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WOMEN SHELLFISHERS AND FOOD SECURITY PROJECT
PARTICIPATORY ASSESSMENT OF SHELLFISHERIES IN THE ESTUARINE AND MANGROVE ECOSYSTEMS OF SIERRA LEONE



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Cover photo: Various women harvesters of Sierra Leone.

Photo credit: Salieu Sankoh

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ACRONYMS

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

Executive Summary

Basic Contextual Information	
Country	Sierra Leone
Total land area	71,740 km ²
Population	7.65 million (2018)
Percentage population living in/near the coast	35%
Gross Domestic Product (GDP)	4.085 billion USD (2018)
Human Development Index Rank	0.438 (181 of 189) (2018)
Length of coastline	506 km
Fish consumption (as a percent of animal protein)	80%
Anemia prevalence	76% among under-five children 70% among pregnant women 48.0% among women of reproductive age (15-49)
Estimated mangrove cover	126,403 ha
Estimated estuarine and mangrove ecosystem-based shellfish harvesters	354
Estimated women shellfish harvesters (percent)	171 (48%)
Estimated direct household shellfish beneficiaries	3,487
Estimated percentage of shellfish harvesters at all nodes of the value chain (vertical integration)	90%
No. of coastal systems with mangrove-based shellfishing	4
Shellfish management regulations	Fisheries and Aquaculture Acts, 2018 Fisheries and Aquaculture Regulations, 2019
Mangrove regulations	-
Coastal ecosystems with shellfisheries identified as Ramsar sites	Sierra Leone River Estuary (295,000 ha)

Sources: Chuku et al. 2020, Global Mangrove Watch, Ramsar Sites Information Service (RSIS)

- Little attention has been dedicated to investigating the status and relevance of shellfisheries in Sierra Leone. This country assessment aimed to document the importance and contribution of shellfish resources to food security and livelihoods of women shellfishers in Sierra Leone.
- The assessment used a participatory approach and involved the identification of shellfish resources found in the country, communities that depend on such resources and their socio-

economic status, methods of exploitation and processing, and opportunities for improved governance. The assessment also looked at comparative quantities of species harvested, their value and ranking as a source of livelihoods to the resource users.

- 15 out of the 20 shellfish harvesters interviewed in the assessment were women and 5 were men. A total of 425 shellfish harvesters/processors were reported to reside in their communities. Of these 425 reported shellfishers, 220 were men or boys and 205 were reported to be women or girls. However, this high number of men shellfishers is perceived to be partly a result of fishers incidentally catching shellfish as bycatch being reported as shellfishers.
- Women harvesters in particular were 40% of reproductive age (15-49) while the remaining 60% were between ages 50-70 years old.
- Women harvesters are reported to be targeting sedentary or slow-moving species (oysters, cockles, razor clams, periwinkles, crabs and crayfish/baby shrimps), with men targeting motile or fast swimming species.
- Eighteen out of the 20 resource user participants interviewed do five of the six shellfishing activities of harvesting, transportation, processing, marketing/retailing and consumption. This indicates that there is no specialization in the shellfish value chain in Sierra Leone and it is highly vertically integrated, implying that improvements at any node can directly benefit harvesters and incentivizing behavior change for sustainable resource management.
- There are more than ten species of shellfish that are economically important and exploited for food and other uses. The most important species as captured in survey responses are crabs, oysters, shrimps (4 species), lobsters, cockles (2 species), clams (2 species), snails (3 species), squids, and octopuses.
- Harvesting of marine swimming crabs, lobsters, cephalopods, and shrimps at the industrial scale, and using pots and seine nets in the artisanal fisheries, is dominated by men. Freshwater crabs, crayfish, and coastal juvenile shrimp are harvested by women and girls using pots and scoop nets. Processing of harvested shellfish (mainly smoking/drying) is dominated by women and girls.
- Some shellfish species (e.g., crab, snails, lobster, squid, and octopus) are available and exploited throughout the year, while others (e.g., oysters, shrimp, cockles, and gastropod snails) are seasonally available mostly in the dry season.
- All reported shellfishes harvested in Sierra Leone are used for human consumption and the shells of a few species are used as feed for livestock, whitewash paints, tiles, ornaments, internal decoration, jewelry, ash trays, road works, and as aggregate in the construction of houses.
- Water bodies where shellfish were reported to be harvested by study participants were the Scarcies River Estuary for the Konakridee and Yongro communities, the Sierra Leone River Estuary for the Tagrin and Pamronko communities, the Sherbro River Estuary for the

Kabawokor community, Nyandehun community, King Jimmy community, Domkobor new site community, and Gbongboma community.

