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WOMEN SHELLFISHERS AND FOOD SECURITY PROJECT

PARTICIPATORY ASSESSMENT OF SHELLFISHERIES IN THE ESTUARINE AND MANGROVE ECOSYSTEMS OF **NIGERIA**

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Cover photo: Complimentary role of women and men in harvesting shrimps.

Photo credit: Emmanuel Dami Omogbemi

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS

CCM	Centre for Coastal Management
CRC	Coastal Resources Center
UCC	University of Cape Coast
URI	University of Rhode Island
USAID	United States Agency for International Development

Executive Summary

Basic Contextual Information	
Country	Nigeria
Total land area	923,768 km^2
Population	206 million (2019)
Percentage population living in/near the coast	19% (2006)
Gross Domestic Product (GDP)	448.12 billion USD (2019)
Human Development Index Rank	0.534 (158 out of 189)
Length of coastline	853 km
Fish consumption (as a percent of animal protein)	40%
Anemia prevalence	68.9% among under-five children 49.8% among women of reproductive age (15 - 49)
Estimated mangrove cover	689,417 ha (2016)
Estimated estuarine and mangrove ecosystem-based shellfish harvesters	39,340
Estimated women shellfish harvesters (percent)	67%
Estimated direct household shellfish beneficiaries	415,548
Estimated percentage of shellfish harvesters at all nodes of the value chain (vertical integration)	40%
No. of coastal systems with mangrove-based shellfishing	7
Shellfish management regulations	-
Mangrove management regulations	-
Coastal ecosystems with shellfisheries identified as Ramsar sites	Apoi Creek Forests (29,213 ha), but largely freshwater wetland

Sources: Chuku et al. 2020, WorldBank, UN World Population Prospects, West Africa Coastal Areas Management Program, Global Mangrove Watch, Ramsar Site Information Services.

Prior to this assessment, information on the number of shellfish harvesters along the Nigerian mangrove coast has been largely unavailable. The Nigerian mangrove ecosystem is among the largest in the world and largest in Africa covering an area of approximately 6,894 km^2 (Global Mangrove Watch, 2016; Adegbehin and Nwaigbo, 1990; Anon, 1995; Macintosh and Ashton, 2003). The importance of shellfisheries livelihoods, which include to satisfy nutritional needs and to create employment, is demonstrated by the fact that in most cases the entire family participates in the whole value chain of the fisheries business. There is, however, a general dearth of reports on women's participation in shellfisheries in Nigeria. The current study assesses the scale and scope of shellfisheries and shellfish-based livelihoods connected with mangrove systems and coastal water bodies in Nigeria through a participatory approach. In total, this assessment involved 42 field survey participants, 22 of which were women, while 20 were men, constituting 52% and 48% respectively. Over 85% of women participants were of reproductive age, an important age group when considering the potential role of shellfish access in alleviating high anemia prevalence in the country (approximately 70% for children under five and 50% for women of reproductive age).

It is estimated that there are approximately 39,340 individuals involved in shellfishing along Nigeria's mangrove coast, approximately two-thirds of whom are women. There are an estimated 415,548 direct beneficiaries of shellfishing harvest in Nigeria. These number figures are the highest by an order of magnitude across the 11 coastal West Africa countries in the assessment. Over one-third (40%) of women participants in this study are working across the entire value chain (engaged in harvesting, processing, trading, and consumption) in women-dominated shellfisheries, with another 60% working at the level of processing and trading in male-dominated harvest shellfisheries. This indicates a somewhat vertically integrated value chain with women harvesters present at every node of some shellfish value chains and implies that value chain improvements at any of these nodes can directly benefit women harvesters, creating an opportunity to incentivize behavior change for sustainable resource management. Furthermore, women engaged in the value chains of women-dominated shellfisheries report carrying out these activities as their sole means of livelihood, increasing the stakes of sustainability within the sector for women.

Harvesting of shellfish is a mainstay of coastal livelihoods in Nigeria. However, the revenue generated from this sector has had little positive impact on standard of living among these communities. This is perceived to be due in part to a lack of business management skills to maximize profits. Resource users report wanting improved processing and storage facilities for improved product quality and increased shelf life.

Shellfishing communities feel that modern storage and processing facilities should be provided by the government or other agencies to improve shellfisheries livelihoods of women. These individuals also reported wanting financial empowerment for women, including the provision of subsidized fishing gears, boats, and engines. This study also revealed that shellfish processing is a primary driver of the harvesting of mangrove material in Nigeria. It was recommended that modernized processing facilities employ the use of other fuel materials to mitigate this threat. Lastly, there is an express need to facilitate the organization of women shellfishers in Nigeria into groups and associations so that they

may be able to build social capital and access tools such as financial assistance in the form of grants and loans.

