

Situational assessment of the SRE and Yawri Bay: Baseline report

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1. Introduction

Mangrove forests stand as a vital ally in our battle against climate change, owing to their remarkable ability to sequester carbon. These ecosystems, besides their carbon-absorbing prowess, offer invaluable services to local communities. They act as nature's shield, helping regulate extreme weather events to reduce the impacts of floods and rising sea levels. Additionally, they provide essential breeding habitats, supporting fish populations, and serve as a wellspring of fuelwood, food, and construction materials.

These forests' extraordinary carbon-sequestering capacity holds promise for mitigating climate change, making them essential contributors to our efforts to combat the environmental challenges we face.

In Sierra Leone, the coverage of mangrove forests has experienced fluctuations over the past four decades. In 1986, it was estimated to be approximately 171,760 hectares, which decreased to 156,496 hectares in 2000 and slightly increased to 157,492 hectares by early 2020. The fluctuations in forest cover can be ascribed to natural cycles and other environmental factors. Nevertheless, in spite of the relatively stable forest cover observed over the past four decades, mangrove ecosystems are encountering escalating pressures stemming from urbanization and economic expansion. Notably, in the Sherbro River Estuary, it is estimated that mangrove ecosystems lost approximately 20% of their cover between 2000 and 2020. This estimation is based on data from Vancutsem (2021) [Vancutsem, C. et al. 2021. 'Long-Term (1990–2019) Monitoring of Forest Cover Changes in the Humid Tropics'. *Science Advances* 7(10)]. Agricultural projects, mining activities, charcoal production, and fish production are identified as significant threats to mangrove forests. Furthermore, the governance structure of the of the mangrove ecosystems does not seem to be effective at preventing deforestation patterns. Consequently, various stakeholders have shown interest in developing strategies to mitigate deforestation, such as through the implementation of REDD+ projects.

Table 1: Head of households by age and gender

Age	Male	Female	hh1
>60	557.2321	71	36
18-30	NA	375	128
30-45	NA	460	162
45-60	NA	188	106

One of the central governance challenges within the mangrove ecosystem is the establishment of mutually beneficial scenarios for both local communities and the preservation of the mangrove environment. This challenge assumes even greater significance given that local communities bear no responsibility for global warming, boast one of the planet's lowest ecological footprints, and often grapple with impoverished living conditions. Nevertheless, they encounter pressure to alter their livelihood strategies to curb the loss of mangroves. The objective of this report is to compile crucial information pertaining to the social and economic requirements of these communities, their interactions with mangroves, and the existing institutional framework within the Sherbro River Estuary. To achieve this objective, the conceptual framework of the doughnut economy has been adapted and implemented. This framework provides a visual representation of the idea that human societies exist between social foundations and ecological boundaries (planetary boundaries). Thriving within an ecologically safe and socially just space requires meeting basic human needs while respecting planetary boundaries. Consequently, conservation projects aimed at ensuring fairness should primarily focus on the development of local communities, enabling them to fulfill their basic needs. The advancement of these communities presents an excellent opportunity to reduce the threats faced by mangrove resources by decreasing their dependence on these resources. Therefore, it is essential to identify win-win situations that benefit both the communities and the preservation of mangrove ecosystems.

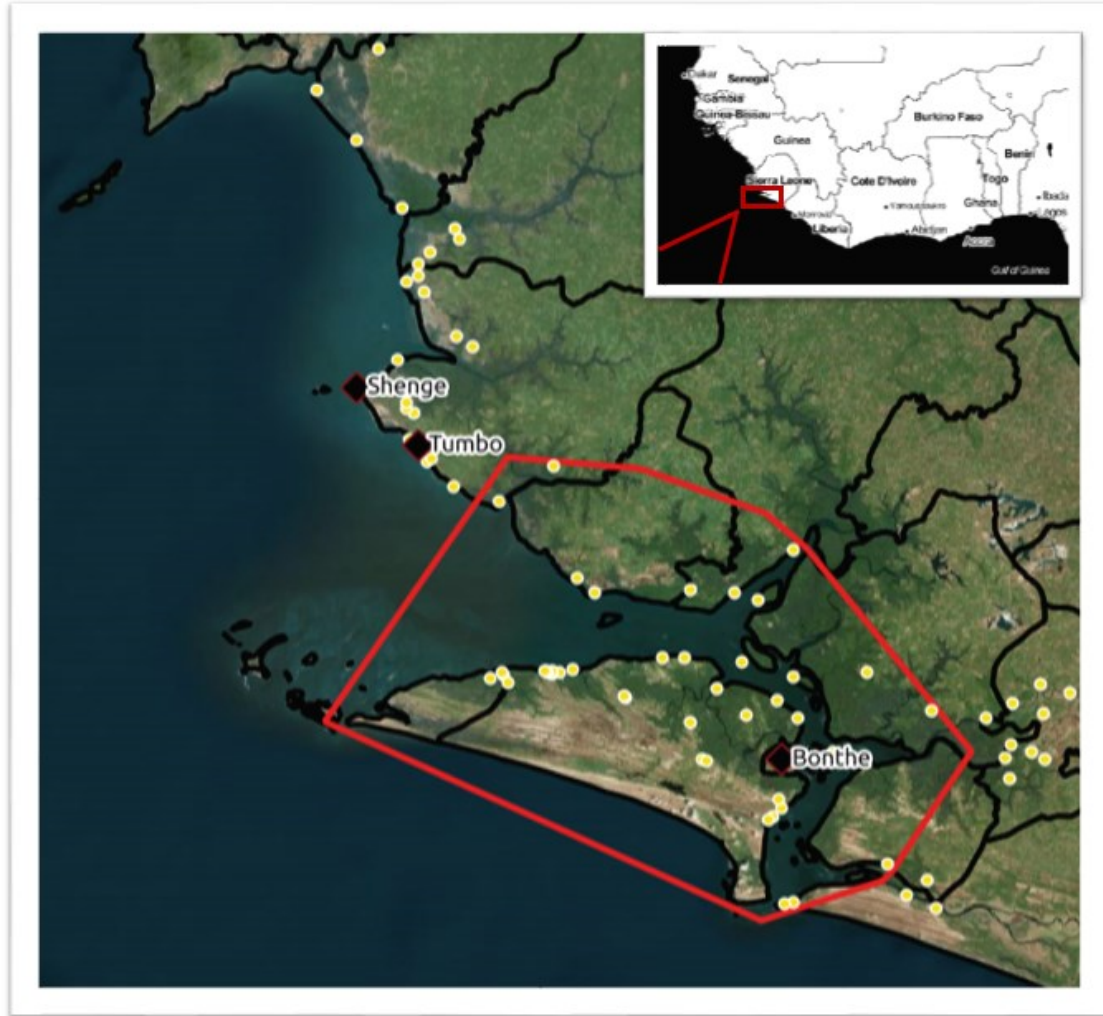


Figure 1: Map of the study area. The yellow dots are the sampled villages. The Sherbro River Estuary, the geographic focus in this report, is delimited in red.

In order to facilitate the formulation of equitable conservation interventions within the region, comprehensive socio-economic surveys were carried out, accompanied by a participatory land planning exercise, in the Sherbro River Estuary encompassing 39 villages across 8 chiefdoms, as well as Yaawri Bay, consisting of 39 villages. This report presents the salient outcomes pertaining to the socio-economic circumstances of the communities inhabiting the Sherbro River Estuary, their intricate associations with mangrove ecosystems, and their expressed inclinations regarding prospective trajectories for development.