- There is no standard method of measurement for daily or weekly shellfish harvests across participant communities, challenging estimates of total harvest volumes and values. Estimates are provided based on best guesses of kilogram equivalents of each of the different units of measurement used across communities. Average monthly income per shellfisher for their primary exploited shellfish species is US \$71.82.
- Market outlets for shellfish in Sierra Leone include local markets in the coastal communities, while smoked products are taken to more remote and higher paying market centers in the interior of the country. Participants reported that smoked snails are packaged for the US market at Tombo, but that these are harvested by industrial trawlers and bought and processed by women.
- Governance of the shellfish resources is currently weak in Sierra Leone with open access by fishers at the small-scale level, whereas industrial operators that target shrimps, lobsters and cuttlefish do pay a license that is more expensive than finfish.
- The small-scale harvesters of shellfish in Sierra Leone are operating as individuals and do not belong to any organized groups. However, there do exist general fishers' organizations such as the Sierra Leone Artisanal fishermen's Unions/consortium and the community management Associations, that claim to seek the interest of all fishers, including shellfishers.
- National and local laws governing fisheries, forestry, wetlands and protected areas management are all applicable to the shellfish exploitation, with a lot of overlap and confusion in the management regimes.
- Mangrove exploitation rate is high given its multiple uses locally, but participants also regarded these habitats as very important in climate change mitigation.
- Major challenges to the sustainability of shellfisheries livelihoods in Sierra Leone include safety regarding accidents at sea, cuts on hands and feet during harvest (particularly for oyster harvesters), the perishable nature of shellfish product, diarrhea and cholera associated with shellfish consumption, and heavy metal accumulation in some shellfish, particularly sedentary species and those located in estuarine habitats experiencing discharge from mining areas.

1. Introduction

The Republic of Sierra Leone is located on the West Coast of Africa, between latitudes 7 and 10 north and longitudes 10.5 and 13 west. The country has 560 km of coastline and a land area of 72,300 km². It borders Guinea to the north and northeast, Liberia to the south and southeast, and the Atlantic Ocean to the west. The country's landscape offers a flat coastal belt, and the eastern half of the nation is covered by hills and high mountains. The main rivers of Sierra Leone are the Sewa River (approx. 340 km), Jong River (230 km), Little Scarcies River (260 km), Rokel River (260 km), and Moa River (190 km) which all drain the northern highlands and discharge into the Atlantic Ocean.

The country's 560 km long coastline has a continental shelf with a width of 100 km in the north and 15 km wide in the south. The coastline is also very irregular in formation (Figure 1) forming many bays and peninsulas. Freshwater swamps and mangrove swamps occupy large extents of the coastline, and the coastal plain is characterized with many estuaries. Sierra Leone's wetlands extend for over 500 km along the country's western coast bordering the Atlantic Ocean. This coastal landscape is characterized by an extensive network of estuaries, which include the Scarcies River Estuary (44.4 km²), Sierra Leone River Estuary (2,950 km²), Yawri Bay (295 km²), and the Sherbro River Estuary (283.54 km²). These estuaries are fed by a network of rivers that originate in the mountain ranges of northern Sierra Leone and central Guinea.

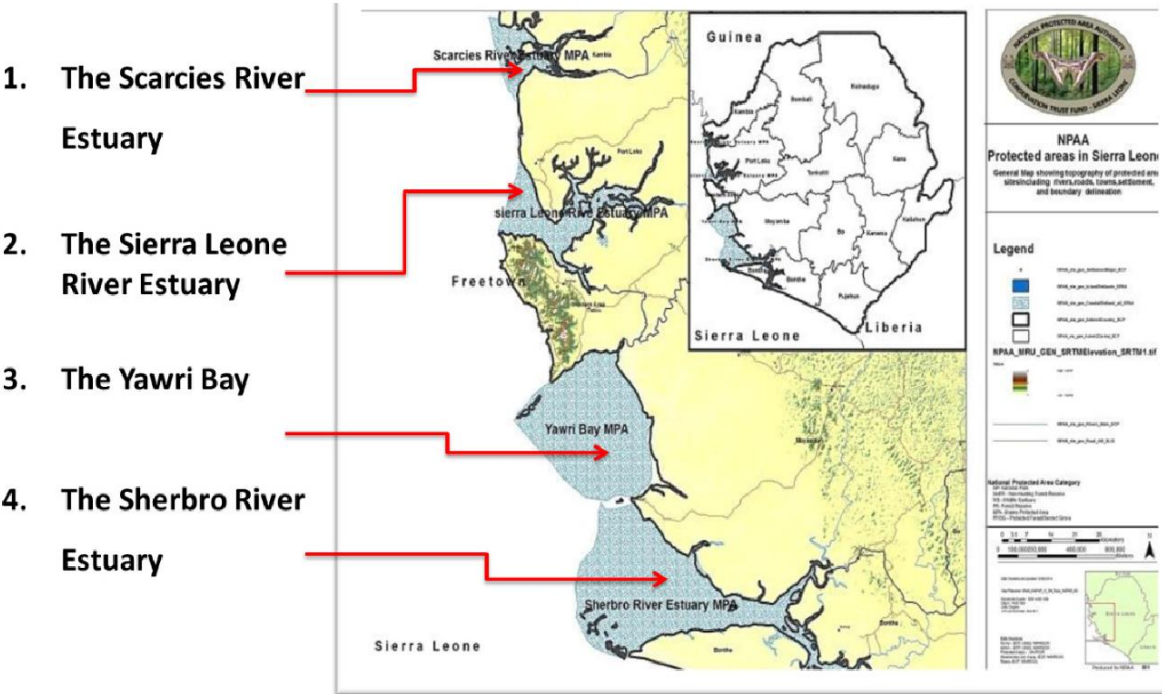


Figure 1: Location of major mangrove areas in coastal Sierra Leone (Source: <http://www.ciesin.columbia.edu/wa-bicc/>).