None of the resource users nor the survey participants from government or academic backgrounds reported any awareness of laws applied to shellfisheries or mangrove systems in Nigeria.

1. Introduction

Nigeria, a West African country with a population of about 210 million people (UNWPP, 2019) is located between latitude 4° and 14° North of the Equator, and between longitudes 2°2' and 14°30' East of the Greenwich meridian with a total land and water area of 923,768 sq km (CIA World Factbook, 2005). It is bordered in the north by the Republics of Niger and Chad, to the south by the Atlantic Ocean, to the east by the Republic of Cameroon and to the west by the Republic of Benin (Ekubo and Abowei, 2012).

The coastline of Nigeria is approximately 853 km long bordering the Gulf of Guinea, Atlantic Ocean, located between latitude 4° 10' to 6° 20'N and longitude 2° 45' to 8°35' E. The terrestrial portion of this zone is about 28,000 km^2 in area, while the surface area of the continental shelf is 46,300 km^2, and with about 200 nautical miles Exclusive Economic Zone (EEZ) of 210,900 km^2 (Bamidele 2017). The coastal area is low lying with heights of not more than 3.0 m above sea level and characterized by freshwater swamp, mangrove swamp, lagoonal mashes, tidal channels, beach ridges, and sand bars (Egberongbe *et al*., 2006). Based on geomorphology, the coast can be divided into four distinct units; (1) the Barrier Lagoon which comprises of the Lekki and the Lagos Lagoons systems, originating from the Nigeria/Benin border to Ajumo village, (2) the Mahin transgressive mud coast which runs from Ajumo village to Benin River, (3) the Arcuate Niger Delta which runs from the Benin River estuary to Kwa Ibo River, and (4) the Strand Coast spanning from the Kwa Ibo River to the eastern border with Cameroon (Egberongbe *et al*., 2006). The vegetation of the coast consists of herbaceous plants and shrubs such as raffia (*Raffia hookeri, Raffia sudanica),* oil palm (*Elaeis guineensis*), and coconuts (*Cocos nucifera*) found along the Barrier Lagoon coast, white mangrove (*Avecinna nitida*) and red mangrove (*Rhizophora racemosa*) that dominate the Mahin transgressive mud coast and the Arcuate Niger Delta, and ferns (*Acrosticum aureum*) and the introduced species of nypa palm (*Nypa fruticans*), which are becoming more abundant (USAID, 2008; Udoh, 2016).

The Nigerian mangrove ecosystem is among the largest in the world and largest in Africa covering an area of approximately 6,894 km^2 (Global Mangrove Watch, 2016; Adegbehin and Nwaigbo, 1990; Anon, 1995; Macintosh and Ashton, 2003). The largest extent of mangroves is found in the Niger Delta between the region of the Benin River in the west and the Rio del Rey estuary in the east. A maximum width of 30 to 40 km of mangroves are found on the flanks of the Niger Delta (Nwilo and Badejo, 2006; Arabomen *et al*., 2016). Due to its abundant natural resources, the Niger Delta system is among ten most important marine ecosystems in the world, contributing more than 50% of the entire domestic Nigerian fish supply, providing natural habitat for a wide variety of endemic coastal and estuarine fauna and flora, and supporting over 60% of species found in Nigeria (IUCN, 1994; World Bank, 1995; Akankali and Jamabo, 2011). The system supports a wide range of ecosystem

services, from various economically significant tree species among which some are of medicinal use, fuel wood use, canoe making, and house construction, to habitat provision for diverse marine and terrestrial organisms, nursery grounds for many finfish and shellfish (thereby supporting the shellfisheries), and shoreline protection via moderating storm impacts from wave energy (Udoh, 2016).

Shellfishery activity in Nigeria includes the harvesting and processing of various shellfish such as clams, mussels, oysters, periwinkle, scallop, and some crustaceans including shrimp, prawn, lobster, crayfish, and crab. These are exploited for consumption as well as in some cases as raw materials for both local and international markets (Jimoh and Lemonu, 2010). Shellfisheries along the mangrove coast are a source of employment for artisanal fishermen, women, and their households. In addition, they provide these communities with a reliable source of protein and micronutrients needed for growth and development as well as disease prevention.

In Nigeria, like other developing countries of the world, women's involvement in fisheries is primarily in post-harvest (processing, marketing, etc.) activities. However, in the shellfishing sector women are important in all aspects of production, from harvesting to processing, distribution, and marketing (IFAD, 2008). Even in some species-specific shellfisheries that are male-dominated, women are still crucial actors through their financing of shellfish production units operated by men such as boats, engines, and gear (Williams, 1996). Bamidele (2017) argued that fisheries in Nigeria, inclusive of shellfisheries, would be more lucrative if more women were involved beyond their traditional roles.