1.1. Demographic

The population size of the selected village located within the Sherbro River Estuary was estimated to be 7500, with approximately two-thirds of the population being under the age of 30. The majority of household heads fall within the age range of 30 to 45, and they are predominantly male. Furthermore,

the average household size is 5 including adults and children. The population is mainly muslim at 92 %, 64 % from Sherbro, and 32 % from the Mende tribe.

Table 2: School attendance by age and gender

Age	Female	Male
12-14	49 %	39 %
15-17	44 %	43 %
6-11	53 %	48 %

The population exhibits a significant prevalence of low educational attainment, as evidenced by the findings of our survey. Among the sampled heads of households, a substantial proportion, specifically 81.64%, reported having no formal education, while a mere 12% indicated completion of primary school. Consequently, the illiteracy rate among the population stands at 76 %. Overall, school attendance rates approximate 50%, with comparatively higher rates observed among females. Furthermore, school attendance demonstrates a slight incline for younger children in comparison to their older counterparts.

1.2. General local political structure

The chieftaincy system serves as the primary political structure at the local level, wherein paramount chiefs hold leadership positions within the chiefdoms and are elected by ruling families. Each chiefdom is further divided into sections, headed by section chiefs who serve as direct hierarchical superiors to the village leaders known as town chiefs or village chiefs. Town chiefs bear the responsibilities of maintaining village harmony, resolving local conflicts, collecting taxes, and fostering local development. This assertion is supported by the findings indicating that over 95% of village chiefs identify these four roles as their primary responsibilities. In addition, respectively, 41% and 31% of village leaders take responsibility for the protection of forests and the protection of biodiversity. The selection of town chiefs is carried out through elections, with candidates being required to belong to a chiefly family. The extent to which families are granted voting rights for town chiefs varies across villages.

In approximately half of the villages, the majority of the population (100%) is eligible to vote for the town chief. However, in a quarter of the villages, less than 58% of families are granted the right to vote, potentially affecting the quality of leadership and the representativeness of decisions.

In addition to the town chiefs, several other leadership positions contribute to the socio-political fabric of the villages. These include:

- The mummy queen and the youth leader can be found in every village from which we gathered data, guiding both the women's and youth groups.
- Tribal authorities: The presence of one tribal authority for every 19 taxpayers is observed, and their role entails participating in the election of the paramount chief.
- Council of elders: Approximately 79% of villages in the project area have a council of elders, which consists of experienced individuals responsible for offering advice to the town chief.
- Societal heads: These individuals bear the responsibility of initiating young boys and girls into the secret society, and they often oversee traditional medicinal practices.

2. Methodology

The research area of interest encompasses the Sherbro River estuary, comprising eight distinct chiefdoms. Through a combination of data sources, including geocoded village lists and satellite image analysis, we obtained information about the number of settlements within the region. Subsequently, a random sampling process was employed to select 39 villages with a minimum of 20 houses as the primary focus for data collection. ¹.

The data collection process involved a listing survey conducted in each village. The listing consisted in visiting each structure in the village to determine the number of households and young adults residing within the village. From that listing, we employed a stratified random sampling where respondents were selected from the gender and age strata. The data collection used a mixed method with qualitative and quantitative data collection:

- Individual surveys: The objective of these surveys was to gather data pertaining to socio-economic conditions, livelihood activities, relationships with mangroves, and political attitudes. Two types of individual surveys were conducted:
 - Village-level surveys: These surveys targeted the town chief, aiming to capture both the socio-economic development at the village level and the socio-economic status and political attitudes of the town chief.
 - Household-level surveys: These surveys focused on 12 randomly selected heads of households in each village. Particular attention was given to ensuring representation from female heads of households during the selection process.
- Land planning activity: This activity encompassed three sections and aimed to explore livelihood activities and conservation preferences across various social groups, including leaders, young men, and young women. A random selection process was employed to choose 12 individuals, consisting of six youths and six leaders.
 - The first section involved an individual survey to elicit key demographic information and assess conservation preferences;
 - The second section entailed a focus group discussion to explore livelihood activities, concerns related to deforestation, and preferred paths for development among different social groups based on their status, gender, and age.
 - The third section involved a participatory mapping exercise, wherein leaders and youth participants were randomly assigned to groups. This exercise facilitated the mapping of

¹ Data collection occurred in the Sherbro River estuary and Yawri Bay. For the report's aim, we only focus on the villages in the Sherbro River estuary.

critical resources, livelihood activities, threats, concerns related to deforestation, and preferred paths for development.

Table 3: Number of observations by gender and age for each methodological tool

General	Individual surveys		Participatory mapping		
	Household	Village	Individual	Focus group	Mapping
	463	40	473	120	40
Gender					
<i>Female</i>	181	-	162	40	-
<i>Male</i>	282	-	311	80	-
Age					
<i>Adult</i>	343	-	237	39	-
<i>Youth</i>	120	-	236	81	-

Overall, 40 villages were visited in the study area for a total of 463 head of households, and 40 land planning activities including 120 focus group discussions.

3. Community well-being

In the assessment of the socio-ecological systems within the Sherbro River estuary, we will employ the doughnut compass as a theoretical framework². This framework is characterized by the utilization of a doughnut diagram, which visually represents the notion that human societies exist within the space between social foundations and ecological limits, often referred to as planetary boundaries. The primary premise is that in order for human societies to thrive in a state that is both ecologically sustainable and socially equitable, basic human needs, including access to essentials such as food, water, and energy, must be met while simultaneously adhering to the limits set by the planet's ecological boundaries. It is worth noting that in comparison to the global context, the Sherbro River estuary experiences relatively lower levels of environmental pressures.

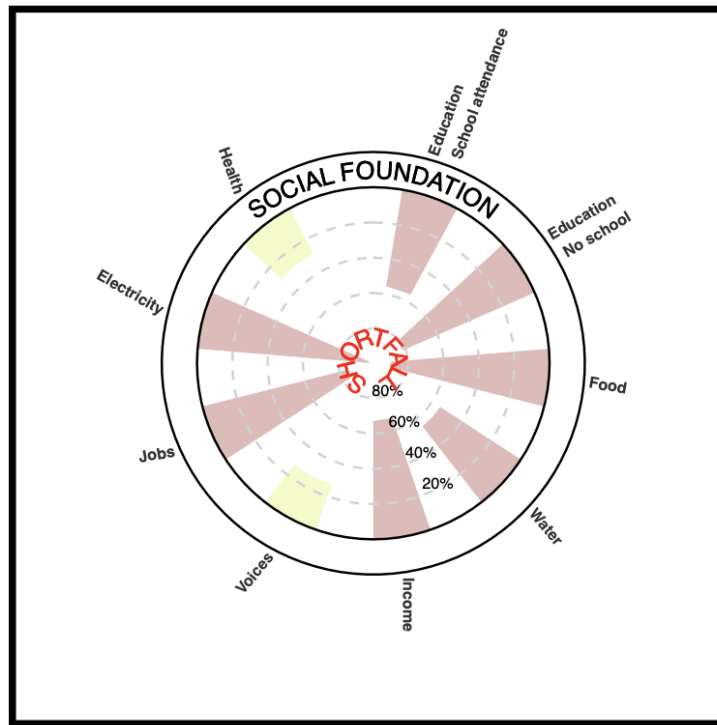


Figure 2: Social shortcomings over 8 dimensions in the Sherbro river estuary

However, there are many societal shortcomings. We summarized those shortcomings over eight key dimensions in figure 2: energy, health, food, water, income, voices, jobs, and education (details over the indicators used for each dimension can be found in appendix 2). The color scheme employed in the analysis represents the proportion of respondents who do not meet their basic needs within a specific dimension. In this scheme, the color red denotes a situation where at least 50% of the respondents fail

² The theoretical framework is derived from Kate Raworth's seminal work, "Doughnut Economics" (2017)

to fulfill their basic needs in that particular dimension while the color yellow indicates that the proportion falls below 50%. The following sections develop the key findings in figure 2.