Little attention has been dedicated to investigating the status and relevance of shellfisheries in Sierra Leone. The few available studies have focused on oysters in the Sherbro Island communities, where oyster harvesting, processing, and marketing are identified as a viable source of livelihoods for women oyster harvesters but considered destructive to mangrove ecosystems in the Sherbro River Estuary. In the Scarcies River Estuary, mangroves have been identified as economically important ecosystems and studies have been conducted identifying living aquatic resources associated with mangroves as well as coastal community dependence on these resources. Sierra Leone's economy is almost entirely dependent on its natural resource endowment, with most employment in the country linked to the environment and natural resources.

Livelihood strategies in coastal Sierra Leone are dominated by fishing and related activities with overall low-income diversification. A USAID/West Africa Biodiversity and Climate Change (WA BiCC) Project study in Sierra Leone recorded that for 30% of households fishing was their only livelihood activity. Fish smoking is mostly carried out by women (Trzaska et al. 2018). The absence of alternative fish preservation methods means that coastal fishing households have few choices but to engage in smoking their fish as the only fish preservation method. The same WA BiCC study recorded that another 30% of the coastal households were engaged in farming but the percentage of farmers varies with location of the coastal community in the study area, ranging from over 85% being farmers to none in several locations (Trzaska et al. 2018). The rest of the respondents in the study were either fish processors, fish traders or petty traders.

Rossi (2017) recorded that oyster and cockle harvesters within the Sherbro River Estuary communities are predominantly female (87%), and typically harvest alone or with one other harvester. Islam (90%) was the dominant religion, with only 10% of harvesters in the 2017 study identifying as Christians. Of Sierra Leone's 18 ethnic groups, only two were represented in Rossi's study areas in the Island: Sherbro (74%) and Mende (26%). Oysters and cockle harvesting was identified as a legacy livelihood in Sherbro Island by Rossi et.al. 2017, where harvesters are reported to traditionally learn the trade from parents or older family members. In the study, harvesters considered the start of their harvesting career to coincide with a permanent shift from a secondary harvesting and processing role (helping their parents) to that of primary harvester, usually at the point of marriage. The age demographic reported in Rossi's study was dominated by younger harvesters, thus it is unsurprising that 33% of women oyster harvesters had only been acting as a main harvester for between two and five years, with an additional 24% between six and ten years.

Shellfish harvesting in Sierra Leone is under the general fisheries regulations and is managed in principle by the Ministry of Fisheries and Marine Resources. Some management responsibilities are officially delegated by these authorities to resource users in co-management arrangements. The management of mangrove forests on the other hand is under the Ministry of Agriculture, Forestry and Food Security and an authority under the ministry, the National Protected Areas Authority (NPAA).

The current study assesses the scale and scope of shellfisheries and shellfish-based livelihoods connected with mangrove systems and coastal water bodies in **Sierra Leone** through a participatory approach. The main objectives were the identification of key stakeholders and assessment of the scale

and scope of existing shellfisheries and shellfish-based livelihoods in mangrove systems or its related water bodies. This study complements a Literature Review (Chuku et. al., 2020) covering shellfisheries in each of the 11 coastal West Africa countries from Senegal to Nigeria. 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

Coastal communities in Sierra Leone with known shellfish harvesting/processing areas were targeted for participation in this assessment. Participating communities ultimately included the Bonthe community in the Sherbro Island, the Konakridee, Yongro, and Bailor communities in Port Loko district, and the Pamronko community in the urban Western Area. Exact study sites are shown in Figure 2.

2.2. Field survey/data collection

Data was collected on the scale and scope of shellfisheries livelihoods in coastal mangrove and estuarine systems in Sierra Leone using a participatory approach that combined focus group discussions, key informant interviews, and resource-user questionnaires.



Figure 2: Google Earth image showing Sierra Leone and the coastal communities where field surveying was conducted.

Participants of focus group discussions were fish and shellfish harvesters, processors, and traders, who were knowledgeable and interested in the topics discussed. One or two focus group discussions with 4-6 participants were held in each of the sampled communities and following information were solicited from the groups:

- Shellfishing activities, seasonal changes in harvest amounts, and commonly harvested shellfish species.
- Descriptions of regular shellfish product customers visiting each site, prices paid, and shellfish processing/preservation methods as well as the locations of processing activity.

