WOMEN SHELLFISHERS AND FOOD SECURITY PROJECT
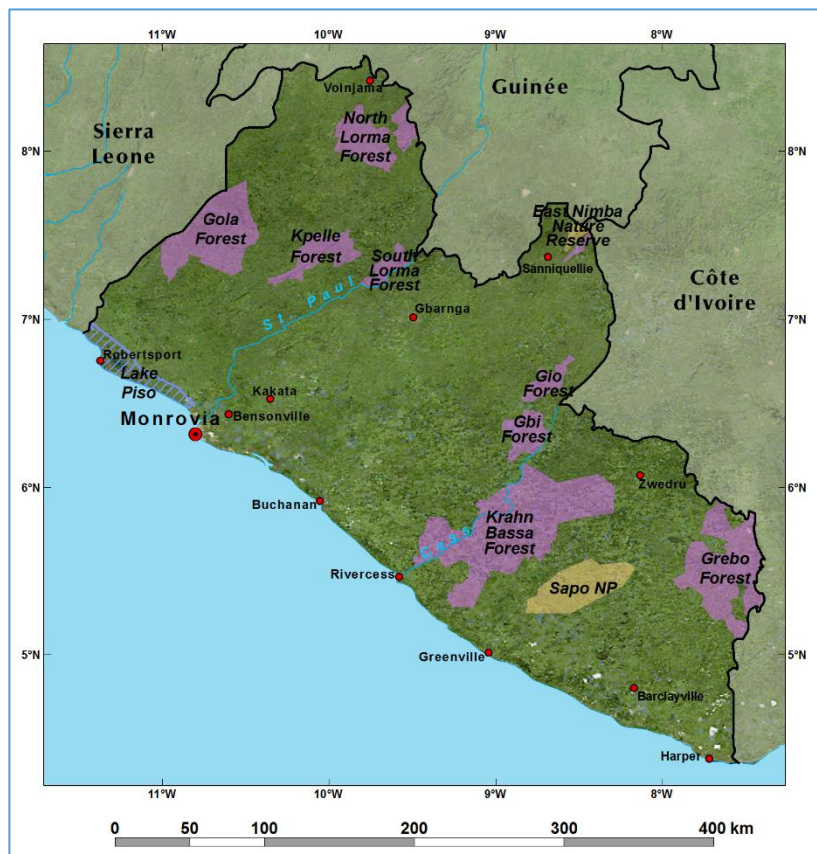
PARTICIPATORY ASSESSMENT OF SHELLFISHERIES IN THE ESTUARINE AND MANGROVE ECOSYSTEMS OF **LIBERIA**

September 2021

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Cover Photo: Map of Liberia, Ramsar sites, National Parks and Forests.

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ACRONYMS

BNF   Bureau of National Fisheries
CSO   Civil Society Organization
EPA   Environmental Protection Agency of Liberia
LFA   Liberia Fishermen Association
NGO   Non-Governmental Organization
SPSS   Statistical Package for Social Sciences
WARFP   West Africa Regional Fisheries Project
WFP   World Food Program

Executive Summary

Basic Contextual Information	
Country	Liberia
Total land area	111,369 km^2
Population	4.819 million (2018)
Percentage population living in/near the coast	-
Gross Domestic Product (GDP)	3.264 billion USD (2018)
Human Development Index Rank	0.465 (176 out of 189)
Length of coastline	565 km
Fish consumption (as a percent of animal protein)	15%
Anemia prevalence	34.7% among women of reproductive age (15-49)
Estimated mangrove cover	18,923 ha (2016)
Estimated estuarine and mangrove ecosystem-based shellfish harvesters	1,066
Estimated women shellfish harvesters (percent)	778 (66%)
Estimated direct household shellfish beneficiaries	8,436
Estimated percentage of shellfish harvesters at all nodes of the value chain (vertical integration)	20%+
No. of coastal systems with mangrove-based shellfishing	9
Shellfish management regulations	

Mangrove management regulations	
Coastal ecosystems with shellfisheries identified as Ramsar sites	Mesurado Wetlands (6,760 ha) Lake Piso (76,091 ha)

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

- The 14-year civil war in Liberia had a negative impact on fisheries resources in general by annihilating fisheries organizations and their capacities to sustainably manage and develop the sector. Policies and interventions geared towards responsible and sustainable management of Liberia's fisheries have been implemented after the war. However, initiatives to rebuild fisheries focussed mainly on the marine and inland fisheries sectors and neglected shellfisheries inhabiting mangrove and estuarine/lagoonal ecosystems, which are highly susceptible to overfishing and climate change. In Africa, wetland shellfisheries support the livelihoods of mostly women, hence the need to equip these women with the tools and knowledge of best practices for the rational exploitation of the resources.

- This survey aimed to gather data on the scale and scope of shellfisheries and shellfish-based livelihoods in connection with mangrove and estuarine ecosystems in Liberia. The study elicited information and identified key stakeholders comprising resource users and non-resource users (government, NGOs/CSOs, and academia/research institutes) whose activities are associated with shellfishery livelihoods and the management of mangrove and estuarine ecosystems.

- A semi-structured interview guide was used to obtain information from a total of 36 resource users and 6 non-resource users. Purposive sampling technique was used in selecting key stakeholders in the study areas and the data were subjected to descriptive statistics using Statistical Package for Social Sciences (SPSS).