3.1. Access to basic services

The region is marked by a limited road network, with most areas accessible solely by boat, and merely 10% percent reachable by motorbike. The maritime transportation routes incur substantial costs linked to motorized boats, while non-motorized boats entail extended travel times. These factors collectively contribute to economic hardships, casting an adverse impact on social interactions and eroding various facets of community life. The task of accessing economic prospects, establishing political connections, and accessing vital services becomes more demanding and expensive. To illustrate, only 29% percent of the villages we visited lie within a 3-hour radius from the chieftom headquarters or the nearest market.

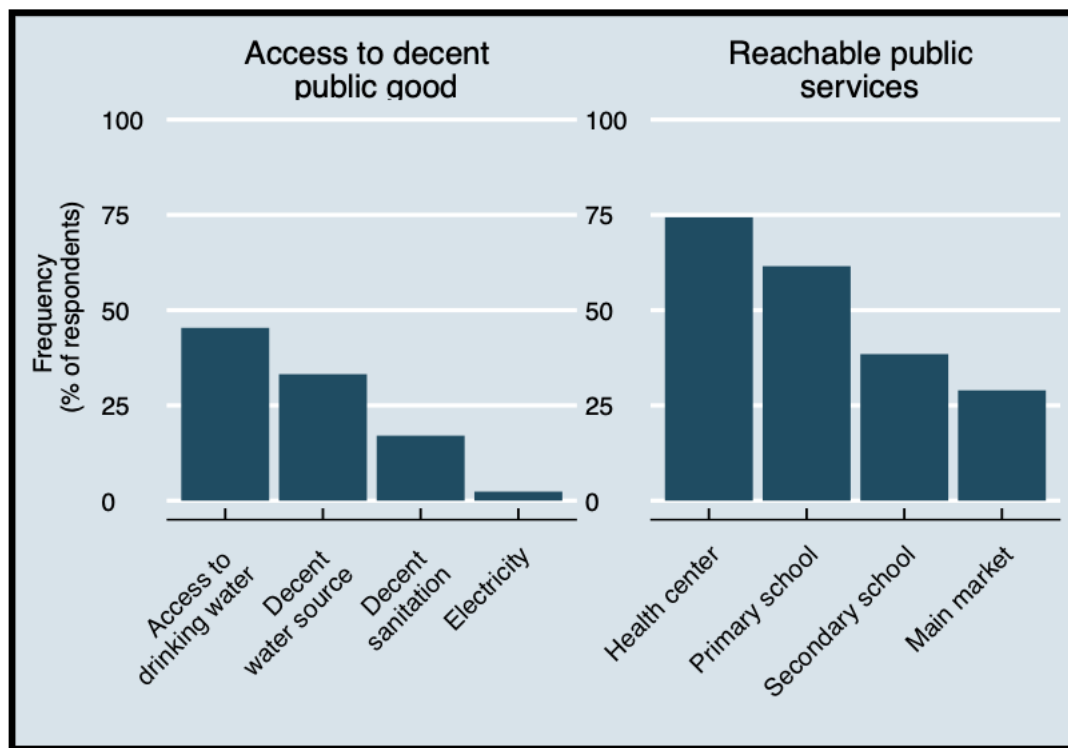


Figure 3: Histogram of the access to basic services. When the service is reachable within 3 hours, it is considered as accessible.

In figure 3, We display how accessible a variety of public goods and services are. Regarding public services, most villages have a relatively close (less than 3 hours) primary school and health center. Nevertheless, the indicator does not consider the service's quality and affordability.

Access to drinking water (%), decent water sources (%), sanitation services (%), and electricity (2%) are far less common and constitute key development priorities. During our research, we conducted

additional qualitative interviews with village chiefs. In one of the selected villages, the chief willingly participated in the interviews, driven by a specific motivation—to express deep concerns regarding the substandard condition of the local water well. The chief actively requested to document the situation by taking photographs, intending to share the story with policymakers and development practitioners.

3.2. Food security

Food security represents a critical domain within the social foundation, as depicted in Figure 2. It captures a multidimensional construct encompassing factors such as food access, availability, and stability, as noted by Johnny, Michael, and Bashiru Mansaray in their study on socio-cultural factors of food insecurity in Sierra Leone (2019). To evaluate the level of food security in the area, we employed indicators derived from the Household Food Insecurity and Access Scale/Household Hunger Scale, developed and promoted by the Food and Agriculture Organization (FAO). Six key indicators were utilized, enabling the differentiation between households categorized as food secure, moderately food insecure, and severely food insecure. A detailed description of the measurement strategy employed to compute these indicators is provided in Appendix 2.

Previous studies have estimated that approximately 70% of the Sierra Leonian population, on average, consumes just one meal per day³. The figures in table 4 are close to that number. Food insecurity is high in the zones with 29 % categorized as severely food insecure and 61 % moderately food insecure. Surprisingly, farmers exhibit levels of food insecurity comparable to other community members, which can be attributed to factors such as poor soil quality, limited access to agricultural inputs, and inadequate capital. Given the relatively low levels of food production in the region, access to food primarily relies on market availability. Therefore, the availability of cash, measured as a respondent experiencing cash shortages in the past year, emerges as a crucial factor associated with food insecurity, as illustrated in table 4.

³ Johnny, Michael, and Bashiru Mansaray. "Socio-cultural factors of food insecurity in Sierra Leone. *Developing Country Studies.*" Vol.9, No.10 (2019)

Table 4: Association between cash emergency (experiencing cash shortages), farmers, and food insecurity

	Food insecurity		
	None	Moderate	Severe
General	10 %	61 %	29 %
Cash Emergency			
<i>No</i>	28 %	69 %	4 %
<i>Yes</i>	2 %	58 %	40 %
Own a farm			
<i>No</i>	15 %	60 %	25 %
<i>Yes</i>	8 %	62 %	31 %

3.3. Livelihood

In this section, we describe the wealth of community members based on material assets, income, and its evolution. We also mention how livelihood activities differ between gender and age.

The main livelihood activity is fishing activities (fishing, transforming, and selling) for 58% of households. To a lesser extent, only 16% of the respondents are self-employed, and 7% have their main livelihood activities tied to agriculture.