Key informant interviews were held with experts and stakeholders in relevant stakeholder ministries, departments, and agencies (e.g., EPA Sierra Leone, Ministry of Fisheries and Marine Resources, University of Sierra Leone, Conservation Society of Sierra Leone, Environmental Foundations for Africa and Reptiles and Amphibians). These were semi-structured interviews using lists of broad, open-ended questions. The interviewees were people identified in their communities to be knowledgeable on shellfishery activity such as processing, marketing, trading, and retailing. Topics covered in questions posed to key informants included the following:

- Shellfish species present locally, location of harvest, and main harvesters.
- Harvesting methods of the various species.

- Seasonality of harvest.
- Existing laws governing access rights to the resources.
- Trends and causes of the availability of shellfish.
- Effects of shellfishing activities on mangrove health.
- Effects of climate change on shellfishing activity.

Field survey questionnaires were administered via semi-structured interviews with shellfish resource users and other stakeholders identified as having interest or legal mandate for the management of shellfish resources in Sierra Leone. Ultimately, 20 resource users and 10 local government and non-governmental organization (NGO) stakeholders were interviewed. The survey instrument is available in the regional summary report (Chuku et al. 2021).

2.3. Summarized background data

Fifteen of the 20 field survey participants were women and 5 were men. Five of the 15 women interviewed reported that they were heads of their families and were widowed. Ages of the 20 shellfishers interviewed in this assessment vary from 31 years to 70 years. Younger harvesters were also encountered during field surveys, but questionnaires were not administered with these individuals as they were busy in the field harvesting and the questionnaires required more than 2 hours to administer to respondents that do not have formal education. The average age of harvesters recorded in the survey was 47.6 years. Women harvesters were 40% of reproductive age (15-49), while the remaining 60% were between ages 50-70 years old. The household sizes of shellfish resource users ranged from 5 to 37, with a mean of approximately 10 members. The mean number of men and boys in households was the same as women and girls at approximately five.

3. Status of Shellfisheries

3.1. Shellfish Exploitation

3.1.1. *Estimated number of shellfishers*

Information on the number of shellfish harvesters in Sierra Leone 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. Using this method, a total of 425 shellfishers were reported to reside in Sierra Leone's coastal communities. Of these 425 reported shellfishers, 220 are estimated to be men or boys and 205 are estimated to be women or girls. However, this high number for men shellfishers is perceived to be partly a result of fishers who have regular, incidental catches of shellfish as bycatch being reported as shellfishers. In an alternative method, the estimate provided for Sierra Leone in the regional summary report (Chuku et al. 2021) represents a combination of information gleaned from available literature sources deemed reasonable from the perspective of ground experience in the women-led shellfisheries sector as well as estimates from the participatory assessment conducted. This method

reports only 354 shellfish harvesters, 71 fewer than on-the-ground estimates. Both figures are provided here as the best available information on the current scale of shellfisheries livelihoods in Sierra Leone.

3.1.2. Insights on gender in shellfish exploitation

Although assessment results appear to indicate some amount of gender specificity in roles for the shellfishing activities, overall there is a mix of women and men operating along shellfish value chains that appear to be species-specific. Eighteen out of the 20 resource user participants interviewed do five of the six shellfishing activities of harvesting, transportation, processing, marketing/retailing, and consumption. This indicates that there is no specialization in the shellfish value chain in Sierra Leone and it is highly vertically integrated, implying that improvements at any node can directly benefit harvesters and incentivizing behavior change for sustainable resource management.

Harvesting of swimming crab, lobster, cephalopods, and shrimp using pots and seine nets in the artisanal fisheries is dominated by men, but as in many fisheries value chains, processing of these harvested shellfish species is dominated by women. It was noted that there is some amount of specialization of the species targeted by different genders, with men targeting deep water and fast-swimming species like swimming crab, shrimp, cephalopods (octopus and cuttlefish), and sea snails, while women target more sessile species like oysters, razor clams, cockles, and intertidal mudflat snails.

Of the five male participants, three of them reported only harvesting and not processing shellfish. This may be further evidence that processing is primarily a women's job. Of the women that do participate in harvesting, it is believed that they are supported by male members of their household. For instance, focus group discussions and key informant interviews revealed that in some cases the pots and traps used for harvesting crab and lobster are constructed by men but deployed by women. It was reported that many women shellfishers are taken to the harvesting sites by their husbands or male children.

3.1.3. Shellfishing as a primary occupation

None of the five men interviewed in field surveys reported shellfishing as their primary occupation but 10 out of the 15 women interviewed expressed that shellfishing was their primary source of livelihood. The primary livelihoods identified by men interviewed were other forms of fishing and farming. Of the women who did not rank shellfishing as their primary livelihood, fish processing and gardening or farming were indicated instead. Upon further examination of the field survey data, it was noted that men shellfishers had chosen farming and fishing as their primary livelihood despite shellfishing earning these respondents a significant amount of income. Farming, fishing, and fish processing are perceived as the main activities for men to feed themselves and their families in coastal Sierra Leone, whereas shellfishing is seen as a means by which the women and few men participating in this study acquire extra money for things such as buying clothes and paying children's school fees and medical bills. It may be for these reasons that men do not consider shellfishing a primary source of livelihood whereas women consider buying clothes and caring for their children to be very important and thus consider shellfishing to be very important.

