because of the assistance they provide to a wide variety of ecosystems, including human societies (Feka et al., 2011). As a result, various elements come into play regarding the rate and quality of a mangrove's self-restorative power (Bosire et al., 2003). One of the elements is the frequency and tone of wood harvest, which has a devastating effect on its regenerative capacity (Feka et al., 2011). On this note, it can be seen from Fig 4 the frequency at which the respondents in different dwelling communities visit the Mangrove forests for sustenance, with daily and weekly visitation at the highest rates. Bonny and Abonnema are communities that exact the pressure on the forests as indicated by the frequencies; 100% daily visitation only in Bonny, while Abonnema has 90% and 10% for Daily and weekly visitation, respectively. Buguma has the highest weekly visitation of 75%, and the remaining 25% is split between daily and bi-monthly visitation. The

Mangrove forests with a somewhat distribution of visitation across the categories are Brass and Nembe mangrove forests, which might give them some reasonable comparative periods for regeneration.

American Museum of Natural History, (2019) also reported that several low-income countries rely heavily on revenue from the tourism industry. Unfortunately, careless visitation and its frequency can damage or even destroy the treasures that tourists come to view. Mangroves and the ecosystems around them are vulnerable to the trash, sewage, noise, fumes, lights, and other disturbances accompanying the influx of tourists who now often walk, drive, or paddle into formerly inaccessible locations. Damage can also be caused by straying from designated trails, starting fires, feeding wildlife, anchoring near reefs, and taking plants and shells as souvenirs. Sustainable tourism only works if visitors travel in small groups and leave the environment in the same condition they met it.

3.3 Preference for Mangrove species in the Forests

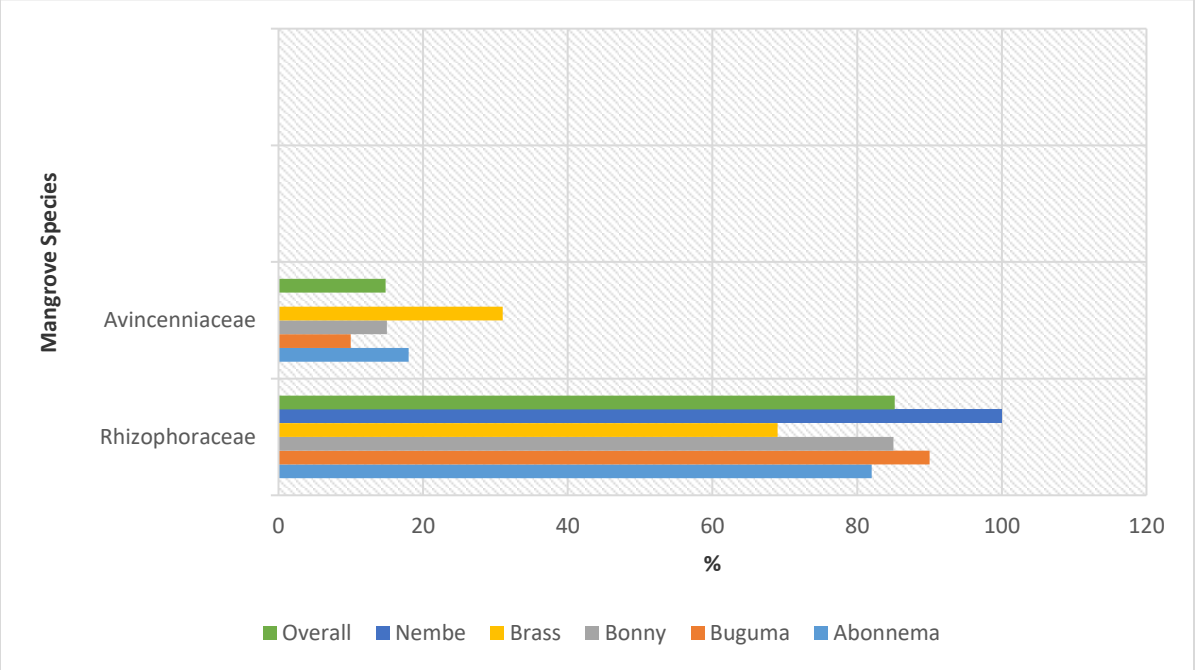

Fig 9. Show the rate of demand of the two species of Mangrove as indicated by the respondents.

During the survey analysis, a high interest in using mangrove species from the family *Rhizophoraceae* (Red Mangrove) over the family *Avincenniaceae* (White Mangrove) from all the coastal communities in the Niger Delta was realized. With Nembe respondents showing 100% interest in *Rhizophoraceae.* In Buguma, there is a 90% need for Red mangroves and over 10% demand for White mangroves, while in Bonny, the percentage demand ratio of Red

mangroves to White mangroves is 85% to 15%, respectively. Abonnema's respondents also indicated a preference of 82% for Red mangroves over 18% for White mangroves, but in Brass, the demand for White Mangrove (31%) is more than all the other communities, and the demand for Red Mangrove is at 69%.

3.4 Knowledge of Mangrove Ecosystem Services.

The study areas noted sixteen (16) mangrove ecosystem services and their significance. People in the investigated communities were knowledgeable about the benefits that mangroves offer. Provisioning services, which accounted for 88.4% of all comments, were the most frequently mentioned, followed by regulatory (5.8%) and cultural (5.8%). Although there were no noticeable differences in respondents' knowledge of regulatory and cultural services between the communities, there were substantial differences in their capacity to recognize provisioning and other services. Fire-wood, fishing, and Building construction materials were the most often mentioned provisioning services. Protecting coastal areas from wind and flooding was one of the regulatory services that received much attention.