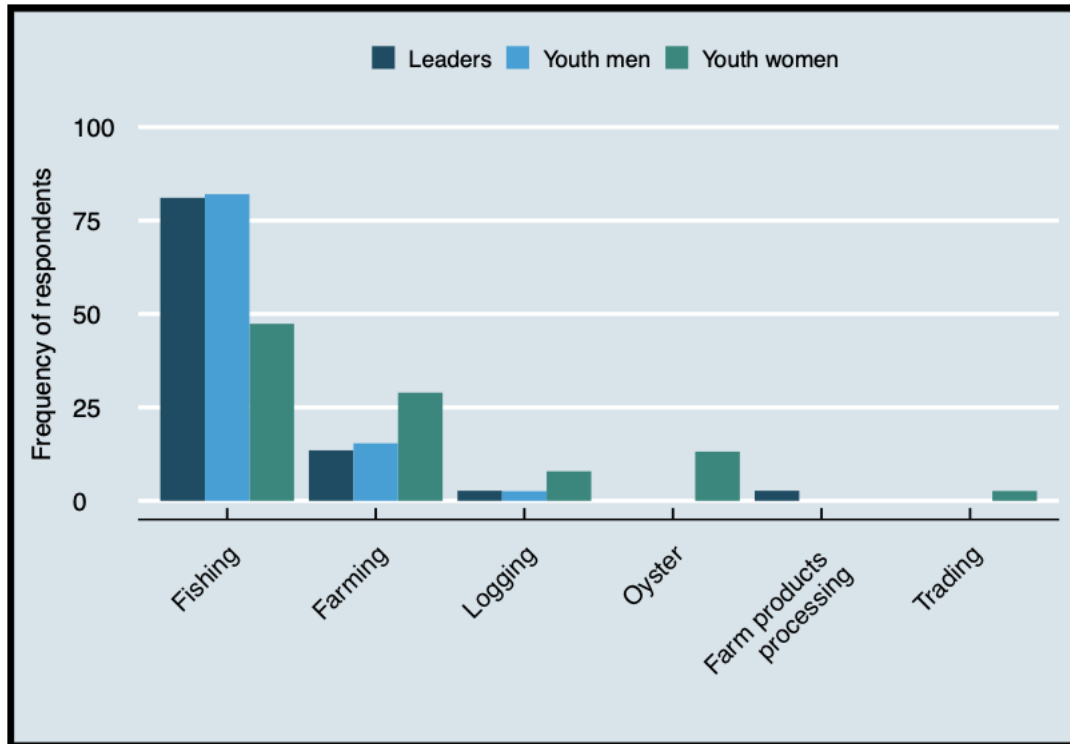


Figure 4: Histogram of the main livelihood activities by social groups

The findings reveal nuanced differences among leaders, youth women, and youth men in terms of their livelihood activities, as presented in Figure 4. The data for this analysis was derived from non-mixed focus group discussions. The majority of male leaders and youth, and to a lesser extent, female youth, reported their livelihood activities to be primarily centered around fishing. For male leaders and youth, fishing constituted their main occupation, while females engaged in fish processing and sales. However, females also exhibited a more diverse range of livelihood activities. More than 25% of female youth indicated involvement in farming activities, while approximately 10% reported engaging in oyster gathering.

It is important to note that the survey did not specifically focus on fishing practices and markets. However, through observations and interviews, certain insights can be gleaned. Firstly, it was observed that 95% of fishing households engage in fishing both for consumption and sale, with only 5% primarily utilizing it for personal consumption, and less than 1% fishing only for sales. Additionally, 67% of the survey participants engage in fishing daily, while 30% do so on a weekly basis. Despite being situated in a remote area, fishermen are integrated into a complex regional and international fishing market, where they often possess limited bargaining power. Fishing activities take place at sea and in the estuary, utilizing both engine and non-engine boats equipped with nets. Preservation of fish poses challenges due to the absence of electricity and refrigeration facilities. Consequently, communities either sell their fish directly to other community members or enter supra-national markets. The extent of economic importance associated with these local and international

markets in the area remains unknown. When participating in the international market, fishermen typically sell their catch to foreign private companies or employ smoking techniques for preservation purposes. Korean and Chinese vessels are frequently present in the area, with a Korean company established in Tumbo. This company contracts local fishermen, providing them with tools and boats to fish specific species. Local youths are also employed to monitor and ensure that fishermen sell their catch exclusively to the company. The company is generally regarded positively in the area due to the employment opportunities and stable income it offers to numerous families. Furthermore, the illegal presence of trollers (larger boats) has been observed, as they operate in prohibited zones close to the coast and within the estuary. These vessels employ problematic fishing methods that pose a threat to fish stocks. Another concerning finding is the illegal practice of drying and selling very young fish in Guinea for poultry farming. This practice is detrimental to the fish population, although respondents justified it by citing the lack of economic opportunities in the region.

The second main economic activity is farming, with 68 % of the respondents stating that they own a farm. The average size of the farm is 2.7 acres ⁴. The most common crop is cassava, followed by rice, pepper, yams, groundnut, maize, beans, okra, oil palm, banana, and eggplant. However, production is insufficient for many farmers to sustain their daily consumption. For instance, half of the farmers have more than two weeks of cassava or rice shortage before their production, and a quarter of the farmers have a 5-weeks shortage or more. The most common alternative is to buy food from the market, which could explain why cash shortage is associated with food insecurity. On average, 74 % of the households own livestock, mainly chickens (10 per household), goats (1 per household), and sheep (0.5 per household).

Furthermore, an investigation was conducted at the household level to examine the patterns of resource extraction for non-timber forest products. Overall, 56% of households reported engaging in the gathering of at least one such product. The specific percentages for the different products were as follows: 32% for oysters, 24% for crabs, 22% for bamboo, 17% for moringa, and 7% for honey.

As table 5 shows, oysters and crabs are frequently gathered by respondents (at least weekly), while honey, moringa, and Bamboo are more occasionally gathered (mostly monthly or in season). Of course, all the items are important for the self-consumption of households. Nevertheless, crab, honey, and oysters also contribute to cash income.

⁴ around 1.1 hectares

Table 5: Frequency and Purpose of non timber forest products gathering

	<i>Bamboo</i>		<i>Crab</i>		<i>Honey</i>		<i>Moringa</i>		<i>Oyster</i>	
	N	%	N	%	N	%	N	%	N	%
Gather										
Yes	97	22	112	24	31	7	67	17	151	33
No	342	78	350	76	431	93	332	83	311	67
Frequency										
Daily	6	6	13	12	0	0	0	0	58	38
Weekly	27	28	81	72	1	3	30	45	72	48
Monthly	21	22	6	5	5	16	32	48	12	8
In season	43	44	12	11	25	81	5	7	9	6
Purpose										
Primarily for consumption	83	86	47	42	9	29	64	96	27	18
Equally for consumption and sale	11	11	61	54	18	58	3	4	91	60
Primarily for sale	3	3	4	4	4	13	0	0	33	22

3.4. Income

Within the household survey, a specific section focuses on household income. However, collecting precise income figures posed challenges for two primary reasons. Firstly, households lack an accounting system that accurately tracks income. Secondly, a considerable portion of economic transactions in the area occurs through a barter system, which is not captured by the income question.

The average monthly income is 597 Le, and the median income is 429 Le (around 20\$ a month). This suggests that approximately two-thirds of the population in the area lives on less than one US dollar equivalent. Furthermore, 45% of the sample reported a reduction in their income over the past five years, while only a fifth reported an increase. When respondents were asked about the reasons for the decline in income, 46% attributed it to family responsibilities and issues, 30% mentioned economic hardships resulting from global inflation and currency devaluation, and 22% cited health problems.

As table 6 shows, non-timber forest products significantly contribute to the income of one-third of the individuals in our study. On average, the annual income generated from the collection of non-timber forest products amounts to 1600 Leone, constituting a substantial portion, ranging from 18% to 27%, of their total annual income. This noteworthy contribution primarily arises from the harvesting of crabs (68 respondents) or oysters (127 respondents).

The prevailing socioeconomic conditions within the region are characterized by a notable paucity in average income, as substantiated by a multitude of empirical markers. Evidently, a mere 19% of the survey respondents affirm their capacity to prudently accumulate financial resources beyond their domestic confines. Furthermore, approximately 35% of the surveyed individuals resorted to securing loans over the course of the preceding year, with a preponderance of such borrowings being directed towards familial acquaintances, close friends, or local merchants.

Table 6: Average Income from Non Forest Timber Products Harvest, figures in Leone.