- Mafa River/Lake Piso, Stockton Creek/Mesurado Wetland, Du River/Junk River/Farmington River, and Mechlin River/St. John River/Benson River are the main wetlands that support shellfisheries in Liberia. The shellfisheries support the livelihoods of over 1,066 individuals.

- The shellfisheries were the primary livelihood of about 80% and 89% of men and women, respectively. Aside from fin fish-related livelihoods, resource-users are engaged in secondary livelihoods like farming, sewing, carpentry, petty businesses, and security services (solely done by men).

- The most exploited shellfish year-round in the study areas in priority order was reported to be crayfish, crabs, periwinkle, oyster, and prawn. The most important shellfisheries in terms of yield per individual per day were reported to be periwinkle (16.73 ± 7.64 kg), crabs (8.35 ± 5.16 kg), oyster (6.42 ± 0.83 kg), and crayfish (2.52 ± 0.60 kg).

- Crayfish are harvested by traps with bait, while crabs are exploited with nets and baited traps. Periwinkles are handpicked, whereas oysters are detached from mangrove roots or hard substratum.

- Women dominated all the categories of the shellfisheries value chain (54.17% harvesting, 62.50% consumption, 62.50% marketing, 85.71% processing and 57.14% transportation) and no form of shellfish aquaculture was practised in the study areas. The shellfisheries value chain appears to be more specialized than in most other countries in West Africa with very few harvesters (at most 20%) claiming to also be involved in processing and transportation of shellfish.

- A few shellfishers (2.86%) engage in subsistence fishing, while the majority (91.43%) trade shellfish in local markets and a minor proportion (5.71%) target distant and/or larger markets.
- The non-resource users highlighted some possible threats to the health of shellfish for consumers. These are the use of dynamite in fishing, indiscriminate disposal of garbage, and oil spillage in wetlands that support shellfisheries.

- Almost all respondents (94%) describe the coverage of the mangrove vegetation in the study sites as moderate. However, 60% of the respondents indicated that mangroves are exploited in the coastal communities and that this is carried out mainly by men (93.94%) for commercial purposes.

- There are no formal laws and traditional customs targeted at regulating the varied coastal and mangrove shellfisheries, hence the resources are unregulated.

- Rainfall is the main climatic factor that causes seasonality in shellfisheries in Liberia.

Recommendations:

- It is imperative that all commercial shellfisheries in the estuarine/lagoonal and mangrove systems of Liberia are regulated to warrant sustainable use and development of the resources.

- Government and NGOs/CSOs with a focus on women should intervene to provide education and training of shellfishers on the ecological services of shellfish and mangrove systems and to promote best practices in the shellfish enterprise.

- The Environmental Protection Agency of Liberia must enforce the regulation against Mangrove exploitation to restore the ecological integrity of mangrove systems.

- The general sanitation of coastal aquatic systems and catchment areas should be improved, particularly ceasing the indiscriminate dumping of garbage and oil spillage, for the betterment of shellfisheries and its consumers.

- Distant or larger markets as well as high-end users of shellfish should be targeted to aid in boosting demand for shellfish by value addition.

- Shellfishers should be supported with soft loans, transportation needs (e.g., canoe), and fishing protective gears (i.e., waders, gloves) to aid the business.

- The aquaculture potential of the shellfishes should be investigated and pursued to lessen the imminent pressure on wild exploitation, improve food security, and reduce the fish production deficit in Liberia.

- The revenue accrued from the mangrove/estuarine ecosystem-based shellfisheries of Liberia should be assessed to appreciate its contribution to the national fisheries production and stimulate the needed interventions.

1. Introduction

According to the World Food Program (WFP, 2010), fish is a primary source of protein for many Liberians. Liberia, a West African country on the coast of the Atlantic Ocean, is endowed with inland fisheries and vast marine fisheries resources along its 565 km coast. Along the coast are several wetlands (estuarine and lagoonal ecosystems) that support shellfisheries. However, the civil war that occurred in Liberia had a negative impact on the rational management and development of the fisheries as fisheries infrastructure was destroyed and fisheries organizations ceased to function.

The Liberian Bureau of National Fisheries (BNF) in collaboration with the West Africa Regional Fisheries Project (WARFP), among other institutions, is undertaking activities to improve the management and regulation of fisheries in Liberia, however, the focus has been on the marine and inland fisheries. The estuarine and mangrove system shellfisheries are side-lined. In other words, little has been done for the management, development, and sustainable use of wetland shellfisheries in Liberia, although some wetlands with Ramsar designation are expected to be protected (i.e., Lake Piso and Mesurado Wetland).

In Africa, wetland shellfisheries support the livelihoods of mostly women, hence the need to equip these women with tools and knowledge of best practices for the rational exploitation of shellfisheries. In Ghana, oyster and clam fisheries have shown female preponderance (Abarike, Alhassan & Alipi, 2015; Asare, Obodai & Acheampong, 2019; Osei, Yankson & Obodai, 2020). The same has been documented in The Gambia oyster fishery (Njie & Drammeh, 2011) and Nigeria's oyster and periwinkle fisheries (Ansa & Bashir, 2007; Akinrotimi, Abu, Ibemere & Opara, 2009).