There are many challenges to the participation of women in capture fisheries in Nigeria, including low participation (particularly of married women) in decision making, lack of basic education, persistent cultural norms and beliefs that women are weaker and are meant for procreation and culinary duties, lack of land ownership in patrilineal society, restricted access to credit, and inadequate dissemination of information through extension services (Bamidele 2017). These challenges are assumed to affect the full participation of Nigerian women in shellfishery livelihoods and value chains as well.

Efforts at conservation of shellfish livelihoods in Nigeria like other environmental and biodiversity policies lag behind other sectors in policy and legislative reforms and have yet to receive the deserved recognition and serious consideration (Raji *et al*., 2012). Existing laws are obsolete as only conservationists, scientists and environmentalists are concerned about biodiversity despite its contribution to the livelihood of rural and urban dwellers. Nigeria has entered into some international treaties on biodiversity conservation, but these have been followed by slow or very poor implementation with little budgetary allocation to implement them. Hence, it is common to observe biodiversity related laws being broken due to low or no awareness and lack of capacity for law enforcement agents to deal with the issue (Nigerian Fifth Biodiversity Report, 2015).

The current study assesses the scale and scope of shellfisheries and shellfish-based livelihoods connected with mangrove systems and coastal water bodies in Nigeria through a participatory approach. This study complements a literature review covering shellfisheries in each of the 11 coastal West Africa countries from Senegal to Nigeria (Chuku et al. 2020). The specific objectives were to:

a. Identify types of mangrove/estuarine ecosystem-based shellfisheries, by species and location.
b. Estimate catch per day/month/season, fishing calendar, seasonality of shellfisheries and harvesting methods, processing, and trading of shellfishes.
c. Estimate revenue generated from mangrove/estuarine ecosystem-based shellfisheries.
d. Determine the challenges and health-related conditions associated with the consumption of shellfishes.
e. Assess mangrove exploitation, its uses, gender attributes in its harvest, condition, and protection status.
f. Determine the governance/management regimes as applied to shellfisheries and mangrove systems.
g. Determine the effect of climate risks on the livelihoods and food security of women who depend on coastal mangrove and estuarine systems.

2. Methodology

2.1. Study sites

Five of the seven states where shellfisheries activities are carried out were selected for field survey. These were Ondo, Delta, Rivers, Akwa Ibom, and Cross Rivers States and they were chosen based on their location in the heart of the Nigerian mangrove ecosystem as representatives of the Nigeria mangrove coast. Fishing villages were selected from each of the states (Figure 1) for interaction and capturing of relevant information. Basic descriptions of these five village communities are as follows:

1. Ogogoro Community, Ilaje Local Government of Ondo State is a fishing community on the Mahin Transgressive Mud coast of the Atlantic Ocean, with low energy from wave action.
2. Ogheye Community, Warri North Local Government of Delta State is a fishing community on the boundary between the Mahin transgressive mud coast and the Arcuate Niger Delta where Koko River empties into the Atlantic Ocean, as has a mix of mud and sand coast along the Arcuate Niger Delta with low wave action.
3. Bonny Island, Bonny Local Government of Rivers State is an isolated island with a heavy presence of oil exploring companies and high wave energy.
4. Ibeno, Ibeno Local Government of Akwa Ibom State is a fishing community where the Kwa Ibo River empties into the Atlantic Ocean at the extreme end of the Arcuate Niger Delta coast and experiences high wave energy.
5. Calabar, Calabar South Local Government of Cross Rivers State is on the Strand Coast and experiences low wave energy into the river/creek.