	N	Annual Income from NFTP	Share of total income
bamboo	15	969	[11% ; 14%]
crab	68	1234	[12% ; 16%]
honey	22	755	[13% ; 17%]
moringa	7	246	[4% ; 4%]
oyster	127	1219	[16% ; 23%]
Total	170	1598	[18% ; 27%]

3.5. Land tenure

Customary land tenure prevails and gives property rights to historical family settlers. 68 % of households own a farm, and 57 % own nonagricultural lands. Almost every household has the right to fish, hunt, log, farm, and collect nontimber forest products for consumption and sale.

We also asked the respondents whether they fear losing their rights to fish, log, farm, or collect non-timber products. Table 7 summarizes the main results. The findings reveal a notable portion of the population experiencing tenure insecurity, with 40% expressing fear of losing their farming rights, 34% apprehensive about losing their logging rights, and 23% concerned about losing their fishing rights. Significantly, there exists considerable heterogeneity among respondents, particularly in

relation to their political status. Individuals without the right to vote exhibit an average tenure insecurity level that is twice as high as that of individuals with political rights. This demonstrates how political marginalization has tangible implications for people’s sense of security regarding their future. These findings align with previous research highlighting the influence of family backgrounds on land access and rights⁵.

Furthermore, gender and income also demonstrate associations with tenure insecurity, although to a lesser extent. Table 7 illustrates that females are slightly more concerned about losing their rights so as poor community members.

Table 7: Tenure insecurity and potential factors contributing to it: gender, right to vote, income

	Are you afraid to lose your rights to:				
	Log	Fish	Farm	NFTP	Hunt
General	34 %	22 %	39 %	26 %	29 %
Gender					
<i>Male</i>	36 %	31 %	27 %	25 %	21 %
<i>Female</i>	44 %	38 %	33 %	29 %	23 %
Right to vote					
<i>No</i>	59 %	53 %	54 %	42 %	34 %
<i>Yes</i>	31 %	27 %	20 %	20 %	17 %
Income per quartile					
Q1	40 %	37 %	23 %	31 %	34 %
Q2	44 %	40 %	32 %	35 %	29 %
Q3	39 %	34 %	32 %	24 %	15 %
Q4	32 %	25 %	30 %	17 %	11 %

⁵ Peter Albrecht (2016). Secrets, strangers, and order-making in rural Sierra Leone, *Journal of Contemporary African Studies*, 34:4, 519-537

4. Mangroves and conservation

Mangrove ecosystems play a pivotal role in sustaining the livelihoods of local communities. They provide crucial support for fishing activities, including fish breeding within the mangrove habitat. Furthermore, mangroves offer valuable material resources such as firewood and timber for construction purposes, while also serving as a protective barrier against extreme weather events. On a global scale, mangroves hold significant importance for carbon sequestration and have garnered considerable attention in recent years as part of the blue carbon mitigation strategy.

This section aims to comprehensively examine the status of the mangrove forest, the utilization of mangrove resources by community members, their attitudes towards conservation, and the institutional framework that establishes regulations governing extractive practices within these ecosystems.

4.1. State of mangrove forest

The assessment of ecological well-being in mangrove ecosystems encompasses various dimensions, including biodiversity, forest cover, soil regeneration, and other related factors. The intricate interrelationships among these variables contribute to the complexity of evaluating the overall ecological health of mangroves. However, due to methodological constraints and the need for a simplified approach, we rely on forest cover indicators as proxies to gauge the state of mangrove forest health. These indicators provide a practical means to approximate and assess the extent and condition of mangrove forest cover, acknowledging that they offer only a partial representation of the broader ecological dynamics at play.

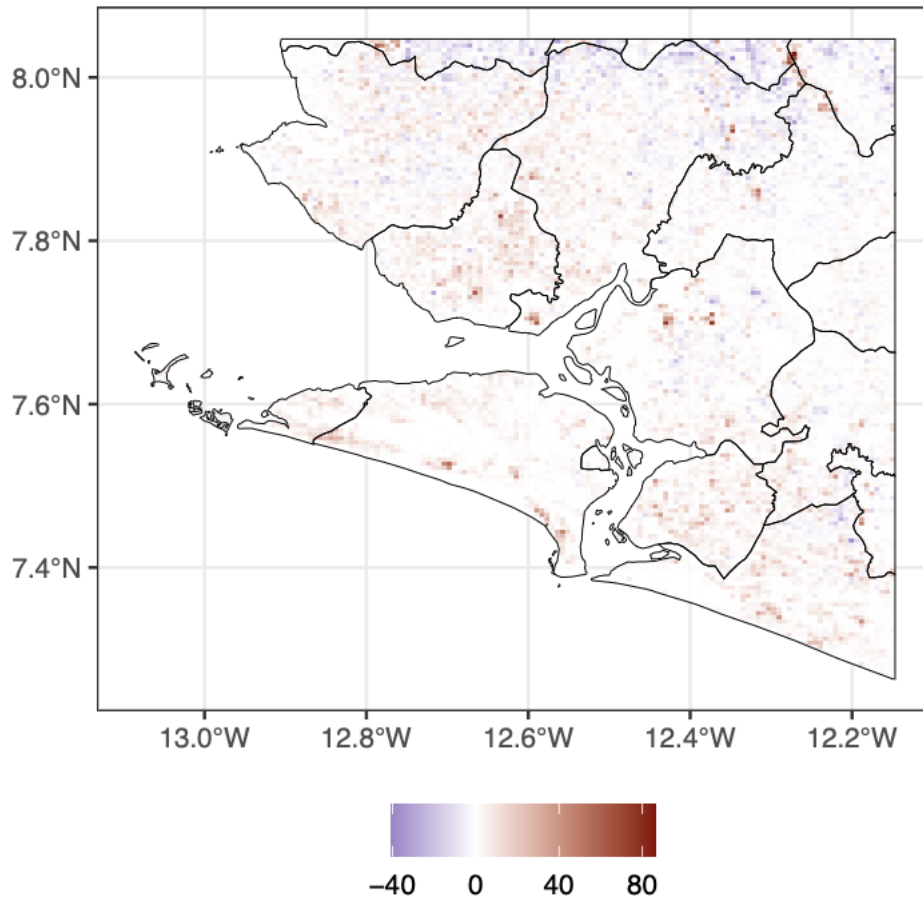


Figure 5: Plot of the evolution of forest cover in the Sherbro River Estuary between 2015 and 2020

At present, the extent of forest coverage, predominantly consisting of mangrove forests, encompasses around 30% of the overall territory, and when specifically considering the Sherbro River estuary, it accounts for approximately 50%. Deforestation rates have been notably higher in the vicinity of the estuary, leading to a decline in forest cover from 53% of the total area in 2000 to 23% in 2020. Within the core region of the estuary, deforestation has been relatively less pronounced, resulting in a reduction in forest cover from 69% in 2000 to 52% in 2020. As depicted in figure 5, the past five years have witnessed considerable variation in deforestation patterns, with certain areas exhibiting less impact compared to others. Mangrove areas in Sherbro Island and the Imperri chiefdom have experienced relatively lower deforestation rates in contrast to the exceptionally high rates observed in the Bagruwa and Bendu-Cha chiefdoms. Furthermore, the presence of regenerated forest (represented by blue areas) in the inland regions of Moyamba and Bonthe districts can be attributed to the complete loss of forest cover between 2000 and 2010.

Interestingly, there is no clear link between the subjective appreciation of forest cover dynamics and remote sensing outputs. For example, approximately 56 % of the households consider that mangrove

forest cover decreased in the past five years, and only 35 % mentioned that mangroves were under threat. Such observations hold significant implications as they necessitate careful consideration. Communities that hold the perception of mangroves being safeguarded or even expanding in the area may require assistance in comprehending and accepting projects that are justifiably aimed at protecting the mangroves.