The current study assesses the scale and scope of shellfisheries and shellfish-based livelihoods associated with mangrove systems and estuarine/lagoonal ecosystems in Liberia 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

The shellfish harvesting locations covered in this study are found in the coastal areas of Liberia. The study sites contain mangrove systems. The wetlands from north to south are Mafa River/Lake Piso, Stockton Creek/Mesurado Wetland, Du River/Junk River/Farmington River, and Mechlin River/St. John River/Benson River (Figure 1).
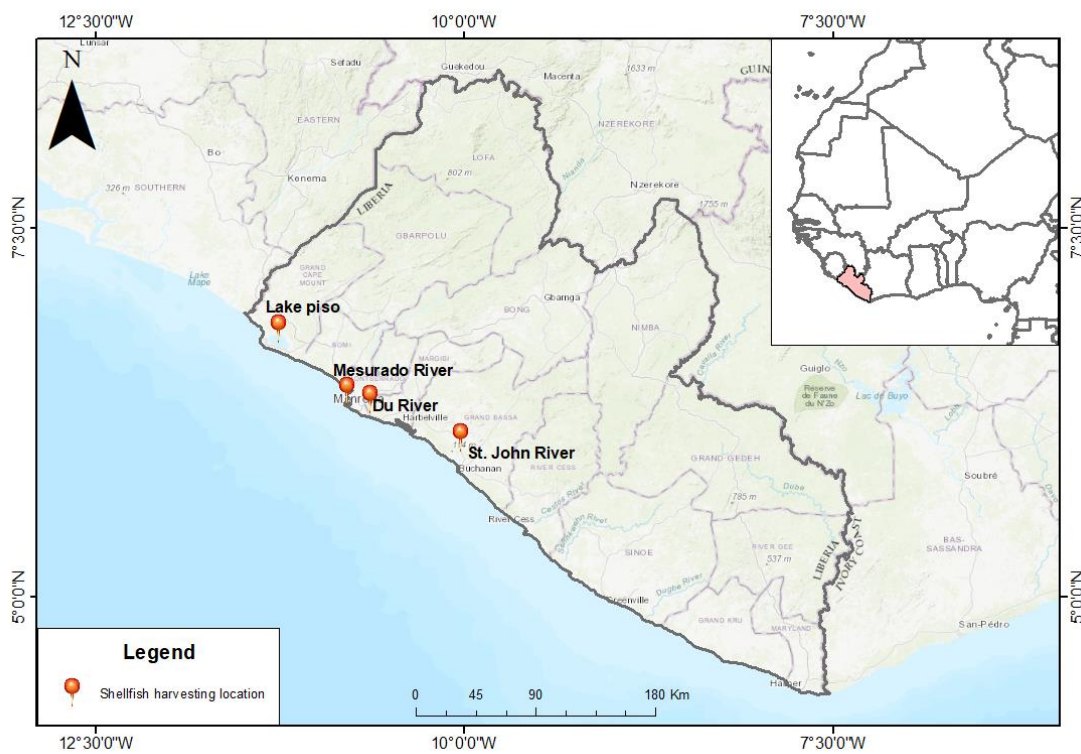
Figure 1: Clusters of shellfish harvesting locations covered in this study.

2.2. Field survey/data collection

Data collection was carried out by participatory engagement with key stakeholders from the 26th February to the 9th May 2021. Stakeholders were categorized into two groups, resource users and non-resource users. The non-resource user group was composed of individuals from government and NGO/CSO institutions. A total of 36 resource users and 6 non-resource users were interviewed using a semi-structured interview guide.

Purposive sampling technique was used in selecting key stakeholders in the shellfisheries. The background data of respondents were analysed by descriptive statistics to summarise features of the data in a form of frequencies and percentages using Statistical Package for Social Sciences (SPSS).

2.3. Estimation of catch

Catch data was collected in kilograms (kg) per person per day: Individual resource-user respondents were asked the weight of shellfish harvested in a day.

2.4. Summarised background data

2.4.1. Background data of resource users

Thirty-six (36) resource user respondents were interviewed (66% female and 34% male) ranging in age from 18-75 years. The majority (74.28%) of resource user respondents were 18-50 years. This is important to note because women 15-49 years are considered as women of reproductive age, an important target age group for health and nutrition initiatives. The data on resource users surveyed is presented in Section 3 below.

2.4.2. Background data of non-resource users

Six (6) non-resource users were interviewed, ranging from 23 to 59 years with about 50% of the respondents in the 40-50 years age range (Table 1). The respondents were mainly males (67 %) (Figure 2). The proportion of non-resource users interviewed by type was NGO/CSO 50%, government 33% and other (unspecified) 17% (Table 2).

Table 1: Age of non-resource user respondents.