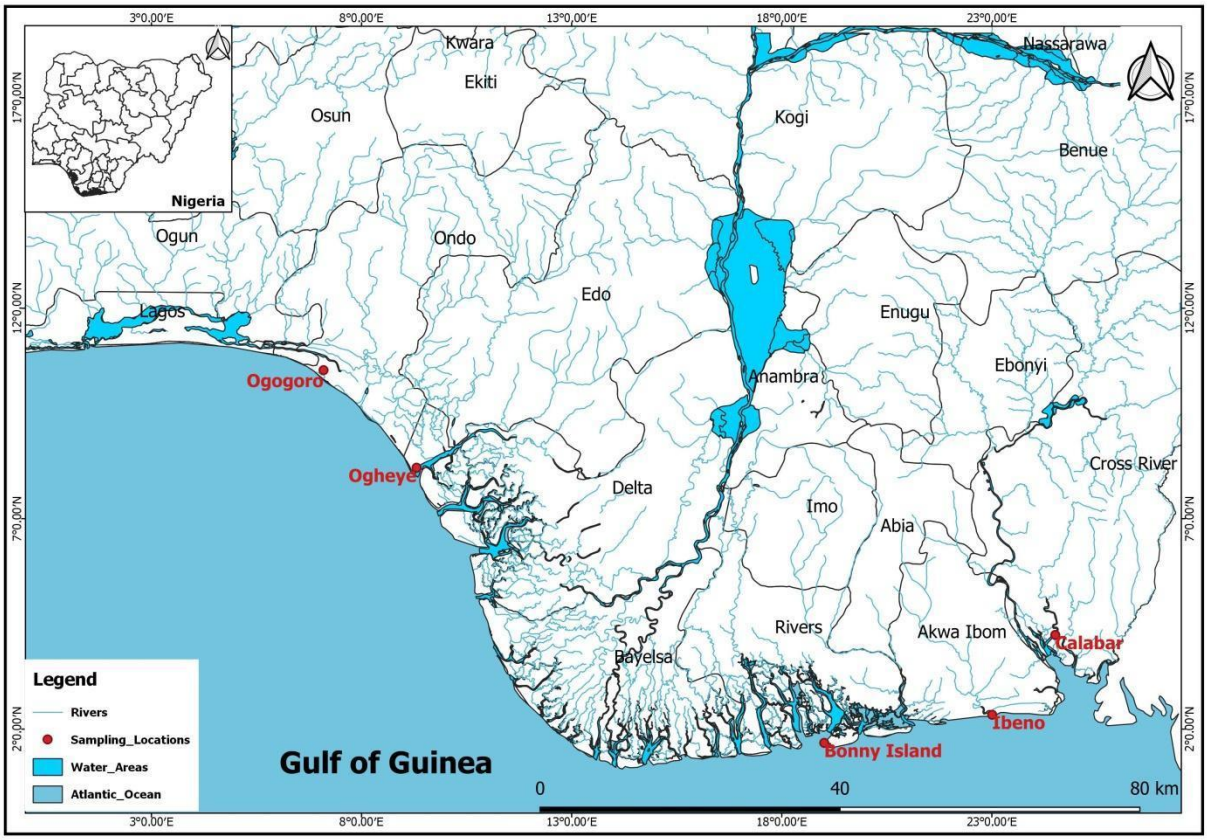

Figure 1: Nigeria Mangrove Coast, showing sampled fishing communities.

2.2. Field survey/data collection

Participatory research was employed with the use of semi-structured interviews guided by a standard survey instrument. The survey instrument is available in the regional summary report (Chuku et al, 2021). The data collection was designed to capture information from men and women who engage in shellfisheries as well as some individuals in governmental organizations and research institutions. Areas covered in the questionnaire include background information of respondents, shellfisheries, mangrove ecosystem, governance and management regimes, and climate risk management. Participation was voluntary and COVID-19 safety protocols were strictly observed. Data collection was carried out from the 11th to the 24th of March 2021. A total of 50 questionnaires were administered to respondents, out of which 42 returned their forms (Table 1). Overall, the response rate was 84%.

Figure 2: Shellfish resource users across communities of the Nigerian mangrove coast.

Table 1: Total response rates and respondents according to participant category and study site.

	Resource Users	Govt/Academic/NGO	Total
Administered			
All sites	40	10	50
Completed			
Ondo State	6	2	8
Delta State	8	2	10
Rivers State	8	2	10
Akwa Ibom State	7	0	7
Cross Rivers State	5	2	7
Total	**34**	**8**	**42**
Response Rate	**85%**	**80%**	**84%**

2.3. Estimation of catch and revenue

For analysis, simple counts and percentages of questionnaire item responses were calculated. With respect to income, hard figures were solicited where applicable. Catch quantities were converted to their equivalent mass in kilograms (kg) and existing market prices were determined.

2.4. Summarized background data

Out of the 42 field survey participants, 22 were women while 20 were men constituting 52% and 48% respectively. The age of the participants ranged from 23 to 75 years (23-75 for women and 30-69 for men), and 97% fall within what is considered locally as the active age bracket of 20-59 years. Over 85% of women participants were of reproductive age. Eighty one percent of participants were resource users, while 12% worked in local government positions, and 7% worked in research or academic positions (Table 2). Shellfishery resource users in Nigeria have an average estimated household size of 11 members, one of the highest across the 11 assessed coastal West Africa countries.

Table 2: Demography of respondents.

Number of Respondents		42
Sex	Female	52%
	Male	48%
Age Range (97% Active Age)	Female	23-75
	Male	30-69
Categories	Resource Users	81%
	Government staff	12%
Family size range		3-33
Shellfish consumption rate		
Daily		60%
Weekly		38%
Monthly		2%

3. Status of shellfisheries

3.1. Shellfish Exploitation

3.1.1. Estimated number of shellfishers

Official information on the number of shellfish harvesters in Nigeria is largely not available. In this participatory assessment, the resource users indicated the number of shellfishers in their communities and/or harvesting areas. Conservative estimates are made with the assumption that each respondent represents exclusively one harvesting area/community to moderately compensate for the shellfish harvesting sites not visited, while averaging obvious duplications for communities with large numbers. The final number figure provided in this report represents a combination of these estimates from the participatory assessment as well as information gleaned from available literature sources deemed reasonable from the perspective of ground experience in the women-led shellfisheries sector.