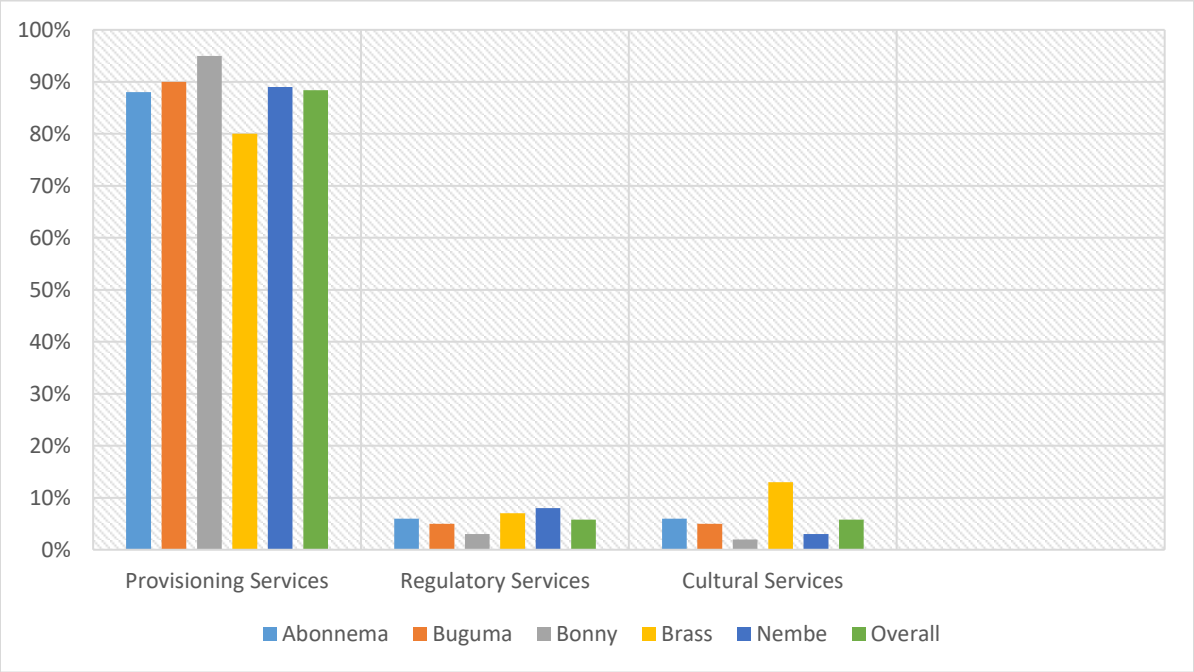

Fig 10 Locals' knowledge of the mangrove ecosystem and its benefits in the study region was classified by service type (n=20 per community).

3.5 Analysis of the Relative Importance index of Mangroves Services

3.5.1 RII Values for Provisioning Services of Mangroves Forest

Mangrove Ecosystem goods and Services	RELATIVE IMPORTANCE INDEX (0-1)						Utilization of Mangrove Resources (% of population n= 100)	
	Abonnema *(n=20)*	Buguma *(n=20)*	Bonny *(n=20)*	Brass *(n=20)*	Nembe *(n=20)*	Overall *(n=100)*	% of Mangrove Resources utilized for Personal usage	% of Mangrove Resource utilized for Financial gain
Firewood	0.6 M	0.8 H	0.5 M	0.8 H	0.8 H	0.7 H-M	20	80
Fishing	0.5 M	0.8 H	0.5 M	0.8 H	0.7 H-M	0.7 H-M	30	70
Building and Construction Materials	0.6 M	0.4 M-L	0.4 M-L	0.7 H-M	0.6 M	0.5 M	35	65
Herbal Medicine	0.5 M	-	0.4 M-L	0.8 H	0.5 M	0.4 M-L	50	50
Periwinkles Harnessing	0.4 M-L	0.5 M	-	0.4 M-L	0.3 L	0.3 L	60	40
Dye Production	0.1 L	-	0.3 L	0.5 L	0.1 L	0.2 L	15	85
Tapping of Honey	-	0.03 M-L	-	0.6 M	0.1 L	0.1 L	35	65
Charcoal Production	0.1 L	0.02 L	0.1 L	0.7 M-H	0.3 M-L	0.2 L	30	70
Crabs Harnessing	0.6 M	0.3 M-L	0.3 M-L	0.5 M	0.3 M-L	0.3 M-L	40	60

Materials for handicraft & weaving	0.1 L	-	0.1 L	0.6 M	0.2 M-L	0.1 L	30	70
Salt production	0.03 L	-	0.03 L	0.3 M-L	0.03 L	0.1 L	80	20
Worms Harnessing as baits	0.1 L	-	0.2 L	0.6 M	0.02 L	0.2 L	100	0
Birds and eggs	0.2 L	-	0.4 M-L	0.4 M-L	0.03 L	0.2 L	60	40

Table 4 showing the rating in term of Importance PES received from the mangrove forest by the coastal communities, this indicated by the RII value as explained in Table 2.

The relative importance index (RII), was calculated for each mangrove resource generated from the ecosystem service to determine which was the most important to the users. The levels of considerable importance were ordered according to their RII values; the closer to 1, the more critical it is to the users. Based on the ratings given to the resources that were derived, it was possible to determine what resource was the most essential to the users, and the frequent demand for that resource could result in more pressure exacted on the mangrove forests. As such, Table 3 lists the Mangrove Ecosystem Services in descending order of importance, where those with the highest RII values are at the top and those with the lowest at the bottom.

PROVISIONING SERVICES OF MANGROVES AS INDICATED IN TABLE 5

As stated in Table 5, the High (H) ranking resources are found in the provisioning services, with Firewood topping the ranking in all the communities but highest in Buguma, Brass, and Nembe with (0.8) ranking each, Abonnema and Bonny have 0.7 and 0.6 that is High-medium (H-M) and Medium (M) rankings, respectively. This means that the need for Firewood supersedes all other needs from the Mangrove forests, and it is harvested for financial gains, as shown in Table 5. Generally speaking, red mangroves are the most dominant species in the Niger Delta and are used most often for manufacturing Firewood and charcoal. In addition, the stems of the trees serve as a source of biomass energy, which may be converted into renewable energy through the production of Firewood and charcoal; these materials are commonly used for cooking in rural communities. In the more rural parts of the Niger Delta, the traditional sources of biomass energy are mostly wood from trees and other plant materials and have become a growing enterprise in

many communities throughout the Niger Delta (Numbere, 2020). Similarly, according to SPDC (2019), the mangrove forests in the Niger Delta, which are abundant in the region, provide nearly all of the Firewood and are sourced locally. Unfortunately, gathering this Firewood typically involves chopping down a substantial amount of Mangrove trees, and this practice is one of the primary contributors to the irreversible damage done to the ecosystem.

Fishing is the following most essential provisioning service obtained from the Mangrove forests based on RII value as computed, where Buguma and Brass have a High (H) rating of 0.8 each, as can be seen from Table 5. Nembe community, with a rating of 0.7, similar to the High-Medium value, is the second community with fishery activity after Buguma and Brass, while Abonnema and Bonny have the same RII rating of 0.5(Medium). The Niger Delta region primarily consists of rural settlements, all of which derive their means of subsistence from the immediate natural environment. More than seventy percent of the population is economically dependent, directly or indirectly, on the natural environment in which they reside (UNDP, 2006). Because of the brackish water characteristics of the coastal environment in the Niger Delta, various kinds of fishes and other aquatic animals can call this area their home and use it as a breeding ground. As a direct consequence, a sizeable portion of the fish harvested in Nigeria originates from the fisheries that operate in the Niger Delta region (Clement, 2013). The mangrove in the communities' forests understudies has some importance as Building and construction material, which is indicated by the value RII where Brass community has the highest value of 0.7 (High-Medium). Compared to Abonnema and Nembe, which have the same usage value of 0.6 (Medium) in the category of Building and construction, Buguma and Bonny have the lowest usage value of 0.4 in this category. Using valuable mangrove timber to construct houses and boats has caused Niger Delta Mangroves to suffer logging, according to Wetland Scientists (2016); mangrove wood is preferred for its resistance to rot and pest attacks such as fungus and borers, making it an excellent choice for submerged structures such as jetties and other wooden based structures.