		Frequency	Percent (%)
Valid	18-28	1	16.66
	29-39	1	16.66
	40-50	3	50.00
	51 and above	1	16.66
	Total	6	100.0
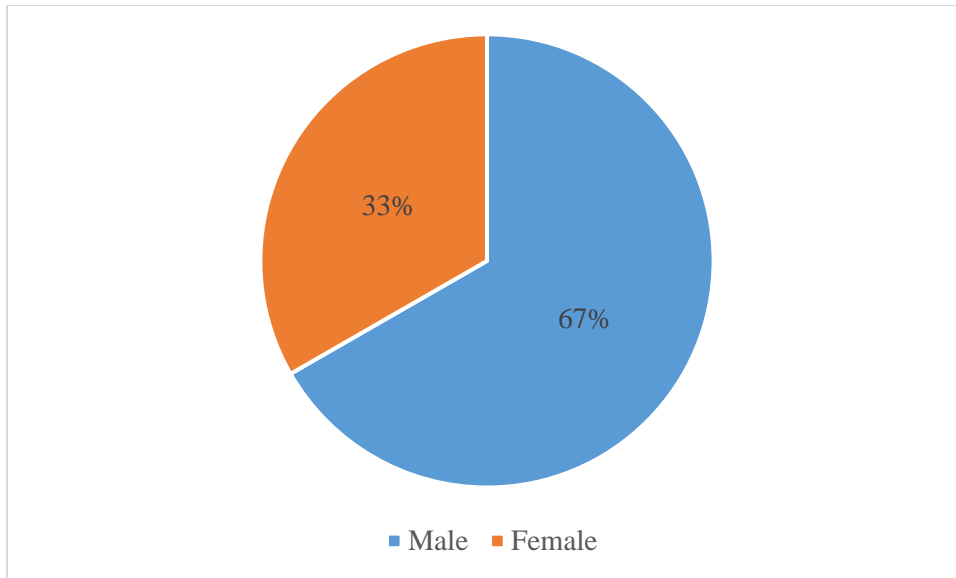
Figure 2: Gender distribution of shellfisheries non-resource users.

Table 2: Shellfisheries non-resource users interviewed by type.

		Frequency	Percent
Valid	Government	2	33.33
	NGO/CSO	3	50.00
	Other	1	16.66
	Total	6	100.0

All the non-resource user respondents but one had expertise in both mangrove and shellfish. Individuals in respondent's household numbered from 1 to 15, with no modal value (see Appendix 1). Households with 4 males accounted for the highest percentage (33.33 %) of male non-resource users, whereas households with 1 female and 3 females both recorded the highest percentage (33.33 %) for non-resource users (Appendix 1). The percentage of males and females in all the households (42 individuals) was 52.38% and 47.62%, respectively. All the non-resource user respondents consumed shellfish in their households.

3. Status of Shellfisheries

3.1. Shellfish Exploitation

Several coastal water bodies support shellfisheries in Liberia, notable among them and captured in this study are Mafa River/Lake Piso, Stockton Creek/Mesurado Wetland, Du River/Junk River/Farmington River, and Mechlin River/St. John River/Benson River.

3.1.1. Estimated number of shellfishers

Information on the number of shellfish harvesters in Liberia 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 estimates provided in this report represent 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.

The estimated number of shellfishers in the 9 water bodies/wetlands considered for this study ranged from 8 to 162 persons for a given site. An estimated 1,066 persons, the majority of which are females (54% to 66%), are engaged in shellfisheries livelihoods in Liberia.

An estimated 8,436 persons are direct household shellfisheries beneficiaries based on the findings of this study. Individuals in resource user respondents' households numbered up to 15, with households of 10 members having the highest occurrence and accounting for 21.66% of respondents' household members (Table 3). The average number of members per household of resource user respondents was 8.

Households with 3 males made up the highest percentage of male household members (19.71%), whereas households with 4 females had the highest percentage of female household members (20%) (Tables 4 and 5). The percentage of males and females among all household members (total = 277) of resource users surveyed was 49.46% and 50.54%, respectively, suggesting a slight dominance of females in households where shellfisheries provide livelihoods in Liberia.

Of the 36 resource-user respondents, individuals ranged from 18 to 75 years, with the predominant age between 29 and 39 years (42.85%) (Table 6). The majority (74.28%) of resource user respondents were 18-50 years. This is important to note because women 15-49 years are considered as women of reproductive age, an important target age group for health and nutrition initiatives.

Table 3: Number of individuals per household of resource users.

	Number (x)	Frequency (f)	f(x)	Percent (%)
Valid	2	2	4	1.44
	4	3	12	4.33
	5	5	25	9.03
	6	5	30	10.83
	7	2	14	5.05
	8	4	32	11.55
	9	1	9	3.24
	10	6	60	21.66
	11	1	11	3.97
	12	1	12	4.33
	13	3	39	14.08
	14	1	14	5.05
	15	1	15	5.42
	Total	35	277	100.00

Table 4: Number of males per household of resource users.

Number (x)		Frequency (f)	f(x)	Percent (%)
Valid	0	2	0	0.0
	2	9	18	13.14
	3	9	27	19.71
	4	3	12	8.76
	5	3	15	10.95
	6	3	18	13.14
	7	3	21	15.33
	8	1	8	5.84
	9	2	18	13.14
	Total	35	137	100.0

Table 5: Number of females per household of resource users.

Number (x)		Frequency (f)	f(x)	Percent (%)
Valid	1	1	1	0.71
	2	6	12	8.57
	3	9	27	19.29
	4	7	28	20.00
	5	5	25	17.86
	6	4	24	17.14
	7	1	7	5.00
	8	2	16	11.43
	Total	35	140	100.0

Table 6: Age of respondents of resource users.