Table 8: Mangrove use and its relationships with cash emergency and political rights

	General	Cash emergency		Right to vote	
		No	Yes	No	Yes
Fuelwood	96	96	95	96	95
Construction	82	77	84	70	86
Source of cash/income	42	44	41	46	40
Source of food	35	31	37	46	31
Fishing gear (acadja)	23	18	25	21	24
Poles	8	13	6	18	5
Spiritual activity	5	1	7	3	6
Charcoal production	1	1	2	2	1

4.2. Mangrove use

The mangrove ecosystem is fundamental for the livelihood of communities, with the 87 % of the households stating that they have gathered mangrove products in the past year.

As depicted in table 8, nearly all respondents indicate their utilization of mangroves for obtaining firewood, while a comparatively smaller proportion utilizes them for construction purposes.

Approximately 41% of the respondents rely on mangroves as a source of cash, highlighting the significant value of mangroves for numerous households in the area and the challenges they face in generating an adequate income. Additionally, one-third of the households utilize mangroves as a source of food, while one-fourth employ them for obtaining fishing gear. A smaller portion of respondents utilize mangroves for acquiring poles, engaging in spiritual activities, or engaging in charcoal production.

We examined two key factors that influence the utilization of mangroves: economic poverty, which is indicated by a lack of cash, and political marginalization, which is indicated by the inability to participate in voting for the town chief. Overall, economic and political marginalization are associated with a higher dependency on mangrove resources for material needs. For instance, households that have experienced a lack of cash in the past year are more inclined to use mangroves for construction and as a food source. However, there is no significant association with the use of cash. With regard to political marginalization, respondents who are unable to vote for the chief are less likely to utilize mangroves for construction but exhibit a higher likelihood of using them for food, cash, and poles.

Many respondents sell mangrove wood for their income (42 %). Most of them (67 %) sell the wood in the area, including the village, while 10 % of the respondents sell the wood in other regions. There is no evidence regarding the presence of private companies or foreigners in buying mangrove wood. Despite being a significant income source, the commodification of mangrove wood raises concerns regarding its impact on the health of the mangrove ecosystem and how it alters local people perceptions of such an ecosystem.

The process of cutting mangrove wood is primarily undertaken by young men, as it necessitates the use of a boat. On the other hand, women are responsible for collecting firewood from non-mangrove forests for domestic purposes. On average, firewood collection occurs once every two or three days and typically takes over an hour. The distances traveled for firewood collection vary, with the majority of households completing the task within an hour from the village. However, 10% of households need to travel for at least 2 hours to collect firewood.

4.3. Conservation attitudes

In order to assess conservation attitudes, we adapted and contextualized the measurement approach proposed by Aiman et al. (2022)⁶. This approach builds upon Bronfenbrenner's ecological framework (1999)⁷. Additionally, we incorporated attitudinal models from Meijer et al. (2015)⁸, which were utilized in the context of forest conservation in rural Africa.

⁶ Aiman, Arief, Nor Akmar Abdul Aziz, Norzanalina Saadun, Evelyn Lim Ai Lin, Alex M. Lechner, and Badrul Azhar. 'Attitudes and Willingness of Local Communities towards Natural Urban Forest Conservation in a Rapidly Developing Southeast Asia City.' *Cities* 129 (1 October 2022)

⁷ Bronfenbrenner, U. (1999). Environments in developmental perspective: Theoretical and operational models. In S. L. Friedman & T. D. Wachs (Eds.), *Measuring environment across the life span: Emerging methods and concepts* (pp. 3–28). American Psychological Association.
<https://doi.org/10.1037/10317-001>

⁸ Meijer, Seline S., Gudeta W. Sileshi, Delia Catacutan, and Maarten Nieuwenhuis. 'Farmers and Forest Conservation in Malawi: The Disconnect between Attitudes, Intentions, and Behaviour.' *Forests*,

Conservation attitude was operationalized into five distinct dimensions: a) Awareness of the ecosystem services provided by mangroves, b) Awareness of the material benefits derived from mangroves, c) Normative beliefs concerning extractive behavior, d) Second-order beliefs pertaining to extractive behavior (i.e., individuals' perceptions of what others think), and e) Concern about deforestation. Initially, we present the disparities between leaders and community members in the first two dimensions. Subsequently, we delve into a more granular analysis to examine variations in these five dimensions across different social groups.

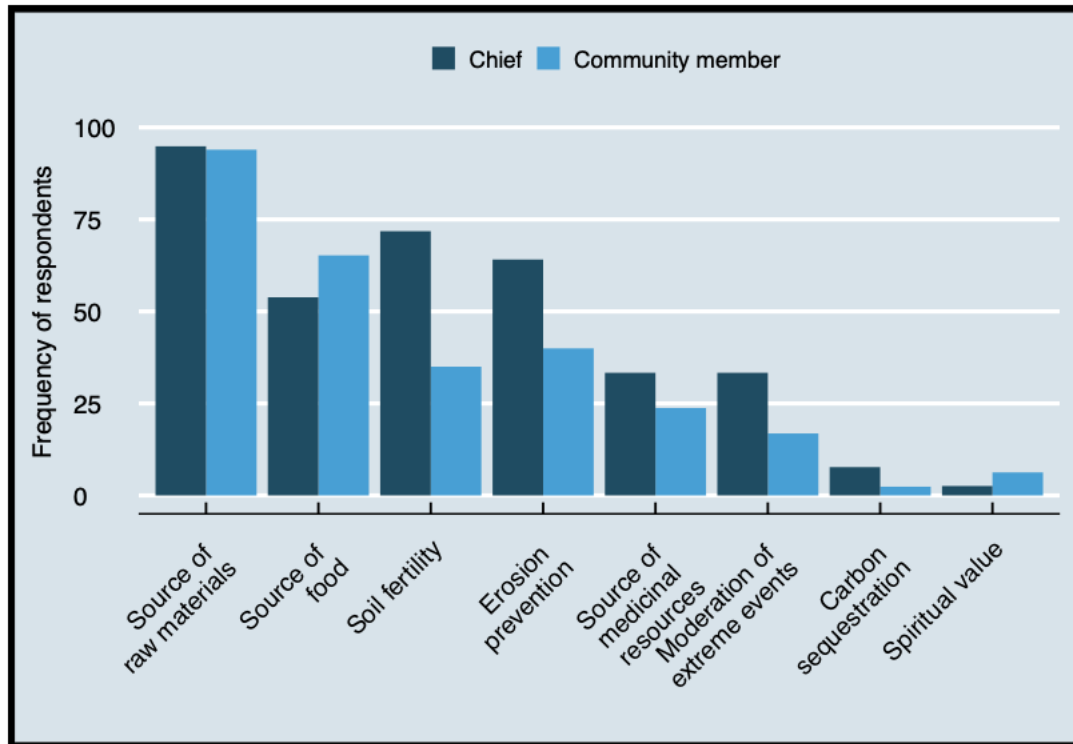


Figure 6: Knowledge about the benefices of mangrove ecosystems

Figure 6 provides an overview of the respondents' level of awareness regarding the ecosystem services offered by mangroves, categorized according to their social status. As expected, the respondents exhibit a higher degree of familiarity with the material ecosystem services provided by mangroves, such as the availability of firewood and food resources. Conversely, a relatively smaller proportion of community members (less than 50%) are knowledgeable about the nonmaterial benefits of mangroves, including their role in enhancing soil fertility, preventing erosion, and

mitigating the impact of extreme events. However, it is worth noting that town chiefs, on average, display a significantly greater awareness of the nonmaterial advantages associated with mangroves. For instance, over 50% of town chiefs demonstrate an understanding of the importance of mangroves in maintaining soil fertility and preventing erosion.