All oyster harvesters reported that the oysters are now less abundant in the wild. Harvesters interviewed in Gbongoma village report growing cassava and harvesting and processing palm oil from palm fruits as supplemental livelihoods.

3.2.3. *The shellfish value chain*

Eighteen out of the twenty resource user participants interviewed in the survey do five of the six shellfishing activities of harvesting, transportation, processing, marketing/retailing, and consumption. One women respondent even mentioned participating in shellfish culture. These diverse roles indicate that there is little to no specialization in the shellfish value chain in Sierra Leone and that it is highly vertically integrated.

Key processing methods include opening and removal of shells or exoskeletons and isolating the meat. Removal of the shell requires heat in oysters and cockles, so these shelled organisms are first steamed. If crab and shrimp are to be smoked for preservation, they are simply washed and smoked in open smoke ovens (locally called *Banda*). As most shellfish harvested in Sierra Leone are benthic species that either feed from the bottom sand or mud or are filter feeders, the meat often has a lot of sand/silt, which needs to be removed by washing. The cleaned meat of the oysters, clams and cockles are most often smoked as means of preservation. In some cases, the steamed meat is cooked or sold in local village markets without further preservation. Oysters are usually boiled in a large drum. Since they are so small, collection and processing of oysters is laborious, production is limited, and distribution is localized.

Shellfish species harvested in Sierra Leone are almost all used for human consumption and the shells are sometimes used as ornaments and interior decorations of homes. Several key informants also reported that the shells of oysters, cockles, and crab are used as a source of calcium for animal feed (specifically for poultry) and that oyster shells are burned to produce whitewash paints. The shells of large gastropod snails are often used as cigarette ashtrays, and small snail shells used in jewelry. Oyster shells are used in feeder road works and cockle shells are used in tiling floors in local bathrooms throughout the coastal communities (Figure 4).

All 20 resource-user participants and the 10 other stakeholders interviewed in this survey reported consuming shellfish. Ten of the 20 resource-users eat shellfish weekly, three fortnightly and six monthly. Only one reported eating shellfish daily. It is not known whether the frequency of shellfish consumption is based on availability, affordability, or preference, but from the quantities reported to be harvested by resource-users, it would be sensible that limited availability acts as the main factor responsible for the low frequency of shellfish consumption, at least for species like oysters, crab, shrimp, and lobster.

Market outlets for shellfish in Sierra Leone include the local markets in the coastal communities and more remote and higher paying market centers in the interior of the country for smoked products. The field survey recorded instances of smoked snails being packaged for the US market at Tombo.



Figure 3: Shellfishing activities by women in Sierra Leone including (a) processing intertidal mudflat snails, (b) shrimp preserved in ice by a fish trader woman who purchased them from women shellfish harvesters, (c) a method of harvesting razor clams, (d) women encountered harvesting razor clams during field surveys, and (e) women processing snails caught by industrial trawlers.



Figure 4: Use of shellfish product including (a) the use of cockle shells for tiling steps and (b) oyster shell used in feeder road construction and maintenance by coastal communities.

Shellfish harvesters and key informants reported various problems surrounding the perishable nature of the shellfish. Once harvested, the shellfish must be quickly processed, or they decompose. Harvesters reported that the requirement of either keeping shellfish alive or smoking them adds to the work needed to make money from shellfish harvesting. Some harvesters and experts interviewed reported that consumption of some shellfish species can cause diarrhea or cholera if not cooked properly. Others suggested that there is potential for heavy metal accumulation in some shellfish, particularly sedentary species and those located in estuarine habitats experiencing discharge from mining areas.

3.1.5. Species harvested

Shellfish species indicated as important by survey participants in coastal Sierra Leone include oysters (mangrove, mud/ sand, and rock oysters), cockles (rough shelled and smooth shelled), razor clams, shrimp, swimming crab, various snail species, and lobster. Many of these species are highlighted in Figure 5. Shrimp and lobster are targeted mainly by industrial fishers, whereas oysters, crabs, clams, and cockles are mostly targeted by women small-scale fishers.

When asked to comment on the relative importance of the above shellfish species, 50% of resource-user participants ranked oysters as the top shellfish species they harvest, while most remaining participants instead indicated crab, and one respondent identified cockles as their most harvested shellfish species. Cockles and oysters were also indicated as important secondary harvest species. Crab and gastropod snails were important tertiary harvest species. Shrimp species are primarily harvested by men around estuaries of the following rivers: Sherbro, Sierra Leone, Moa, Scarcies, Sulema, Sewa and Panpana. The major species landed are *Penaeus notialis* and *Parapenaeopsis atlantica*.

Mangrove oysters are an important source of protein in Sierra Leone for the poorest people. Oysters are normally classified as rocky, muddy, or mangrove type based on the substrates on which they are found. Mangrove roots with oysters attached to them are cut by men and women using dug-out canoes and machetes. Smaller amounts are also gathered by women mostly from mud banks and rocks.