		Frequency	Percent (%)
Valid	18-28	4	11.43
	29-39	15	42.85
	40-50	7	20.00
	51 and above	9	25.71
	Total	35	100.0

3.1.2. Insights on gender in shellfish exploitation

Females dominated the respondents by 65.70% (Figure 3), which suggests female dominance in the shellfisheries.
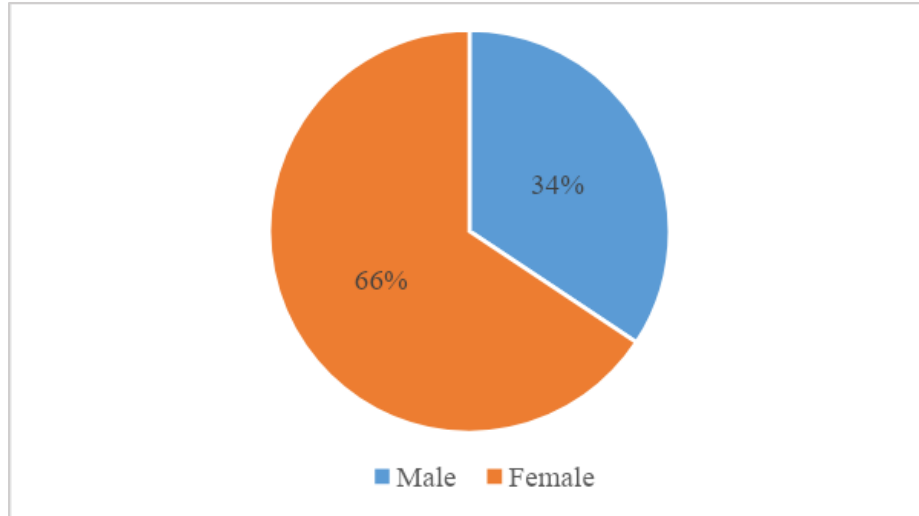
Figure 3: Gender distribution of shellfisheries resource users

3.1.3. Shellfishing as a primary occupation

Individuals inhabiting the coastal areas of the study sites are mainly involved in fish-related activities (fishing, fish processing, and trading), farming, and trading of general goods. About 80.00% of men and 89.29% of women resource user respondents engaged in the shellfisheries as their primary livelihood. Aside from the fish-related livelihoods like processing of finfish (which is carried out by women) and fin-fishing, resource-user respondents are engaged in secondary livelihoods like farming, sewing, carpentry, petty businesses, and security services (solely done by men).

3.1.4. The shellfish value chain

Figure 4 indicates that most of the respondents are engaged in harvesting (68.57%) and consumption (68.57%), followed by marketing (60.00%) and then processing (22.86%) and transportation (20.00%) along the value chain. Women dominated all the above-mentioned value chain categories (54.17 % harvesting, 62.50 % consumption, 62.50 % marketing, 85.71 % processing and 57.14 % transportation). The shellfisheries value chain appears to be more specialized than in most other countries in West Africa with very few harvesters (at most 20%) claiming to also be involved in processing and transportation of shellfish. Resource-user respondents practiced no form of shellfish aquaculture in the study areas.
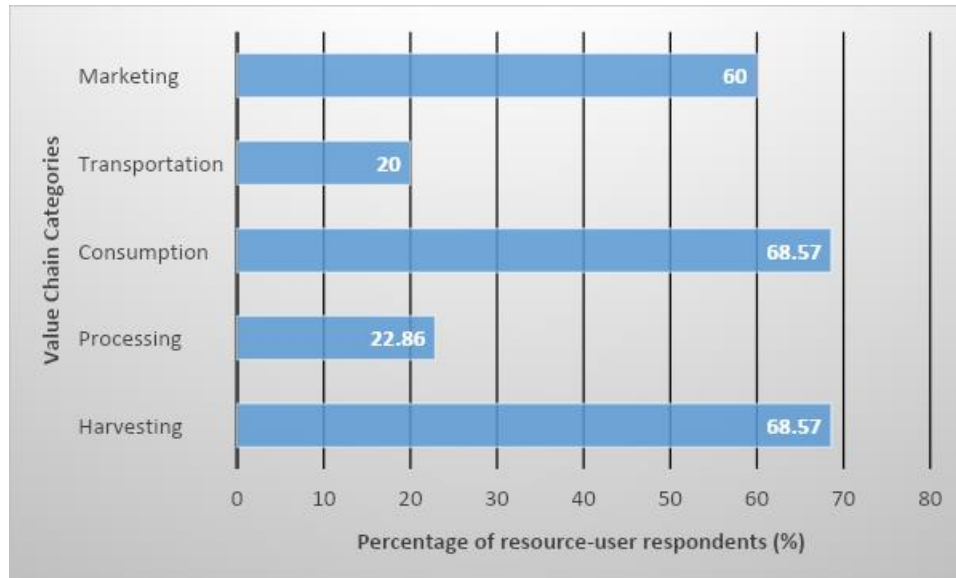
Figure 4: Value chain involvement of shellfisheries resource users.

The exploitation of shellfishes in the study areas is highly commercialised with about 2.86% of the resource-user respondents involved in subsistence fishing. The shellfish are mainly (91.43%) sold in local markets, while a few (5.71%) traders target distant and/or larger markets. Some of the traders (8.57%) deal with middlemen in marketing the shellfishes. However, shellfish traders do not sell to hotel and restaurant operators.

About 97.14% of resource-user respondents indicated that shellfishes were consumed in their households mainly daily (34.29%) and weekly (38.24%) as shown in Table 7.