While climate change represents a global phenomenon, the distribution of responsibility for its causes varies, thereby influencing individuals' perceptions of their environment and ecosystems. Consequently, it is unsurprising that more than 95% of both community members and leaders exhibit a lack of awareness regarding carbon sequestration, likely due to the minimal carbon footprint associated with their activities. Nonetheless, acknowledging the significance of carbon sequestration is pivotal when formulating initiatives related to carbon management and reduction efforts.

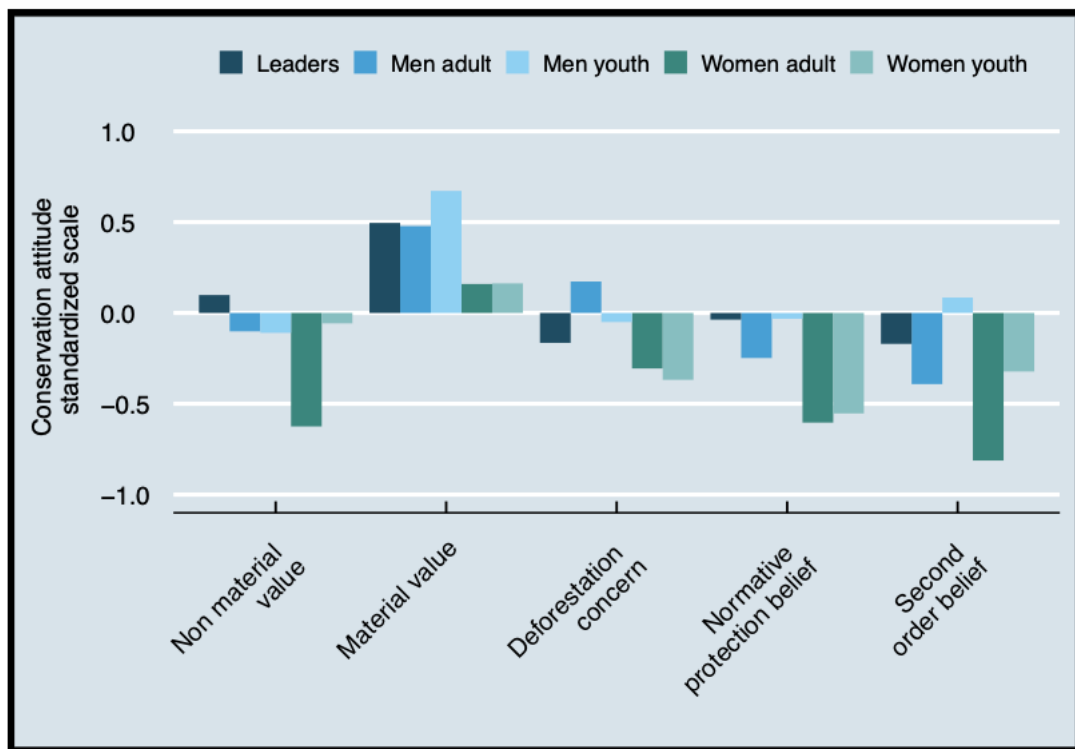


Figure 7: Conservation attitudes between social groups across 5 key dimensions

Figure 7 a comprehensive overview of conservation attitudes across the five dimensions, delineated by distinct social groups, namely leaders, gender, and age. The y-axis portrays the standardized average of the dimension's constituent items. Notably, the findings reveal several noteworthy trends. Firstly, youth men (below 30 years) exhibit the highest conservation attitudes across four of the five dimensions, followed closely by leaders and adult men. Secondly, it is surprising to observe that women consistently scored lower than their male counterparts across all dimensions. This

observation is unexpected, as previous research has indicated that women generally possess more pro-environmental attitudes⁹, particularly in the context of forest depletion, and express greater conservation preferences¹⁰, generally because they are primarily impacted by deforestation¹¹. Conversely, women in the project area perceive themselves to be less reliant on mangrove resources. Furthermore, youth men emerge as the social group reporting the highest dependence on mangrove resources, potentially accounting for the variability in conservation preferences.

However, such dependency and individual preferences do not translate into a willingness to act and regulate deforestation patterns. During focus group discussions, despite being more concerned about deforestation, youth men were less likely to express a willingness to act against deforestation. In addition, differences between social groups seemed less salient during focus groups than individual surveys.

Finally, only 8 % of the targeted households have already participated in climate change training. Surprisingly, trained households are not clustered in some areas but spread across villages. 48 % villages that have at least one household who participated in training in the past.

4.4. Mangrove governance

Mangroves can be conceptualized as a common resource, and in such cases, the unregulated utilization of these resources can lead to a tragedy, where individuals are incentivized to free-ride and exploit the resources excessively. To mitigate this threat to mangrove ecosystems, various political regulations can be implemented. Private and public regulations are more prevalent in northern countries, while community management approaches are commonly adopted in many countries in Asia, Latin America, and Africa.

In the Sherbro River Estuary, it was reported that 30 out of 38 villages claim communal ownership of the mangroves, while the remaining communities chose not to provide a response. To evaluate the governance of mangroves, we employ the conceptual framework established by Ostrom, renowned for

⁹ Casaló, Luis V., and José-Julián Escario. 'Heterogeneity in the Association between Environmental Attitudes and Pro-Environmental Behavior: A Multilevel Regression Approach.' *Journal of Cleaner Production* 175 (20 February 2018): 155–63.

¹⁰ Leone, Marinella. 'Women as Decision Makers in Community Forest Management: Evidence from Nepal.' *Journal of Development Economics* 138 (1 May 2019): 180–91.
<https://doi.org/10.1016/j.jdeveco.2019.01.002>.

¹¹ Chigbu, Uchendu Eugene. 2020. 'Land, Women, Youths, and Land Tools or Methods: Emerging Lessons for Governance and Policy.' *Land* 9(12): 507.

her work on sustainable anthropo-ecosystem dynamics through different institutional designs¹². This framework encompasses several key elements, including: 1) clearly defined group boundaries, 2) rules that align with the needs and conditions of the community, 3) participation of community members in the process of rule-making, 4) recognition of these rules by external authorities, 5) monitoring mechanisms, 6) graduated sanctions, 7) accessible dispute resolution, and 8) the presence of a polycentric governance system.

In most villages, mangroves are characterized by an open-access system, where no restrictions on resource extraction exist. While 13 villages reported having some rules pertaining to resource extraction, only one village had rules specifically addressing extraction periods, and none had rules regarding extraction quantities. The absence of regulations can be attributed to the perceived abundance of mangrove resources and the absence of threats or concerns. In the absence of perceived risks, there is often a lack of necessity to establish rules. Moreover, among the villages where the town chief mentioned the existence of rules, it was observed that community members did not participate in the rule-making process¹³. Given the lack of clarity surrounding the rules, discussions about enforcement and monitoring would be impractical.

Considering the prevalence of conflicts related to farmland and village boundaries, it is likely that there are no clearly defined boundaries governing access to mangroves, especially in the absence of regulations. Additionally, the appropriate scale at which mangrove resources should be regulated remains unknown.

¹² Ostrom, Elinor. *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge University Press, 1990.

¹³ However, we have reservations about the actual existence and details of these rules, as we did not receive comprehensive information about them.