With this in mind, it is estimated that there are about 39,340 individuals involved in shellfishing activities distributed across various villages and states along Nigeria's mangrove coast. Of this pool of shellfish resource users, approximately two-thirds are women. There are an estimated 415,548 direct beneficiaries of shellfishing harvest in Nigeria. These number figures are the highest by an order of magnitude across the 11 coastal West Africa countries in the assessment.

3.1.2. Insights on gender in shellfish exploitation

In terms of gender role interactions with shellfish species, 90% of field survey participants report that men are involved in crayfish and prawn harvesting in the deeper regions within the estuarine and marine ecosystem while women are involved in harvesting of crabs, oysters, periwinkles, etc., in the

shallow waters of the mangrove swamp. Women dominated shellfishery species are shown in Table 4.

About 60% of the women population of shellfish resource users in Nigeria participate in male-dominated shellfisheries as processors and traders. The other 40% of women shellfish resource users harvest, process, and trade in the various other shellfish species completely independent of men. All of the men resource user participants reported harvesting shellfish for consumption, indicating shellfishing as a subsistence activity at least partially for these users. In the case of women however, 63% of participants report operating solely at the level of shellfish processing and trading while 37% combine these activities with harvesting. The latter appears to line up with and represent the aforementioned portion of women who are working within women-dominated shellfisheries. Overall, shellfishing activities in Nigeria involve both women and men and, in some cases, involve all members of the fisher households as an avenue to provide nutrition and means of livelihood.

Figure 3: Women complementing men's effort in harvesting P. notialis in Ibeno, Akwa Ibom State and Ogheye, Delta State from left to right respectively.

3.1.3. Shellfishing as primary occupation

The 40% of women shellfishers who are engaged in shellfisheries absent of men are carrying out these activities across the value chain (harvesting, processing, and trading) as their main source of livelihood. Therefore, those women operating in women-dominated shellfisheries are doing so as their primary occupation. Processing and trading by women of species harvested by men is considered a lucrative activity with a high rate of return on investment. This observation may point also to this work as a primary form of occupation for women working higher up the value chain in male-dominated harvest shellfisheries, though this was not explicitly reported. Carpentry is reported as the main form of alternative livelihood for male survey participants which includes boat building and stilt house

construction where applicable. Field survey participants reported that they harvest shellfish on a daily basis except on Sundays.

3.1.4. The shellfish value chain

Participants indicated that 100% of male resource users are primarily involved in harvesting. Women are either harvesting, processing, and trading species of shellfish solely exploited by women (40% of women resource user respondents) or processing and trading the shellfish species harvested by men. This indicates a somewhat vertically integrated value chain with women harvesters present at every node of some shellfish value chains (i.e., oysters and periwinkles) and implies that value chain improvements at any node can directly benefit women harvesters. This creates an opportunity to incentivize behavior change for sustainable resource management. Furthermore, women engaged in the value chains of women-dominated shellfisheries report carrying out these activities as their sole means of livelihood, increasing the stakes of sustainability within the sector for women

As a result, 100% of processing and sales of shellfish are being carried out by women both in local and distant markets. Some women also invest in the harvest activities carried out by men such as through the purchase of outboard engines, boats, and nets. This investment by women is motivated by the result of secured access to privileged shellfish supply and pricing from men. Some estimates across West Africa place this cash flow by women in processing and marketing roles as financing 60% of shellfishing activity (Williams, 2003), clearly indicating the economic importance of women in the sector. However, participants in Nigeria also stated that they feel men's participation is important and needed for a robust shellfishing business. An illustrative example of the complementary roles of women and men in shellfishing in Nigeria is shown in Figure 3.

The various methods of preparation of shellfish for consumption include smoke drying over fire, which is referred to as smoking and typically involves crayfish, prawns, and crabs. Other preparation methods include boiling and shell removal (carried out with periwinkles and oysters) and cutting and cooking (carried out with periwinkles). Other uses of shellfish in the various communities reported by field survey participants were the seasoning of sauce or soup (using crayfish and prawn), animal feed (using crab, crayfish, and prawn), concrete making in construction (with the shells of periwinkles and oysters), traditional medicine making (with oyster shell), and ornament making (with bivalve and clam shell).