Table 7: Frequency of shellfish consumption by household of resource users.

		Frequency	Percent
Valid	Daily	12	35.29
	Weekly	13	38.24
	Fortnightly	6	17.65
	Monthly	3	8.82
	Total	34	100.0

The challenges associated with shellfish consumption in the study area are lack of tools to harvest shellfish, lack of market facilities, lack of awareness creation about the health benefits of shellfish consumption, and lack of regulation to ensure constant regular supply of shellfish. On health risks of shellfish consumption, the non-resource users highlighted several challenges which may be a threat to

consumers. These included the possibility of having diarrhoea if mud on shellfish is not cleaned properly, the use of dynamite in fishing, dumping of garbage in rivers and creeks, and oil spillage in waters that may lead to bioaccumulation of heavy metals and pathogens in especially filter-feeding shellfishes (i.e., oysters and clams).

3.1.5. Species harvested

The percentage composition of shellfisheries in order of importance by harvest throughout the year in the coastal water bodies/sites of Liberia as given by both resource-user and non-resource user respondents is shown in Figure 4. The most exploited shellfishes in the study areas in order of importance were reported as crayfish, crabs, and periwinkle. Oysters and prawns had similar importance by harvest (Figure 5).
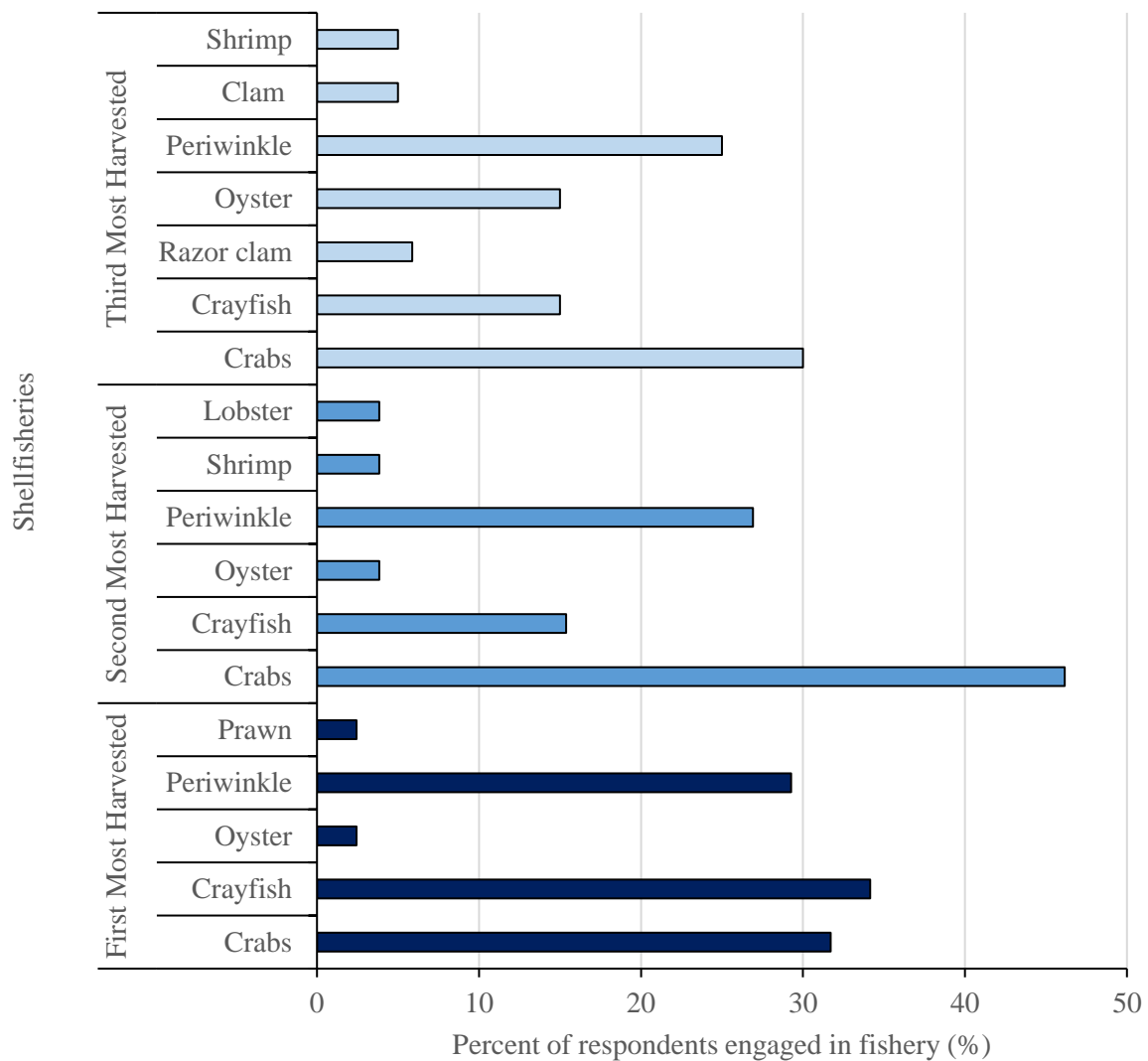

Figure 5: Percentage composition of most exploited shellfisheries in selected wetlands of Liberia.