Despite the development of modern medicine, the inhabitants of coastal communities have been using the bark, leaves, and roots of mangrove trees as herbal medicines to treat a wide variety of illnesses for a very long time, even as modern medicine exists (Abdullahi, 2011). Herbal medicine is the primary therapy for high fever in children caused by malaria in developing nations such as Ghana, Mali, Zambia, and Nigeria. This method is employed for 60 percent of these children (WHO, 2002). According to the findings of the survey, the community of Brass has the highest RII rating with a value of 0.8 (High), which indicates that the utilization of mangrove forests for herbal medicine is more prevalent in Brass than it is in Abonnema and Nembe, both of which have the

same RII value 0.4 (Medium-Low). The response to the inquiry indicates that Buguma does not possess any associated RII for herbal medication. The RII rating value of other provisioning services obtained from Mangrove forests in these five coastal communities are: Periwinkle Harnessing was found to be more critical in Buguma with a rating of 0.5 (Medium) more than in Abonnema and Brass communities with a value of 0.4 (Medium-Low) each, Nembe has the least rating of 0.3 (Low). According to UNIDO (2007) report, there is the belief that nobody who lives in the Nembe Local Government Area is authorized to participate in the periwinkle trade; unfortunately, some people have the misconception that giving it a shot will result in their demise. Using Mangrove resource in the Dye Production Brass community has the highest rating with an RII value of 0.5 (Medium), while the rest coastal communities understudy has a Low level (L) rating with a value of RII under Buguma, following the respondents' response. In terms of Tapping of Honey from the forests, the Brass community has a Medium (M) rating of 0.6, followed by Buguma with a Medium-Low (M-L) of 0.3, while Nembe has a Low (L) of 0.1 and No rating in both Abonnema and Bonny communities. Charcoal, a byproduct of the manual transformation of mangrove wood by artisans in coastal communities of the Niger Delta, whose skills have persisted from generation to generation, is a fuel used extensively for both the preparation of food and the provision of heat during the colder months (Numbere, 2020). Although, according to the survey result, the respondents' feedback shows charcoal production has Medium-High level importance in Brass with an RII value of 0.7 while other communities have a Low (L) value except for Nembe that has Medium-Low (M-L), though as seen from Table 5 most of the charcoal produced is for commercial purposes. Crabs are an excellent source of protein, which helps develop and maintain muscle mass; they can survive in various temperatures and salinities in water, from salty to brackish to fresh and from hot to cold (Dan, 2020). In coastal communities like Niger Delta, children gather crab as part of their cultural roles. The Crabs (*Callinectes spp*.) are caught in local traps fashioned from recycled beverage cans and wood, with Pawpaw or Onion as bait, and placed on the mangrove floor after the water has receded. The river water crab gets caught using nets. Every day at midday, when the tide is high, crabs are collected from the rising seas using nets placed in the area. As a method of making money, these species can be bought from fishers or traders who purchase them in bulk; however, the difficulty of catching crabs means it seldom serves as a gift (Henry et al., 2013). The RII rating for Crabs Harnessing in Table 5 has a Medium (M) value of 0.6 for the Abonnema community, 0.5 for Brass, and 0.3 (Medium-Low) for the Buguma, Bonny, and Nembe communities; which is mostly done for financial gain. Farming, fishing, and mat-weaving activities are the sub-economic sectors in the Nigerian Niger Delta, where men are primarily engaged in farming, fishing, and hunting while women primarily weave

mats and craft baskets using reed material from the Mangrove forests (Ehinmore, 2014). As such, the calculated RII value from the respondents' feedback has Brass community with a 0.6 (Medium) rating of importance among the other communities, Nembe with 0.2 (Medium-Low), and Abonnema and Bonny have the same value of 0.1 (Low). On the other hand, there is no RII value for Buguma Communities, as seen in Table 5, which indicates that handicrafts and weaving take place for commercial purposes. According to UNIDO (2007), one of the ways in which the prop roots of mangrove trees come to be used in the Niger Delta is in the local salt production. The following steps outline how the salt can be produced using the mangrove prop roots; 1. First, the roots are chopped and burned until they are reduced to ashes, 2. Then, the ashes are gathered and placed on a unique dish combined with water, 3. The ash water is then heated until it is dry, and the salt produced is dried in the sun. It is of utmost significance to point out that the roots of the mangrove not only serve as a source of raw material for the production of salt but also play a role in the process of bringing salt water to its dry state through cooking. Accordingly, going by the value shown in Table 5 with regards to salt production, which is basically for domestic use, it can be seen that Brass has a value of 0.3 (Medium-Low), with Abonnema, Bonny, and Nembe communities having the same rating value of Importance of 0.03(Low) while no value computed for Buguma which was due to the responses received from the respondents. Although fisheries are data-constrained, regionally focused, and mostly unregulated, bait is an essential component of coastal life regarding fisheries activities but is regarded as a low-value resource despite the significant ecological effects it has while collecting (Gordon et al., 2016). Worms harnessing as baits in Mangrove forests are part of the goods and services derived by the coastal communities in the Niger Delta for their fishing activities; the values evidence this in Table 5, where the Brass community has an RII rating value of 0.6 (Medium) while the rest of the communities have a low rating. As reported by UNIDO (2007), a total of 44 bird species from 25 different families have been observed in the Niger Delta mangrove forests, all of which need mangrove trees for nesting. Grey Herons (*Ardea cinerea*), Cattle Egrets (*Ardeola ibis*), black-headed Herons (*Ardea melanocephata*), black kites (*Mulvus migrans*), river eagles (*Haiaetus vocifera*), and small sparrow Hawles (*Accipiter evgythropus*) were among the more often spotted species at the site (UNIDO, 2007). Most of these birds are hunted as food as proteins. The RII values for Birds and eggs in Table 5 show that Bonny and Brass Mangrove forests have 0.4 (Medium-Low) each from the respondents' perspective, while Abonnema and Nembe have 0.2 (Low) and 0.03 (Low), respectively, with no value found for Buguma.

3.5.2 RII Values for Regulatory Services of Mangroves Forests

Mangrove Ecosystem goods and Services	RELATIVE IMPORTANCE INDEX (0-1)					
	Abonnema *(n=20)*	Buguma *(n=20)*	Bonny *(n=20)*	Brass *(n=20)*	Nembe *(n=20)*	Overall *(n=100)*
Protection from wind and flood	0.2 L	0.1 L	0.1 L	0.5 M	0.4 M-L	0.3 L

Table 5 showing the rating in term of Importance RES received from the mangrove forest by the coastal communities, this indicated by the RII value as explained in Table 2.