The water bodies where shellfish were reported to be harvested by key informants and field survey participants were the Scarcies River Estuary for the Konakridee and Yongro communities, the Sierra Leone River Estuary for the Tagrin and Pamronko communities, and the Sherbro River Estuary for the Kabawokor community, Nyandehun community, King Jimmy community, Domkabor new site community, and Gbongboma community.

Other water bodies reported to have shellfish harvesters include Kagboro Greek in the Yawri Bay and Gbangbantok community, where people harvest mostly cockles and clams. Bajor, Kortimaw and `Yeliboya communities were also reported to have a significant number of seasonal shellfish harvesters. They are also reported to catch a lot of shrimps, crabs, and lobsters in the dry season between November and April. Within the river estuaries and the Yawri Bay are areas where shellfishing is carried out. Similarly, the specific habitats for the different shellfish species, for example habitats for oysters, were recorded as mangroves, sand and mud banks, and rocks. Whether these are different species or the same species attaching on different substrates available to the spats is yet to be determined.



Figure 5: Shellfish species harvested in Sierra Leone. Pictured are (a) oysters harvested by women in Konakridee, Northern Sierra Leone, (b) sea snail harvested by artisanal shellfishers, (c) cockles harvested by women encountered during field surveys, (d) razor clams harvested by women, (e) smoked snails produced by women, (f) mud oysters harvested at Yongro, (g) cockles picked by women encountered during field surveys, and (h) swimming crab harvested and processed in the Sierra Leone River Estuary and taken to the Yargoi weekly market for sale.

3.1.6. Harvesting methods

Shellfish that are harvested by either hand picking or digging include snails, cockles, and clams. Alternatively, clams and some crab may be dug out of the mud or sand using cutlasses (curved blades) and sticks. Mangrove oysters are often scraped from mangrove roots in the field, but also sometimes harvested by cutting the roots on which the oysters are attached, brought home in boats, scraped off there and then steamed before shucking. Other oyster types are harvested with cutlasses or handpicked. Shrimp are netted using scoop nets or seine nets. Juvenile shrimps are harvested by using mosquito nets designed into simplified seine nets and pulled by two women. Lobster, and in some cases crab, are caught by women by using traps and pots.

3.1.7. Harvest volumes and value

It is difficult to quantify the daily or monthly harvest of shellfish from the different communities. Respondents do not have standard measurement of the shellfish they harvest each day or week. Depending on species, units of measurement were reported in dozens for lobsters, snails, and sometimes cockles. Oysters are instead quantified in bowls or cups of processed (steamed or smoked) meat. Crab, clams, and small snails are quantified in bowls or pans. The sizes of pans, bowls, and cups are not standardized across communities. However, estimates are provided here based on best guesses of kilogram equivalents of each of the different units of measurement used across communities.

In instances where oyster and crab were reported as the primary shellfish species harvested, estimates of the kilogram equivalents of each of the units of measurement indicated an average of 25 kg of crab

harvested per day by each shellfisher (n = 5) and an average of 5.31 kg of oysters harvested per day per shellfisher (n =12). The average monthly income per shellfisher for these primary exploited shellfish species is estimated at US \$71.82.

In terms of species identified with secondary importance, average quantities of shellfish harvested per day were 40.25 kg for crab with an average monthly sale of US\$44 (n =4), 5 kg for shrimp with an average monthly income of US\$76.67 (n =3), 7.42 kg for cockles with an average monthly income of US\$38.67 (n = 6), and 1.24 kg for oyster with an average monthly income of US\$35.5 (n = 3).

Cockles, crab, lobster, snails, and razor clams were also identified species of tertiary harvest importance by several resource user participants. The average daily harvest for the above cockles, crabs and lobster are 9.1 kg, 15 kg, and 3.9 kg respectively. Snails and razor clams were not estimated by quantity. The average monthly sales were US\$ 51.5 for these cockles, US \$56 for the crab, and US\$ 103.13 for the lobster.

3.1.8. Seasonality of harvests

Shellfish availability was reported to be seasonal, depending on the species. Some species were reported to be available throughout the year, although exact abundance varies across the year. Others were reported to be available in the dry season and not available in the rainy season.

Species reported to be only available in the dry season include cockles, clams, and oyster. These species of shellfish are sedentary, either buried in mud or sand, or attached on substrate such as mangroves, boats, or floating logs. Because these organisms cannot move rapidly between microhabitats when environmental conditions like salinity, water temperature, pH, conductivity, or turbidity become harsh, they either must adapt to tolerating wide variations or stop growing, hibernate, or die. Shellfish species that can actively swim, like the swimming crab, cuttlefish, octopus, and lobsters were mostly reported to be available year-round, likely because of their ability to migrate to more favorable habitats when environmental conditions change significantly. Table 1 presents the reported seasonal availability of shellfish. Note that months reported for the same species availability vary from one location to the other, and this is believed to be due to differences in precipitation rate and the geology of the sea bottom.

Table 1: Seasonality of shellfish harvest in coastal and estuarine waters of Sierra Leone.