3.1.6. Harvesting methods

The above-mentioned shellfishes inhabit sandy-mud substratum of wetlands. Apart from the sandy-mud substratum, by preference the mangrove oyster settles on red mangrove root or any hard substratum (e.g., oyster shells and rocks).

Crayfish are trapped using baskets (mainly woven by the women) with bait (e.g., palm nuts). The baskets are set along the banks of the water body/wetland and checked for crayfish the next day. Crabs are fished with nets which are normally operated by men, while some women trap crabs with bait (e.g., turkey necks). Periwinkles are handpicked, while oysters are detached from mangrove roots or hard substratum. Generally, the men harvest shellfishes and transport shellfishers on their fishing expeditions in non-motorized canoes. Women sponsor the men's fishing activities.

About 76.47% of the respondents indicated that the withdrawal of men's support would adversely affect the harvesting of shellfishes, hence men should be included in the design of any intervention to develop the shellfisheries. The reasons are men support in rowing the canoes, assist in harvesting and setting of traps, and offer protection during high tides. Nonetheless, a few of the women are able to go on fishing without any form of support.

3.1.7. Harvest volumes and value

The approximate catches in kilograms per person per day of key shellfisheries exploited in the selected wetlands in Liberia is shown in Figure 6. The order of importance in terms of shellfish yield per individual per day is reported as periwinkle (16.73 ± 7.64 kg), crabs (8.35 ± 5.16 kg), oyster (6.42 ± 0.83 kg), and crayfish (2.52 ± 0.60 kg). However, the resource users indicated that crayfish is the most harvested shellfish year-round followed by crabs and periwinkle, perhaps a relatively higher number of shellfishers exploit these shellfishes in that order, hence the higher yields.
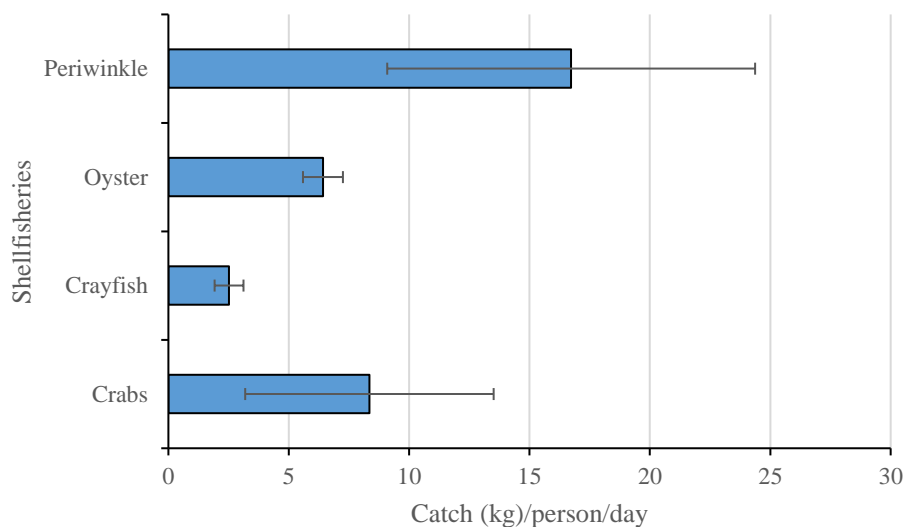

Figure 6: Distribution of catch (kg) per person per day of key shellfisheries exploited in selected wetlands of Liberia.

3.2. Mangrove Ecosystem

Mangrove vegetation exists in the water bodies or study sites covered in this survey. About 60% of the respondents indicated that mangroves are exploited despite the caution by the Environmental Protection Agency of Liberia banning its exploitation. Mangrove exploitation is mainly carried out by men (93.94%). About 73.53% of shellfishers earn direct income from trading in mangroves. The mangroves are mainly used as fuelwood and for construction (e.g., houses, sheds, and fences).

Mangroves support the shellfisheries, particularly in harvesting and processing. Mangrove systems serve as a habitat for shellfishes including crabs, periwinkle, and oysters, a place for harvesting, and provide fuelwood for processing shellfish. About 94.12% of the respondents describe the health of the mangrove vegetation in the study sites as moderate.

3.3. Governance/Management Regimes

Although Liberia has enacted and amended a fisheries law (now the Fisheries and Aquaculture Management and Development Law 2019) which regulates the general fisheries and fishing related activities, there is no specific fisheries management plan safeguarding the exploitation of shellfisheries and mangrove vegetation. However, the Environment Protection Agency of Liberia has banned the exploitation of mangroves. Among the study sites covered in this survey, Lake Piso and Mesurado Wetland are the only designated Ramsar sites in Liberia (i.e., wetlands of international importance). Conspicuously, the ban on the harvest of mangroves needs enforcement since mangrove exploitation is actively carried out in the wetlands under study. Also, there are no traditional customs and byelaws currently applied to the shellfisheries.

There are no shellfisheries associations or any intervention from government and NGOs/CSOs to assist in the management, development, and sustainable use of the shellfish and mangrove resources in the study areas. Although some shellfishers are a part of the Liberia Fishermen Association (LFA), which focuses on fishing activities in general and the wellbeing of its members.