REGULATORY SERVICES OF MANGROVES AS INDICATED IN TABLE 6

The RII rating for the Protection from wind and flood has a value of 0.5 (Medium) in Brass and 0.4 (Medium-Low) in Nembe, while Abonnema, Buguma, and Bonny Communities received a Low rating of 0.2, 0.1, and 0.1, respectively.

3.5.3 Cultural Services of Mangroves to the communities Mangrove forests

Mangrove Ecosystem goods and Services	RELATIVE IMPORTANCE INDEX (0-1)					
	Abonnema *(n=20)*	Buguma *(n=20)*	Bonny *(n=20)*	Brass *(n=20)*	Nembe *(n=20)*	Overall *(n=100)*
Recreation and tourist attraction	0.1 L	0.1 L	0.1 L	0.6 M	0.1 L	0.2 L
Cultural Heritage	0.1 L	0.02 L	0.1 L	0.5 M	0.1 L	0.2 L

Table 7 showing the rating in term of Importance CS received from the mangrove forest by the coastal communities, this indicated by the RII value as explained in Table 2.

CULTURAL SERVICES OF MANGROVES AS INDICATED IN TABLE 7

Regarding Recreation and tourist attraction prioritization among the coastal communities, the value for the RII rating in Brass is 0.6 (Medium), while the remaining four communities have a value of 0.1 (Low) each. Accordingly, evaluating the significance of Cultural Heritage from the respondents' perspective has RII values of 0.1 (Low), 0.02 (Low), 0.1 (Low), and 0.1 (Low) for

Abonnema, Buguma, Bonny, and Nembe, respectively, however, Brass has a value of 0.5(Medium).

According to the findings, provisioning services were the most highly valued by the communities. Obtaining resources like crabs, Periwinkles, and food are activities that the communities engaged in which benefits all local households. Subsistence activities like gathering firewood, fishing, and making shelters from timber comes next. Spiritual practice and recreational use of the forests are two examples of Cultural Heritage uses of the wetland. However, only a tiny fraction of respondents emphasized the importance of ecosystem regulation services. Although many respondents indicated ignorance of the term ecosystem services, however they were familiar with the concept, particularly regarding provisioning and cultural services. Unfortunately, regulatory and cultural services do not receive the attention they deserve. People of all educational backgrounds mentioned providing and cultural services, but only those with higher levels of education mentioned regulatory functions of the ecosystem. This suggests that the familiarity with these services among respondents who have no use for them is related to their level of education.

3.6 Results for the Interview

An Audio Interview was conducted, as explained in section 2.6, regarding the policy framework for managing and protecting Mangrove forests in Niger Delta and Nigeria as a whole. In Appendix D, you will find the transcription for Respondents A and B. Respondent A's responses have been assigned code names such as CODE-RES A1, CODE-RES A2, and CODE-RES A3, whereas Respondent B's responses have been assigned code names such as CODE-RES B1, CORE-RES B2, CODE-RES B3, Etc. Most of the responses answer the questions on the questionnaire.

CHAPTER 4

4.0 DISCUSSIONS

Understanding humans' relationship with the environment requires a number of different research tools, one of the most significant of which is a deeper comprehension of the level of awareness that individuals have regarding the products and services provided by ecosystems (He et al., 2018). When there is a high level of coastal community knowledge, individuals can better appreciate what an ecosystem has to offer, and this awareness also helps to understand the role that ecosystems may play in supporting peoples' living standards and well-being (Su et al., 2020). Expanding on the existing knowledge of the community can also serve as a starting point for building management interventions by identifying various interests in the usage of ecosystems. This might assist with balancing exchange in ecosystem services and support activities that build on multidimensional ecosystems and the sustainable utilization of natural resources (Quyen et al., 2017). In the current study, we investigated how local communities in the Niger Delta region experience various ecosystem services supplied by mangrove forests and the effects caused by dependence and indiscriminate use of these services.

4.1 Benefits of Mangrove Forests to the Coastal Communities in the Niger Delta

The mangroves of the Niger Delta contribute to all four types of ecosystem services outlined in the report titled "Millennium Ecosystem Services": regulating, provisioning, cultural, and supporting services (TRCC, 2022). The regulation of the atmosphere and climate, the prevention of flooding and erosion, the use of wood as fuel, construction, and traditional medicine, forest crops for cooking, the cycling of nutrients, and the provision of habitat for fish nurseries are some examples of these benefits. Because of their importance to the environment, society, and the economy, mangroves are essential to sustainable development. Several tens of different applications of the mangrove ecosystem have been identified and cataloged (IUCN 1993). Wetlands like that of the Niger Delta, in general, offer people a wide variety of benefits and goods, such as staple food plants, fertile grazing land, support for coastal and inland fisheries, protection from flooding, breeding and foraging grounds for birds, and a source of fuel wood (Hoang Tri et al., 1998). Crustaceans (such as prawns, shrimps, and crabs), mollusks (e.g. oysters, mussels, and cockles) and finfish are all edible species found in the ocean. The ecosystem of mangroves is also home to honey bees, which are responsible for producing honey and commonly collected by human dwellers. Mangrove ecosystems produce various forestry goods, most notably wood. Due to the high energy content of mangrove woods, they serve as fuel woods in addition to their

application in civil construction activities such as boats, bridges, and buildings. Finally, the benthic along the coast is driven to a large extent by the organic matter and nutrient flow that comes from the ecosystem of mangroves (Das et al., 1997). Such high nutrients content has allowed coastal people to use mangroves for the cultivation of rice in West African countries (Sylla et al., 1995), but also elsewhere in African and South east Asia. For example, there is one abandoned rice farm in Diebu Creek, located somewhere in Bayelsa State; however, the cultivation of mangrove rice is not widespread in Nigeria.

On the other hand, mangrove ecosystems play an essential role in the Niger Delta for fish farming (Dublin-Green et al. 2003). Bandaranayake (1998) thoroughly investigated the various cultural and therapeutic applications of Nigeria's mangrove species. All environmental and ecological functions are performed by mangroves, such as the hydrological cycle, carbon fixation, sediment control, and storm buffering (Gilbert and Janssen 1998). The treatment of wastewater that contains heavy metals is one of the essential functions that mangroves perform. Heavy metals can accumulate in the mangrove soil in inaccessible forms for extended periods (Tam and Wong 1996). According to Blasco et al. (1996), the economic values of mangroves include serving as a source of timber and poles and providing material for tanning, food, and medicine. The readers are referred to the IUCN (1993) report for a more in-depth analysis of mangroves' benefits.