All participants in this study report consuming shellfish, the majority of whom do so daily (60%), while smaller percentages report consuming shellfish either weekly (38%), or monthly (2%) (Table 2). The local consumption of oysters is restricted to the coastal areas with very little known about it in other Northern parts of the country.

3.1.5. Species harvested

Shellfisheries in Nigeria are considered by survey participants to be dominated by shrimp and prawn fishing. The pink shrimp (*Peneaus notialis*), generally known as crayfish, is the dominant species. This activity is mostly carried out in the mangrove and is male dominated but complemented by women (Iheme, 2014). However, Nigeria has additional diverse shellfish resources ranging from the molluscs

such as the bloody cockle (*Senila senilis*), cockles (*Cardium costatum*), periwinkles (*Tympanotonus fuscatus*) and oysters (*Crassostrea tulipa*) to the crustaceans which includes the Penaeidae taxonomic family group (shrimp), Palaemonidae (shrimp), Portunidae (swimming crab) and Palinuridae (spiny lobster). This diversity is reflected in the various species mentioned by respondents as shown in Table 3 and those pictured in Figure 4. Other species encountered include the invasive giant tiger prawn (*Penaeus monodon*) and dog winkle (*Thais haemastoma*). These species are harvested from a range of water bodies including the Ogogoro coast and adjoining waters stretching to the Atlantic Ocean, the Benin River estuary, the Ogheye coast and adjoining Koko River, Nembe River, Bonny River, Andoni River, Bodo Creek, Buguma Creek, Kwa Ibo River, Oron River and Ibeno Coast, Calabar River, and Cross River. Specific habitats for these species are listed in Table 3.

The mangrove oyster *Crassostrea tulipa* is harvested in the coastal swamps in Nigeria. According to Ajana (1980), the *C. tulipa* occurs throughout the year in the Niger Delta of the River state and also in the coastal saline swamps of Bendel, Cross River and Rivers State. It is considered an important fishery resource in the Rivers state. This oyster species can also be found in Lagos State along the Badagry Creek (Sandison and Hill, 1966). Within this region, it can be found during the dry season (between November and Mid-May) along the harbor, Apapa and Iddo areas, and Kuramo waters throughout the year.

More popular bivalve species in Nigeria include estuarine bloody cockles (*Senila senilis* and *Anadara senegalensis*), cockles (*Cardium costatum*), and clams of the Donacidae family. Other species found in Nigerian estuaries include univalves such as *Pachymelina quadriserata*, *Tympanotamus fuscatus* (periwinkle), which lie in or on the sediment of the mangrove swamp and are exposed at low tides (Jimoh & Lemomu, 2010).

Figure 4: Shellfish species harvested from mangrove and estuarine coastal systems in Nigeria. Pictured are: (A) P. notialis, (B) P. atlantica, (C) T. fuscatus, (D) Cuttlefish, (E) Oyster, and (F) T. haemastoma.

3.1.6. Harvest volumes and value

The total harvest amount for all shellfish species in Nigeria has been estimated to yield about 51,760 metric tonnes annually (Jimoh and Lemonu, 2010). Shrimp and prawn species are estimated to have the highest commercial importance with production levels estimated between 10,000-15,000 metric tonnes annually. However, according to field survey participants across shellfishing communities of the Nigerian mangrove coast, crayfish, periwinkle and crabs are consistently ranked as the three most important species from an economic perspective based on volume and value.

Price and catch of shellfish in Nigeria vary with location. In Ondo State, the average weight of a basket of crayfish was estimated at 50 kg and shellfishers were stated to harvest up to 6 baskets per day for a total catch of 300 kg per shellfisher per day. Delta and Rivers States also averaged 50 kg catches for a single basket but reported up to 40 baskets per fisherman for total catches of up to 2,000 kg per shellfisher per day. Akwa Ibom estimated an average weight of catch in a single basket as 30 kg and reported up to 40 baskets harvested per shellfisher for catch amounts of up to 1,200 kg per shellfisher per day). In Cross Rivers, total catch amounts were estimated at up to only 90 kg per shellfisher per

day. Total catch weights for other species where they are available for more than one location were estimated to be uniform, but with varying prices as shown in Table 5. The oysters and periwinkle species harvested by women have a dramatically lower price than the species harvested by men.

Table 3: Common names and habitats of shellfish species of the Nigerian mangrove coast.

Species	Common Name	Habitats
Peneus notialis	Pink Crayfish	Sandy mud substratum/ water column (marine)
Parapaeneopsis atlantica	Prawn	Sandy mud substratum/ water column (marine)
Macrbrachium macrobrachion	Brackish water prawn	Sandy mud substratum (estuary)
Callinectes amnicola	Crab	Sandy mud substratum (estuary)
Tympanotonus fuscatus	Periwinkle	Mud substratum (estuary)
Pachyemelina auratus	Rough skin Periwinkle	Mud substratum (freshwater)
Egeria radiata	Bivalves	Sandy mud substratum (freshwater)
Cantharus viveratus	Whelk	Roots of mangrove (estuary)
Crassostrea tulipa	Mangrove Oysters	Roots of mangrove (estuary)
Octopus vulgaris	Octopus	Water column (marine)
Nerita senegalensis	Sea snail	Sandy mud substratum (estuary)

Table 4: Shellfish species harvested corresponding to gender.