3.4. Climate Risk Mitigation

Both resource users and non-resource users indicated that rainfall and sea level rise are the main factors that cause seasonality in the Liberian shellfisheries. Both factors have a positive relationship with salinity in coastal wetlands, especially systems with freshwater influence. However, rainfall is more likely to contribute to seasonality of shellfisheries than sea level rise because rainfall causes wider variation in salinity of wetlands, which occurs seasonally. The shellfisheries associated with mangrove and estuarine coastal waters are known to thrive in brackish environments.

About 14.63% of the respondents explained how shellfisheries and mangrove livelihoods affect climate. Two main links reported by respondents were that mangrove logging causes deforestation which adversely impacts the local climate, and that mangroves mitigate the impact of climate change by reducing carbon, which is a component of carbon dioxide, a primary greenhouse gas. According to Alongi (2012) and Nayak et al. (2014, shellfishes (especially bivalves and gastropods) and mangrove ecosystems are described as carbon sinks, contributing to reduction in atmospheric carbon which in

turn affects the climate. Thus, climate may be impacted by reduction in biomass of oysters and mangroves.

4. Conclusion and Recommendations

The identified stakeholders in the estuarine and mangrove ecosystem shellfisheries in Liberia were resource users and non-resource users, comprising government and NGO/CSO officials. The main coastal water bodies or wetlands that support shellfisheries in Liberia are Mafa River/Lake Piso, Stockton Creek/Mesurado Wetland, Du River/Junk River/Farmington River, and Mechlin River/St. John River/Benson River. Over 1,066 individuals engaged in the shellfisheries value chain nodes (harvesting, processing, marketing, transportation, and consumption) are mainly women, and shellfisheries are largely their primary occupation. Women sponsor the men's fishing activities. Men support women's shellfishing activities with transportation and other tasks. A few women go on fishing expeditions without any form of support from the men.

The most important shellfisheries by harvest year-round in the study areas are crayfish, crabs, periwinkle, oysters, and prawns. The key shellfisheries in terms of yield per individual per day are periwinkle (16.73 ± 7.64 kg), crabs (8.35 ± 5.16), oyster (6.42 ± 0.83 kg), and crayfish (2.52 ± 0.60 kg).

These shellfishes inhabit sandy-mud substratum of coastal water bodies and mangrove ecosystems. The mangrove oyster preferably settles on red mangrove root or any hard substratum. Crayfish are trapped using baskets with bait, whereas crabs are fished with nets or baited traps. Periwinkles are handpicked, while oysters are detached from mangrove roots or hard substratum.

A few shellfishers engage in subsistence fishing, while the majority trade the shellfishes in local markets. A few target distant and/or larger markets.

There are health concerns pertaining to shellfish consumption as wetlands are polluted.

The mangrove coverage in the study sites is moderate. Mangroves support shellfisheries predominantly in production/harvest and processing. The mangroves are exploited and mainly used as fuelwood and for construction.

Lake Piso and Mesurado Wetland are the only designated Ramsar sites among the study sites covered in this survey. There are no formal laws or traditional customs targeted at regulating the varied coastal and mangrove shellfisheries.

The main climatic factor that causes seasonality of shellfisheries inhabiting the estuarine, lagoonal and mangrove systems of Liberia is rainfall.

Recommendations are as follows:

- It is imperative that all commercial shellfisheries in the estuarine/lagoonal and mangrove systems of Liberia are regulated to warrant sustainable use and development of the resources.

- Government and NGOs/CSOs with a focus on women should intervene to provide education, training, and capacity development of shellfishers on the ecological services of shellfish and mangrove systems and to promote best practices for sustainable management and to optimize yield in the shellfish enterprise.

- The Environmental Protection Agency of Liberia must enforce the regulation against Mangrove exploitation to restore the ecological integrity of mangrove systems.

- The general sanitation of coastal aquatic systems and catchment areas should be improved, particularly ceasing the indiscriminate dumping of garbage and oil spillage, for the betterment of shellfisheries and its consumers.

- Distant or larger markets as well as high-end users of shellfish should be targeted to aid in boosting demand for shellfish by value addition.

- Shellfishers should be supported with soft loans, transportation needs (e.g., canoe), and fishing protective gears (i.e., waders, gloves) to aid the business.

- The aquaculture potential of the shellfishes should be investigated and pursued to lessen the imminent pressure on wild exploitation, improve food security, and reduce the fish production deficit in Liberia.

- The revenue accrued from the mangrove/estuarine ecosystem-based shellfisheries of Liberia should be assessed to appreciate its contribution to the national fisheries production and stimulate the needed interventions.

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Appendices

Appendix 1: Background data

Table 8: Number of individuals per household of non-resource users.

	Number (x)	Frequency (f)	f(x)	Percent
Valid	1	1	1	16.7
	4	1	4	16.7
	6	1	6	16.7
	7	1	7	16.7
	9	1	9	16.7
	15	1	15	16.7
	Total	6	42	100.0

Table 9: Number of males per household of non-resource users.

	Number (x)	Frequency (f)	f(x)	Percent
Valid	0	1	0	16.7
	3	1	3	16.7
	4	2	8	33.3
	5	1	5	16.7
	6	1	6	16.7
	Total	6	22	100.0

Table 10: Number of females per household of non-resource users.

Number (x)		Frequency (f)	f(x)	Percent
Valid	1	2	2	33.3
	2	1	2	16.7
	3	2	6	33.3
	10	1	10	16.7
	Total	6	20	100.0