4.2 Effects of human activities on the Mangrove Forests in the communities understudy.

As a result of the harvesting of wood for firewood and the construction of homes and fishing equipment out of the woods, the Niger Delta's mangrove forests are slowly but steadily disappearing. Similarly, various oil and gas exploration activities across the Niger Delta area open up the woods to increased utilization of natural resources and encroachment by foreign species such as Nypa palms (*Nypa fruticans*), (Numbere, 2018a). The destruction of natural habitats is one of the three primary causes of recent extinctions of animal and plant species. The other two are over-harvesting and introducing foreign species (Aber et al., 2001). The destruction of mangrove habitats will result in the cessation of the ecological services that previously contributed to human (Dobson et al., 2006).

The demographic data analysis included in these studies revealed human pressures exerted on mangrove forests in coastal communities in Abonnema, Buguma, Bonny, Brass, and Nembe. Accordingly, an analysis of section 3.1.1 reveals that most respondents are between the ages of 20 and 70, averaging 84%. Clement (2013) states that in the academic literature, the dependency ratio measures the proportion of economically dependent individuals to the productive population,

such as children too young to work and elderly individuals who cannot earn a living. Consequently, individuals under the age of 20 and those above the age of 70 make up the dependent part of the population, while individuals whose ages range from 20 to 70 years make up the productive part of the population. This ratio is helpful because it provides insight into how much of a financial burden and economically dependent people pose on the productivity sector of the population in terms of providing for their necessities like health care, food, shelter, and education. Consequently, Clement (2013) statement above indicates that all the respondents of the communities under study are within the productive demographic of the population.

This showed that the respondents fall into two categories: those just starting and trying to find their place in society (ages 20-30) and those (ages 31-70) who have seemingly established families and looking for ways to support themselves. If all of these groups were to rely solely on the forest for their day-to-day nutrition, economic benefits, and shelter, this would place a significant amount of stress on the forest's ability to provide these services, which could lead to severe degradation, especially given the recent trend of population growth in Nigeria and the fact that this region cannot be an exception to this trend.

Mpendulo and Mang'unyi (2018) found a relationship between levels of education and unemployment, for example, Applegate et al. (2014) discovered that joblessness is much lesser among individuals who have graduated from high school. This is especially true when considering the low education level among the residents of these communities, as mentioned in section 3.1.4, where most of the respondents' highest educational level is a secondary certificate. Clement (2013) revealed that, in a population, the number of educated people could have an impact, either positively or negatively, on economic growth, which is why it is stated in published works that education and economic growth are related to one another. However, in the coastal communities of the Niger Delta, cultural attitudes, communal conflicts, and a lack of parental commitment all play a role in determining the level of school participation in the enumerated communities. As a result of these facts, individuals with a low education level get occupations with lower income paying potential; this may be the reason why the residents of the community engaged in much trade (as seen in section 3.1.5) to satisfy the rising need for food. According to Sachin et al. (2020) and Arifanti et al. (2022) those with more resources, such as a better level of education or a steadier income, are more likely to get involved in community projects like mangrove restoration and conservation because they have a greater incentive to do so. However, when mangrove resources serve as a commodity, as the case may be, that indicates a high potential for exacting pressure on them, which could lead to catastrophic degradation if the strain is not relieved.

Many coastal communities in the Niger Delta's mangrove habitat derive their non-material well-being from cultural, historical, spiritual, artistic, ethical, and recreational values. These values are essential to the residents of these communities because they allow them to live fulfilling lives (James et al., 2013). This is consistent with the findings presented in section 3.1.2, which showed that the majority of the respondents are native inhabitants therefore might have the potential to participate in cultural and traditional pursuits. Consequently, the demand for these values tends to add more stress to the mangrove forests, giving them little to no time for regeneration and causing severe degradation. Incidentally, this might be exacerbated by an increase in the population in the coastal communities when it coincides with a high visitation frequency (section 3.1.2). James et al. (2013) states that, the use of components originating from mangrove forests is still present in certain religious and spiritual rituals today. For example, during the yearly Masquerade festival in the Buguma community, drums are beaten with roots of Rhizophora mangrove species.

The preference for certain mangrove species over others (as mentioned in section 3.3) due to cultural beliefs or their quality as a material for making furniture is another factor that might increase the severity of the degradation of mangrove forests, which can lead to the extinction of the species or cause the ecosystem to become unbalanced. Therefore, this is another factor that can contribute to the severity of the degradation of mangrove forests. According to Palacios & Cantera (2017), the primary reason for harvesting mangroves is the quality of wood they provide. *Rhizophora* species are the primary wood providers, and literature shows they are the most popular and desired choice of Mangrove species for building and construction processes like homes, furniture, fences, and even boats because of their excellent wood strength. Due to their high calorific value, mangrove woods like *Ceriops tagal* and *Rhizophora mucronata* frequently serve as cooking fuel. They are used as flavorings in foods like porridge and tea; they can also be used to disinfect cuts and treat burns. The leaves of the *Xylocarpus granatum* tree have long been used to treat stomachaches. Cattle are given leaves from *Avicennia marina* and *Heritiera littoralis*. Chewing ground-up *Avicennia marina* fruit can alleviate heartburn symptoms.

Mora oleifera (*Triana ex Hemsl*), a mangrove associate, is the sole wood supplier for building stilt houses. The composition and structure of the forest have changed considerably due to the selective harvesting of these species.

4.3 Finding from RII Analysis

An ecosystem's RII value reveals how significant a given resource is, accordingly, ecosystem service with a high RII value; indicates how essential it is, considering how it was ranked with a high value. Consequently, high demand for a particular resource may place much pressure on the ecosystem, which may accelerate its degradation. From the analysis in section 3.5.1, the respondents believed that mangroves could provide provisioning, regulating, cultural, and functions; nevertheless, compared to the other services, provisioning services were the ones that were mentioned the most frequently. This conformed with the conclusions that López-Santiago et al. (2014) had discovered, which stated that many provisioning services are more upfront to be identify by the public because of their direct market value. Firewood, fishing, timber for building construction, and herbal medicine came out on top as the essential provisioning services for sustaining the local livelihoods compared to the other evaluated ecosystem services. These services were essential to the Abonnema, Buguma, Bonny, and Nembe coastal communities; however, the Brass and Buguma coastal communities placed a higher value on them than the other coastal communities. Buguma, a community, came in second place to the Brass community, due to high demand for firewood usage and fishing and had the highest value in periwinkles harnessing. The brass community has the highest RII rating value in all 16 of the listed mangrove ecosystem services. Buguma community came in second place to the Brass community. According to the RII, almost all of the communities in the region depend on mangroves for fishing, wood for firewood, building homes, manufacturing furniture, traditional medicine, and building boats because of the accessibility of these resources. Only four of the services provided by the mangrove ecosystem have received the highest rating from the community; these are the provision of firewood, fishing, the requirements for building and construction materials, and herbal medicines.