Species	Male	Female
Peneus notialis	+	-
Parapaeneopsis atlantica	+	-
Macrbrachium macrobrachion	+	+
Callinectes amnicola	+	+
Tympanotonus fuscatus	-	+
Pachyemelina auratus	_	+
Egeria radiata	_	+
Cantharus viveratus	_	+
Crassostrea tulipa	_	+
Octopus vulgaris	+	_
Nerita senegalensis	+	_

Table 5: Estimated price per kilogram of shellfish species along the Nigerian mangrove coast.

Species	Ondo State	Delta State	Rivers State	Akwa Ibom State	Cross Rivers State
P. notialis	$2.96	$2.09	$1.57	$2.62	$4.80
P. atlantica		$1.57	$1.47	$2.44	
T. fuscatus	$0.03	$0.16	$0.05		$0.78
C. amnicola	$0.09	$1.75	$0.17	$0.87	$2.09
C. tulipa	$0.05			$0.26	$0.87
O. vulgaris				$1.22	

3.1.7. Seasonality of harvests

Seasonality of shellfishing activity along the Nigerian mangrove coast varies by location and is presented in Table 6.

Table 6: Seasonality of shellfish harvesting by species along the Nigerian mangrove coast.

Ondo State			
Species	Seasonality	Months	Frequency
Peneus notialis	+	June to September	Daily
Parapaenopsis atlantica	+	June to September	Daily
Tympanotonus fuscatus	+	December to April	Daily
Callinectes amnicola	+	December to April	Daily
Crassostrea tulipa	+	December to April	Daily
Delta State			
Species	Seasonality	Months	Frequency
Peneus notialis	_		Daily
Tympanotonus fuscatus	_		Daily
Callinectes amnicola	_		Daily
Crassostrea tulipa	_		Daily
Octopus vulgaris	_		Daily
Rivers State			
Species	Seasonality	Months	Frequency
Peneus notialis	+	November to January	Daily
Tympanotonus fuscatus	_		Daily
Callinectes amnicola	_		Daily
Crassostrea tulipa	_		Daily
Akwa Ibom State			
Species	Seasonality	Months	Frequency
Peneus notialis	+	April to December	Daily
Parapaenopsis atlantica	_		Daily
Tympanotonus fuscatus	_		Daily
Callinectes amnicola	_		Daily
Crassostrea tulipa	_		Daily
Octopus vulgaris	_		Daily
Cross Rivers State			
Species	Seasonality	Months	Frequency
Peneus notialis	_		Daily
Tympanotonus fuscatus	_		Daily
Callinectes amnicola	+	April to October	Daily
Crassostrea tulipa	+	November to April	Daily

NOTE: (+) indicates seasonal, (-) indicates not seasonal.

3.2. Mangrove Ecosystem

Mangrove forests of Nigeria are the largest in Africa, ranking among the largest in the world at 689,417 total hectares of mangrove cover nationally (Global Mangrove Watch, 2016), with 504,800 hectares coming from the Niger Delta and 95,000 hectares coming from the Cross River State areas alone (UNIDO, 2007).

A majority of the country's mangrove forests are found in the Niger Delta system, particularly between the Benin and Cross rivers, and are dominated by the red mangrove species *Rhizophora racemosa*. However other species include *R. harrisonii*, *R. mangle*, and the white mangrove species *Avicennia nitidae*. Most shellfish resources in Nigeria are found within this region (Amosu A. O, 2012; Jimoh & Lemomu, 2010). The Mahin mud coast stretches approximately 20km inland and is dominated by mangroves, particularly by *Rhizophora racemosa* and *Avicennia spp.* The Strand coast constitutes about 85km of the Nigerian coastline with species of mangrove similar to the Niger (Awosika & Folorunsho, 2005). The Apoi Creek Forests (29,213 ha) located in the Central Niger Delta is the only Ramsar site close to the coastal areas in Nigeria (RSIS, 2016). It is primarily a freshwater wetland.

Mangrove forests in Nigeria have been degraded over the years and continue to face threats including destruction due to oil exploitation and mining, urbanization, commercial shrimp farming, and tourism. In particular, oil and gas exploration activities have been one of the main causes of the destruction of mangroves in the Niger Delta since these activities began in 1956 (Numbere, 2018). Degradation also results from overexploitation of the mangroves for fuelwood, charcoal production and building materials.