Shellfish species	Months harvested											
	J	F	M	A	M	J	J	A	S	O	N	D
Crab												
Oyster												
Shrimp												
Cockles												
Snails												

Lobster												
Squid												
Octopus												
Gastropod snails												

3.2. Mangrove Ecosystem

Six species of mangrove have been identified along the coast of Sierra Leone, namely *Rhizophora racemosa*, *Rhizophora mangle*, *Rhizophora harrisonii*, *Laguncularia racemosa*, *Avicennia germinans*, and *Conocarpus erectus* (USGS West Africa; see also Table 2). Mangroves serve as a habitat for fish and shellfish, which eventually serve as a source of food for the people of Sierra Leone (Chong, 1987; Garnett & Mansaray, 2007).

Table 2: Six mangrove species of Sierra Leone.

Scientific Name	<i>Avicennia germinans</i>	<i>Rhizophora harrisonii</i>	<i>Rhizophora mangle</i>	<i>Rhizophora racemosa</i>	<i>Conocarpus erectus</i>	<i>Laguncularia racemosa</i>
Common Name	Black Mangrove	Red Mangrove	Red Mangrove	Red Mangrove	Button Mangrove	White Mangrove

SOURCE: USGS West Africa: Land Use and Land Cover Dynamics Report (2017)

The coastal mangroves in Sierra Leone are associated with unique shellfish fauna showing both vertical (tree fauna) and horizontal zonation (in mudflats below). Within these mangrove systems, particularly in the Sherbro River Estuary, are a matrix of permanent and semi-permanent traditional human settlements that have unregulated open-access rights to the coastal and marine resources, including shellfish and mangroves resources. Among the resource extractive livelihoods found within the mangrove ecosystems in the Sherbro Island is the mangrove-dependent oyster fishery, characterized by epiphytic oysters, which are found attached on intertidally submerged roots systems of the mangrove trees, as well as mud and sand bank oysters and cockles. The female-dominated trade of harvesting, processing, and selling oysters and cockle meat is seen by some as directly associated with mangrove degradation (Rossi et al. 2017). It is also a significant economic opportunity in the Sherbro River Estuary, the Sierra Leone River Estuary, the Yawri Bay, and the Scarcies River Estuary. Oyster fishery related mangrove degradation is primarily a result of harvesting of mangrove trees to provide fuelwood for the processing stages of fish and shellfish production.

Broadly, the key drivers of mangrove loss in Sierra Leone include conversion for rice fields and salt production, overexploitation, and logging for wood and timber (GoSL, 2015; Garnett & Mansaray, 2007). Some mangrove lands have also been cleared to provide new areas for rice production, and trees have also been cut to provide cheap fuel for fish smoking, a major way of preserving food and for salt production. The clearing of mangrove forests, for various purposes such as housing, agriculture

and fuel wood, is common in many of the densely populated coastal zones. This is particularly evident in areas encompassing the Freetown coastline (mainly for fuel wood), and the Scarcies River Estuary (mainly for rice cultivation). The rate of mangrove deforestation has accelerated over the last two decades because of the rapid population growth across the Freetown Peninsula, which was initially driven by the civil war between 1991 and 2001 but is now increasingly influenced by rural-urban economic migration. Siltation and pollution of estuaries are also major threats to mangroves (UNEP, 2007; Konoyima & Johnson, 2020). There is still a scarcity of information with regards to the status of mangrove ecosystem in Sierra Leone and linkages between the social and economic conditions of coastal communities and mangrove resource utilization.

The Sierra Leone River Estuary is the sole coastal system with shellfishing activity in Sierra Leone that is designated as a Ramsar site, with coverage of approximately 295,000 ha. This estuary, near Freetown Peninsula, is dominated by mangrove systems, with lowland coastal plains to the north. As it enters the Atlantic Ocean, the estuary widens to about 11km and deepens to form a natural harbor said to be the third largest in the world. 19% of Sierra Leone's total mangrove is included within the site.



Figure 6: Exploitation of mangrove material including (a) mangrove oyster harvested by cutting mangrove roots on which oysters are attached and (b) use of mangrove wood for smoking/steaming of fish and shellfish, cooking, and construction in coastal fishing villages.

3.3. Governance/Management Regimes

Shellfish harvesting is under the general fisheries regulations and is managed in principle by the Ministry of Fisheries and Marine Resources under the Fisheries and Aquaculture Act 2018 and Fisheries and Aquaculture Regulations 2019. The Fisheries and Aquaculture Act 2018 provides for delegation of some management responsibilities to resource users in co-management arrangements. The management of mangrove forests is under the jurisdiction of the Ministry of Agriculture, Forestry and Food Security and a second authority under the ministry, the National Protected Areas Authority (NPAA). The Forestry Act, 1988, the Forestry Regulations, 1989 (P.N. No. 17 of 1990) and the National Protected Area Authority and Conservation Trust Fund Act, 2012 are the legal basis at the national level for the management of fisheries and marine resources including mangrove resources. The Ministry of Fisheries and Marine Resources has also established four Marine Protected Areas for

the sustainable management of fisheries and other ocean resources including mangroves. These are the Scarcies River Estuary in the North, the Sierra Leone River estuary in the West, near Freetown, the Yawri Bay, and the Sherbro River Estuary in the South (see Figure 1)