4.3.1 The choice of Mangrove for firewood

Red (*Rhyzophora racemosa*), white (*Avicennia germinans*), and black (*Laguncularia racemosa*) mangroves make up 62.5%, 25%, and 12.5% of the Niger Delta's mangroves, respectively (Numbere, 2019). All three species provide firewood, but the red mangrove has the most potential; Rhizophora species stems are tough and catch fire and burn faster than other species' stems (Numbere, 2020). They are used to make firewood and charcoal for cooking, barbecuing, heating dwellings, drying fish, baking, creating bricks, clay pots, casting metal, and pottery. Mangroves make good firewood and charcoal. This high demand for firewood and charcoal is a consequence of the irregular supply of electricity which has led many city dwellers to use firewood for cooking

and heating (Numbere, 2020). However, increased firewood consumption can cause land degradation, deforestation, soil erosion, and flooding. Consequently, unregulated tree removal can also lead to barren wastelands. Continuous tree removal can also reduce mangrove ecosystem services globally and in the Niger Delta (UNEP, 2017).

4.3.2 The choice of Mangrove for building and construction

In the construction of stilt houses, also known as pile dwellings, the primary building material utilized is wood from Mangroves. Because mangroves yield exceptionally dense and robust wood, the inhabitants of the area make use of it in the construction of their homes, including the subflooring, walls, and ceilings. The surveys indicate that *Rhizophora spp.* (red mangrove), *Laguncularia racemosa*, (white mangrove), *Avicennia germinans* (L.) (black mangrove), *Pelliciera rhizophore* Planch. & Triana (pin uelo), and Mora oleifera (*Triana ex Hemsl*.) *Ducke* (nato) are important species used for construction (Palacios & Cantera, 2017). When mangrove trees are cut down for their wood to serve as materials in building and construction, this practice is known as selective cutting. As a result, a more considerable proportion of Mora oleifera (*Triana exHemsl.*) species appears in the construction of dwellings, as well as posts for the construction of basements and the management of area-specific erosion. As a result of such selective cutting, the structure of the mangrove forests deteriorates, and certain species become vulnerable to increased demand.

4.3.3 The choice Mangrove for Herbal medicine

Mangrove plants have a long history of usage in folk medicine, and there is evidence that extracts from many kinds of mangrove trees have an inhibitory effect against human, animal, and plant infections (Vinoth et al., 2019). Example of Mangrove species use as medicine are:

Excoecaria agallocha: It has been used for centuries as a uterotonic and to treat various conditions, including epilepsy, conjunctivitis, dermatitis, hematuria, leprosy, and toothache.

Rhizophora apiculata: The tannin found in the bark effectively keeps mosquitoes at bay. In addition, it is an astringent, an antibacterial, an antihemorrhagic, a remedy for typhoid fever, and even used to treat diabetes.

Acanthus ilicifolius: Coughs and asthma can be treated with the expectorant root. In addition, the root commonly treats leucorrhea and overall weakness by boiling it in milk.

4.4 Mangrove forests are threatened by the three uses of mangroves mentioned above

Cutting woods for timber, firewood, building construction materials, Herbal Medicine, Dye production, Charcoal production, and materials for handicraft & weaving harm or adversely affect the Mangrove trees. Moreover, such high demand can course severe degradation of mangroves since obtaining the woods involves cutting them down mostly in an unsustainable manner, thereby distorting the trees with their roots beyond the regeneration capacity of the Mangrove species. These activities are among the sixteen goods and services listed in the questionnaire about the Mangrove Ecosystem. In addition, the nutritional cycle in a forest ecosystem can be disrupted by tremendous human activities like fishing, harvesting periwinkles and crabs for food, producing salt, harvesting worms for bait, hunting birds, and collecting eggs. Therefore, the cumulative pressure put on an ecosystem in collecting these resources as sustenance could potentially harm the environment. Consequently, the RII rating value shows that in the course of cutting mangrove for firewood; Buguma, Brass, and Nembe Mangrove forests receive more pressure as entailed by the High rating of 0.8 while Abonnema and Bonny Mangrove forests have Medium pressure of 0.6 and 0.5, respectively. This is further clarified by Respondent B during the Interview session by stating that *"The communities go collect wood from mangroves to use as charcoal. Some do not even look at whether it is mature enough or big enough because they feel it is a surplus, well looking at it from one angle, it seems like a surplus, so they will cut down ones that are not even needed and drop it they will take it as wood for charcoal, so that is one of the major threats apart from oil spillage that is causing a major problem to the mangrove" (CODE-RES B3)*

4.5 Mangrove management and protection Policy in Nigeria

Considering the vital role mangroves play in coastal ecosystems and the importance of these systems to the quality of life in these places, it is imperative that policies be put in place to ensure the long-term viability of mangrove ecosystems (Faisal Siregar, 2013). However, Nigeria has forestry policies and regulations; even so, it is dispersed and not comprehensive and does not deal with mangroves in particular. Additionally, there is not a well-defined mandate for managing mangroves; consequently, there is not a well-developed policy or framework for managing this resource at this time. The region's mangrove resources have not been effectively managed because of insufficient management recommendations, which has hampered conservation efforts. As a result, mangroves are seen as a shared resource that may be utilized freely without being

subject to any regulation (TRCC, 2022). This further confirmed, by CORE-RES A1 in response to the question on of Mangrove management policy in Nigeria, where Respondent A states that *"We are yet to have a national policy on mangrove management, restoration, and conservation; no clearly defined mangrove legislation and policy in Nigeria. Okay, at the national level and even at the state level, but there are pieces of, you know, legislations that you know, talks about wetland and talking about conventional mangrove, but not one that focuses only on mangrove"* (CORE-RES AF1), Respondent B also testify to the no Management policy in Nigeria in a response with code CORE-RES B1. However, Respondent A notably states *"it is long overdue in Nigeria to have Mangrove management policy, because Nigeria mangroves, as you know, are the largest in Africa and are a very strategic resource ecosystem for commercial fisheries in the Gulf of Guinea*." (CODE-RES A1).