Nearly all (98%) of field survey participants reported that there are mangroves near or within the water bodies where shellfishes are harvested in their communities. Participants added that mangroves are being exploited in their community for various reasons including use in the building of houses (huts), traditional medicine, as firewood for processing fish and shellfish, construction of footbridges in some parts of the coast, and in the making of fishing gears. Fishing gears such as trap nets for prawn, crayfish, and crab have been observed to be made partly with mangrove branches. However, the most important use of mangrove material to coastal dwellers is thought to be its use in the processing of fish and shellfish as there is almost no alternative method in Nigerian coastal fishing villages for drying these resources.

Despite these accounts of exploitation, 80% of survey participants reported that mangrove habitat in their various communities is in good condition. The Niger Delta system that hosts much of this mangrove cover remains characterized by high biodiversity. However, at the same time there are reports of pollution from oil exploration, asphyxiation of the mangrove trees due to blockage of their pneumatophores, habitat degradation, sea level rise, coastal erosion, and introductions of exotic species, an example of which is the Nypa palm that is displacing mangrove species in the southeastern part of the coast. Nypa palm was introduced to Calabar, Oron, and Opobo from Singapore by the British in 1906 for use in coastal erosion control and has spread as far as Ogun State. The presence of Nypa increases soil acidity and negatively impacts local finfish and shellfish species (UNIDO, 2007).

3.3. Government/Management Regimes

All field survey participants (100%) reported that there are no formal laws/regulations currently applied to specific shellfisheries and mangrove systems in their communities along the Nigerian mangrove coast. In relation to traditional practices or customs, 19% of participants mentioned that harvesting of shellfish and mangrove material is not allowed on Sundays, specifically in Bonny Island, River State. One individual mentioned that some amount of money is paid to representatives of traditional rulers when mangroves are harvested in Cross River State. Another individual mentioned that the cutting of mangroves is prohibited for a period of time in Ondo State, perhaps indicating a type of closed season for mangrove material harvest. Aside from a few unique accounts, there does not appear to be a generalizable, traditional custom or practice related to mangrove exploitation. Ajana (1980) reported that in some villages a license is necessary to harvest oysters and a monthly catch quota is imposed during the oyster harvest season. In Kuramo, there is a closed season (February-April) when no oyster harvest is allowed.

None of the resource users nor the survey participants making up the 19% holding government or academic positions reported any awareness of laws applied to shellfisheries or mangrove systems in Nigeria.

3.4. Climate Risk Mitigation

Nearly all (98%) of the field survey participants identified rainfall as the major climatic factor affecting shellfisheries in Nigeria. Fluctuating coastal water levels resulting from the presence and absence of rain substantially impact shellfish catch amounts. Various observations of opportunities and challenges related to rainfall were provided by participants, such as one individual who shared that the dry season increased chances of getting shellfish such as crayfish. Another participant mentioned that increased water levels posed difficulties to those who must dive into the water to collect certain species, while on the other hand sea level rise was pushing marine species landward, making their collection easier.

The vast majority of participants saw climate change as affecting shellfishing activities and not vice versa. The small percentage (2%) that perceived this relationship as coupled noted the removal of mangrove material for its use as fuel for drying fish increases impacts of rainstorm events and coastal erosion.

4. Conclusion and Recommendations

This assessment has demonstrated that shellfishing livelihoods are active along the Nigerian mangrove coast, and that both women and men participate in the venture. Men dominate the harvesting of

Penaeus notialis and other species associated with its harvesting such as *Parapeneopsis atlantica*, while women dominate the harvesting of *Tympanotonus fuscatus, Callinectes amnicola and Crassostrea tulipa*.

Harvesting of shellfish is a mainstay of coastal livelihoods in Nigeria but the revenue generated from this sector has had little positive impact on standard of living among these communities. This is perceived to be due in part to a lack of business management skills to maximize profits. An almost complete majority (98%) of participants in this assessment feel that modern storage and processing facilities should be provided by government or other agencies to improve shellfisheries livelihoods of women in their communities. These individuals also reported wanting financial empowerment for women, including the provision of subsidized fishing gears, boats, and engines. Lastly, a respondent suggested education and training for women shellfishers in culture techniques to grow higher value species for the market, thereby enhancing livelihoods.

This study also revealed that shellfish processing is a primary driver of the harvesting of mangrove material in Nigeria. Indiscriminate harvesting of mangrove can lead to depletion of mangrove resources including as habitat for shellfish. It is recommended that modernized processing facilities can employ the use of other fuel materials to mitigate this threat. Lastly, there is a need to facilitate the organization of women shellfishers in Nigeria into groups and associations so that they may be able to build social capital and access funds in the form of grants and loans from corporate organizations.

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