Management strategies for the marine protected areas included the organization of coastal communities into Community Management Associations (CMAs), which in turn have developed community by-laws for the management of fisheries and related coastal resources like mangroves. However, access management of the small-scale fisheries has remained over the years largely open, hence the lack of comprehensive data on shellfishers and the quantities of shellfish they harvest. Until 2012, under the West Africa Regional Fisheries Programme (World Bank), there was no requirement for registering a fishing canoe in Sierra Leone. Shellfishers who do not require use of a canoe are not required to register with either local or national fisheries authorities, so the government knows very little about the scale and exact activities of shellfishers in the country. Similarly, there are no or very few known registered shellfishery organizations around Sierra Leone, apart from one organized in Bonthe District under the Bonthe Oyster Project, funded under the [Darwin Initiative](#).

3.4. Climate Risk Mitigation

All resource user participants and key informants of this assessment agreed that shellfish harvesting, and processing affects climate change. Most of the effects are perceived to be from the harvesting of mangroves for use as fuelwood in the processing of the shellfish (smoking). Apart from the mangrove oysters, no other shellfish was reported to be harvested by cutting the roots of mangroves. However, the boats used for harvesting shellfish, the poles used for propelling the boats, the market stalls, and smoke ovens are all constructed using mangroves. When mangroves are cut down, the capacity of the mangroves to absorb carbon dioxide is reduced and when they are burned as fuel wood, the carbon dioxide stored in the mangrove biomass is again released into the atmosphere, thus increasing greenhouse gases. Apart from the greenhouse gas emissions and reduction of the carbon sink, mangroves are also known/reported to mitigate against coastal erosion, reducing the impact of storms/wind on coastal infrastructure.

4. Conclusion and Recommendations

4.1. Conclusions

1. Shellfish harvesting is an important livelihood activity in Sierra Leone for both men and women.
2. Some of the women harvesters were reported to be the heads of their households, with five of them being widows and providing sole care of their children.
3. There is little to no specialization in the shellfish value chain in Sierra Leone and it is highly vertically integrated, implying that improvements at any node can directly benefit harvesters and incentivizing behavior change for sustainable resource management.
4. All oyster harvesters reported that the oysters are now less abundant in the wild. And that they now must go farther to get a good harvest within the Sherbro river estuary.

5. At the time of this survey, virtually no oyster harvesting was taking place (February) the women reported that the peak harvest period is May to July every year. Throughout the survey period 20th February to 27th February only one woman was met processing a small quantity of mangrove oysters for household consumption at a village called Donbokoh.
6. Some of the harvesters reported that because of the scarcity of oysters in the past two years, they have embarked on cassava and groundnut farming to feed their families.
7. These women also reported that 5 years ago, they started harvesting oysters in December, so that people visiting the Island from Freetown for Christmas holidays will buy oysters from them at very good price, but for the past two years, mangroves oysters were only ready for harvest by May. This is believed to be due to the combined result of overexploitation of the oysters and effects of climate change. The rainy season was reported to extend up to December, lowering salinity of the estuary water and affecting the growth of the oysters on the roots of mangroves.
8. Harvesters in Nyendehun and Kambawokoh are switching to harvesting cockles on sand and mud banks when mangroves oysters are scarce.
9. Harvesters interviewed in Gbongoma village are growing cassava and harvesting and processing palm oil from palm fruits as supplemental livelihoods.

4.2. Recommendations

1. Conduct more detailed and comprehensive studies on the status and importance/relevance of shellfish resources in Sierra Leone in its totality for the sustainable management of such resources.
2. Register all shellfishers and collect and analyze data on shellfish exploitation.
3. Standardize the units of measurement of shellfish harvested, if possible, in kilograms
4. Improve the shellfish harvesting and processing methods to minimize the use of mangrove wood in the process, by using fuel efficient cook stoves and smoke ovens or use woodlots to provide for alternative fuelwood sources.
5. Harmonize all national and local laws governing fisheries, forestry, wetlands, and protected areas management to minimize overlaps and confusion in the management regimes.
6. Raise awareness of shellfishers on the importance of mangroves for the sustainability of shellfishing and climate change impact mitigation.
7. Conduct trainings and extension services for shellfish harvesters on more efficient and environmentally best practices in shellfish harvesting and processing.
8. Organize and register shellfisher organizations as in the umbrella Sierra Leone Artisanal Fishermen's Unions (SLAFUs) and Community Management Associations (CMAs) in different parts of the country to advocate for greater participation in decision-making and use rights/co-management governance schemes.
9. Support harvesters with shellfish market intelligence, so they can derive more income for their labor. For example, lobster, shrimp, cuttlefish, and crab are very expensive in hotels and restaurants, but most harvesters interviewed did not know about this.

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