4.6 Who is responsible for the Management and Protection of Mangrove Forests in Nigeria.

Ideally, the Government and policy maker should be responsible, however, in the course of the interview session, when asked if there is any commitment by government to management the forests, Respondent B in CODE-RES B5 said *"There is no sign of commitment from the government to manage and protect the mangroves, and they are not even interested. Let me start with the local government chairman. They are not even interested. So it seems like those affected mainly, their heads are not interested, the local government is not interested, the state is not interested federal government is not interested. If there is any interest, it mostly comes from the traditional heads of the communities; that is when they have seen that their communities have been so impacted by the lack of these things that they use as livelihood"*

CHAPTER 5

5.0 Conclusion

As crucial as mangroves are to the coastal economy, their contributions to the National economy are not as immediately visible as those of oil and gas or commercial crop grown in some areas, like sugar cane or cocoa. Generally speaking, they are primarily responsible for protecting coral reefs from sediments and pollution, mitigating the effects of cyclones and storms on property and coastlines, and keeping coastal fisheries afloat; all rely heavily on the presence of mangroves. Red (Rhizophora racemosa), black (Laguncularia racemosa), and white (Avicennia germinans) are the predominant species of Mangroves in the coastal communities of the Niger Delta with abundant Mangrove forests; as they can provide for firewood, herbal medicine, and building and construction materials, they are highly sought after for personal and commercial use. It has been observed that almost all these mangrove forests, Abonnema, Buguma, Bonny, Brass, and Nembe communities are sources of too many foods (One planet, 2020). According to the World Bank, the Niger River Delta is regarded as a global leader in biodiversity conservation. It has the largest mangrove forest in Africa and the Atlantic Ocean combined. As a result of this ecosystem, the local population has access to food, firewood, building materials, medicinal herbs, and other edible plants (Numbere, 2018a). However, with an increase in population in these coastal communities, there will be high demand for these ecological resources. Though the RII value is relative, such that a lower value seems small in figure, however, when dealing with a vast population demand, it is worth considering as this depicts high demand for the resources and that demand can quickly move up in a short period. According to the findings of this research, the demand placed by humans for a place to live, opportunities for economic advancement, and overall health and happiness places significant stress on the services provided by mangrove ecosystems, which can lead to irreversible degradation if appropriate regulations are not implemented.

5.1 Recommendations

According to Numbere (2018a), the "evil quartet" consisting of pollution, deforestation, invasion, and urbanization is responsible for the destruction of mangroves in the Niger Delta. Even though natural disasters such as hurricanes, tsunamis, climate change, and rising sea levels significantly reduce the global mangrove population. As a result, some factors contributing to deforestation within the evil quartet were identified during this research, and recommendations should be made based on these observations.

1. In order to regulate the inappropriate use of mangrove forests and make certain activities or products obtained without permission illegal and subject to stringent rules, a specific regulatory framework for mangrove ecosystem services ought to be created, and the provisions contained within ought to be strictly enforced.

2. A widespread awareness campaign ought to be conducted to make the people who live in the community aware of the impact their very burden has on the mangrove. This should be done in a way that they will understand the tendency of losing these resourceful ecosystem, which might result in losing their heritage as well.

3. It was observed that due to abject poverty in some of these communities, there is a low educational level among them, so the Government, both state and Federal, as well as some corporate organizations, oil companies, etc., should assist in educating those dwellers that are interested in education, from primary to University, through scholarships as part of cooperate social responsibility and those not interested should be trained on skills acquisition programmes. Most of the intended students going to University and colleges should be made to see reason to study forestry and ecology, as this will make a lot easier to pass down the knowledge in their local dialect.

4. Agricultural extension services should be expanded to these regions to educate the local population on ecologically responsible methods of forest management and tree harvesting.

5. It is recommended that the Federal Government make kerosene and cooking gas available and affordable for rural dwellers to use as alternatives to firewood and charcoal, which rural residents use for cooking and warming their homes during the colder months. The Niger Delta region is the center of Nigeria's oil and gas industry. When something like this is done, it will lower the pressure placed on mangrove forests for these products.

6. The residents of the communities, particularly the women, should receive training and empowerment in skills other than the inherited farming and fishing that are sorely needed by the communities; this training and empowerment should be provided in collaboration with Government, corporate organizations, nongovernmental organizations (NGOs) and other charitable organizations. Consequently, the pressure that they exert on the mangrove will decrease as a result.

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APPENDIX A

Dear Participant,

Thank you for agreeing to participate in this research interview, which is carried out in connection with a Dissertation that will be written by the interviewer, in partial fulfilment of the requirements for the degree of Master of Science in Maritime Affairs at the World Maritime University in Malmo, Sweden.

The topic of the Dissertation is *Investigating the factors affecting Mangroves Area in the Niger Delta region of Nigeria*
The information provided by you in this interview will be used for research purposes and the results will form part of a dissertation, which will be published online and made available to the public. Your personal information will not be published. You may withdraw from the research at any time, and your personal data will be immediately deleted.

Anonymized research data will be archived on a secure virtual drive linked to a World Maritime University email address. All the data will be deleted as soon as the degree is awarded.

Your participation in the interview is highly appreciated.

Student's name: Bashir Shehu ABUBAKAR
Specialization: Ocean Sustainability, Governance, and Management
Email address: w1011981@wmu.se

* * *

I consent to my personal data, as outlined above, being used for this study. I understand that all personal data relating to participants is held and processed in the strictest confidence, and will be deleted at the end of the researcher's enrolment.

Name: ……

Signature: ……

Date: ……

APPENDIX B

Sample of Questionnaire for rural areas that are reliant on mangroves.

Date_____

1) Community: ☐ Abonnema ☐ Bonny ☐ Buguma ☐ Brass ☐ Nemba

2) Age: ☐ Years

3) Gender: ☐ Male ☐ Female

4) Indigene: ☐ Native ☐ Settler; if a settler for how long, ☐ Years

5) Education: ☐ Primary ☐ Secondary ☐ Tertiary ☐ Formal ☐ Other

If other, please specify: _____

6) Source(s) of Income

Which of these is your source(s) of Income	**Please tick**
Fishing	
Aquaculture	
Farming	
Using Mangrove Resources	
Canoe/Boat Transportation	
Civil Servant	
Sand Mining	
Trading	

Other (please specify) _____

7) How many time do you go to the Mangrove Forest?

☐ Everyday ☐ Everyweek ☐ 1-2 times in one month ☐ Every Month ☐ Never

8) Benefit drived from the Use of Mangrove Vegetation goods and services

1= not important, 2= important, 3= very important

Benefits you get from Mangrove forest goods and service	Degree of importance			Reason of the use	
	1	2	3	For home use	For selling
Fire wood					
Charcoal Production					
Herbal Medicine					
Production of dye					
Fishing					
Periwinkles Harnessing					
Crabs Harnessing					
Tapping of Honey					
Salt production					
To get worms for catching fish					
Building and construction materials					
Materials for handcraft & weaving					
Birds and eggs					
Recreation and tourist attraction					
Protection from wind and flood					
Cultural Heritage					

Other uses (please specify) _____

9) Among the mangrove types (species) which one do you think it is being use most?

☐ Rhizophoraceae (Red Mangrove) ☐ Avicenniaceae (white Mangrove) ☐ Combretacea

10) What are your reasons for the answer in Question 9 above?

11) What do you think about the Mangrove forest and its trees from the last five years?

☐ Increasing ☐ Decreasing ☐ same no difference

12) If you tick Decrease in question 10 above, then what do you think is the cause of the Decrease of Mangrove forest over time?

☐ Firewood need ☐ Road construction ☐ Oil Spillage ☐ Building construction

Other (Specify Please) _____

13) Is there any measure put in place by the government to protect the mangroves from being destroyed? ☐ Yes ☐ No

If Yes, what type of measure is that? _____

14) What is your opinion about reforestation?

APPENDIX C

Sample of Questionnaires for Official of Nigerian Government, Agency or Academic Institutions used as guide for interview questions.

Please tick as appropriate

1) **Gender:** ☐ Male ☐ Female

2) **Name of your organization:** _____

3) **What is your position in this organization?** _____

4) **Does this Agency/organization deal with the issue of Mangrove management and protection in Nigeria?** ☐ Yes ☐ No

b) if yes, what is it responsible for

☐ policy/regulation creation ☐ policy/regulation implementation

Other (please specify) _____

5) **Is there existing policies or regulations for the Management and protection Mangrove Vegetation in Nigeria?**

☐ Yes ☐ No ☐ I have no idea

6) **Which type of governance structure do you have for Mangrove protection and management**:

☐ Top to Down approach (Technocratic) ☐ Bottom to up approach (participatory)

other (please specify) _____

7) Do you engage the mangrove dependent communities when making key decisions about Mangrove Management and Protection?

☐ Yes ☐ No

b) if yes, at what point:

☐ Before and at policy formation ☐ At the implementation stage

other (please specify) _____

8) Do you think that the current policy for the Mangrove protection and management is adequate to address issues of degradation of Mangrove Vegetation in the coastal zone of Nigeria?

☐ Not Adequate ☐ Moderately Adequate ☐ Very adequate

If you tick **"Not-Adequate"** or **"Moderately Adequate"** as in question 8 above, what are the needed suggestions for improvement?

9) To what extent do people comply with the policies and regulations of the coastal ecosystem?

☐ Non-compliant ☐ Moderately compliant ☐ Highly compliant

10) If there is no or low compliance to the coastal zone policy/regulation, what do you think might be the reason?

☐ Public deliberately choice to disobey ☐ The regulations too rigid to comply to ☐ Public are not sensitized enough about the regulations

other (please specify) _____

11) What is the main cause of the degradation of Mangrove vegetation in Nigeria?

☐ Climate change ☐ Human activities

other (please specify) _____

12) If you tick Climate Change as the main cause of the degradation of Mangrove Vegetation in Nigeria as in question 11 above,

please specify the Climate change effect? _____

13) If human activities are the main causes for the degradation of Mangrove Vegetation in Nigeria, which of these human activities is the major one?

☐ Oil Spillage ☐ Need for fuel (Fire wood & Charcoal) ☐ Building Construction

Other (please specify) _____

14) If degradation of Mangrove vegetation is considered a threat to mangrove dependent communities, which of these communities is most threatened?

☐ Abonnema ☐ Bonny ☐ Buguma ☐ Brass ☐ Nembe

b) Does the Government / Organization have any plan to rescue the threatened community?

☐ Yes ☐ No

If yes; please specify _____

APPENDIX D

THE TRANSCRIPTION OF INTERVIW WITH REPRESENTATIVES OF ACADEMIA BETWEEN "RESPONDENT A" AND "RESPONDENT B"

INTERVIEW WITH RESPONDENT A

"We are yet to have a national policy on mangrove management, restoration, and conservation; no clearly defined mangrove legislation and policy in Nigeria. Okay, at the national level and even at the state level, but there are pieces of, you know, legislations that you know, talks about wetland and talking about conventional mangrove, but not one that focuses only on mangrove. So, we are saying that we cannot get, you know, the kind of no net loss of mangroves in terms of conservation in terms of restoring degraded areas without having a unilateral mangrove for cost policy or legislation. And it is long overdue in Nigeria because Nigeria mangroves, as you know, are the largest in Africa and are a very strategic resource ecosystem for commercial fisheries in the Gulf of Guinea." (CODE-RES A1)

"Our policy advocacy point in terms of policy formation is co-management. Ok, I practice Common Co-management; thus, the local people must be in charge; they depend on the mangroves, live in them, and interact with them every day of their lives. So they must drive sustainable management frameworks. In establishing the policy, the local community will play an active role; they must participate in the entire process from start to end since they implement the policy on the ground. The government at different levels gives policy assistance. The local communities will execute the policy, not simply the community members; who will be involved? Civil society, academics, and even oil and gas companies will be present since their activities harm mangroves. They must be involved in policymaking." (CODE-RES A2)

*"Should a Mangrove management policy be in place today; the communities will comply with it because the community already knows the importance of mangroves. Though, then they are also facing livelihood pressures; however, where we stand today, you cannot rescue the situation and sustain it without providing them with some incentives in terms of alternative livelihood opportunities or providing with other environment-friendly businesses, yeah, it is very crucial." (*CODE-RES A3*)*

INTERVIEW WITH RESPONDENT B

"There are no policies for Mangrove management and Protection in Nigeria. So the people in the local communities carry out irresponsible fishing. They go and fish anyhow and conduct uncontrolled wood exploitation. They use the Mangroves a lot; Some of them are even they will just cut it off without consideration. They dispose of the ones they feel are not big enough". (CODE-RES B1)

*"Should there be a mangrove management policy today, they will definitely comply, especially if their traditional rulers carried along with the policies. Government can make policies, but enforcement or implementation of the policies might be a problem. However, most of our communities are in Nigeria; if a traditional leader says that, nobody should go and cut any tree from there. They will definitely obey the king. Yeah. So whatever policies are put in place or that are being put in place, it has to be a synergy between the traditional rulers of the communities and the government for it to be effective; if not, it will be challenging to be effective" (*CODE-RES *B2)*

*"The communities go collect wood from mangroves to use as charcoal. Some do not even look at whether it is mature enough or big enough because they feel it is a surplus, well looking at it from one angle, it seems like a surplus, so they will cut down ones that are not even needed and drop it they will take it as wood for charcoal, so that is one of the major threats apart from oil spillage that is causing a major problem to the mangrove" (*CODE-RES *B3)*

"Using the forest as a source of livelihood, I will say Brass is more under severe anthropogenic pressure than Nembe, and Brass is more coastal than Nembe. When I say more coastal, I mean as their source of livelihood, not just for the mangrove plants now, but even the fishes and other animals; most of the communities depend more on the mangrove in Brass than Nembe. So I want to say Brass is more affected by anthropogenic pressure than most coastal communities. Moreover, most people producing charcoal in the communities are from Brass local governments" (CODE-RES B4).

“There is no sign of commitment from the government to manage and protect the mangroves, and they are not even interested. Let me start with the local government chairman. They are not even interested. So it seems like those affected mainly, their heads are not interested, the local government is not interested, the state is not interested federal government is not interested. If there is any interest, it mostly comes from the traditional heads of the communities; that is when they have seen that their communities have been so impacted by the lack of these things that they use as livelihood” (CODE-RES B5)