5. Inclusive development within planetary boundaries

In Section 3, we have delineated the principal social challenges encountered within the study area. To begin, a substantial portion of households grapples with inadequate access to fundamental necessities, including food security, energy, employment prospects, and education. Secondly, there is an urgent need to address the issues of water quality improvement and access to adequate financial resources. Lastly, a notable concern lies in the lack of political representation experienced by approximately one-third of the sampled population, which adversely affects various aspects of their social well-being.

It is important to note that these indicators were selected based on established international recommendations for assessing overall well-being. In addition to these external benchmarks, we also collected data on the preferences of community members regarding their development priorities. In the final section of this document, we present and discuss these findings, exploring their potential implications for the conservation and management of mangrove forests in the region.

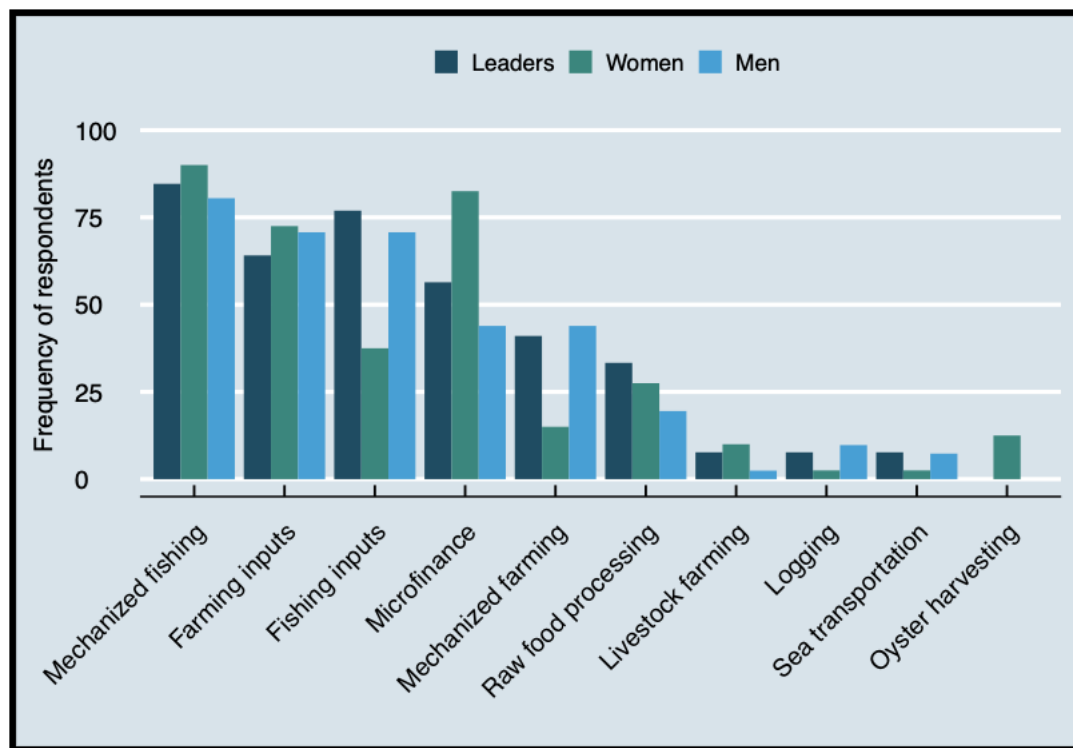


Figure 8: Key priorities for local development by sector and social group

5.1. Key priorities for local development

During the non-mixed focus group discussions, we sought insights into the community's priorities for development initiatives. As depicted in 8, two key areas of development emerged across social groups: the mechanization of fishing activities and the enhancement of farming inputs. Mechanization of fishing activities entails the provision of engine boats (only 10% of respondents currently possess

them) and refrigeration facilities for fish preservation. It is important to consider that the development of engine boats could potentially exert increased pressure on fish populations and indirectly impact mangrove forests due to the associated smoking process. Conversely, the introduction of refrigeration facilities may reduce the reliance on smoking fish and subsequently decrease the demand for mangrove wood. However, it is worth exploring further research to assess the potential rebound effect that could lead to an increased demand for mangrove wood. It is important to note that the development of fridges is unlikely to affect the market for small dried fish used in poultry farming.

Regarding farming inputs, there is a collective desire for better seeds, increased fertilizer quantities, and training. However, it is important to acknowledge that the efficacy of increased inputs on production may be hindered by poor soil conditions, characterized by sandy soil. While there is no direct link between the demand for mangrove wood and the provision of agricultural inputs, an increase in food availability resulting from improved farming practices could reduce the need for cash income and subsequently decrease reliance on wood sales as a source of income.

Most male respondents emphasized the need for the development of fishing inputs such as nesting sites, fishing ponds, and fishing feeds, with a lesser focus on agricultural mechanization. Projects aimed at enhancing the productivity of existing economic activities hold potential to increase income and reduce the necessity to harvest wood for income generation. However, an increase in fishing production without proper access to markets and fish preservation facilities may lead to a heightened demand for wood for drying purposes.

In contrast, most women expressed the need for the development of micro-finance projects, considering the limited presence of village savings and loan associations in the area. The divergence between men and women's priorities can be attributed to the higher representation of women in entrepreneurial endeavors. Additionally, many households indicated that the lack of capital posed a tangible constraint to the development of their economic activities.

During the village survey, we solicited the town chief's preferences for livelihood programs. Surprisingly, approximately half of the chiefs identified women's empowerment and youth employment programs as the primary priorities for village development. Vocational training, sea transportation improvements, and mechanized fishing were also frequently mentioned as key areas of focus.

5.2. Alternative livelihood strategies

5.2.1. Aquaculture

Aquaculture products hold a prominent position in local markets. A modest proportion of households, slightly below 20%, have ventured into aquaculture production, while an impressive 77% of

respondents expressed their willingness to engage in such practices.¹⁴ The adoption of aquaculture production has the potential to alleviate the pressure on the existing fish population, which is crucial considering that many respondents reported a decline in income due to the dwindling fishing resources. However, it is worth considering that the effectiveness of aquaculture in mitigating threats to mangrove forests hinges upon the availability of fish preservation technologies. Without suitable alternatives, smoked fish remains the primary method of preservation, potentially maintaining the reliance on mangrove wood.

5.2.2. Informing cook stove intervention

The enhancement of cook stoves, while not aligning with the prioritized social needs highlighted by the indicators or community members themselves, holds the potential to address certain underlying concerns. Particularly, the improvement of cooking conditions, specifically for drying fish, could contribute to a reduction in the demand for mangrove wood and enhance overall health by mitigating respiratory illnesses. The average reported annual health center visits related to eye problems, respiratory ailments, or cooking-related burns stands at 0.7, with 25% of respondents indicating at least one visit for such issues.¹⁵

A significant majority of households, approximately 97%, engage in outdoor cooking or utilize a separate structure, employing firewood (83%) alongside stone (83%) or wood stick (14%) supports. A quarter of the sample employs alternative firewood sources, including crop residues and waste materials. Although no explicit dissatisfaction with the current cooking methods was identified,¹⁶ all respondents expressed their willingness to explore alternative approaches.

5.2.3. Development of micro-finance

Village savings and loans associations (VSLA) are participatory institutions characterized by a trust-based framework that facilitates members' savings. In and around Sherbro Island, VSLA is present in only 13% of the villages and 26% of the households participate in such a system. Therefore, in this area, where only 8% of the respondents stated having access to micro-credit, there is a strong interest in developing VSLA (83%).

¹⁴ It is important to note that the survey design inadvertently limited the question to households involved in fishing activities, representing around 80% of the sample.

¹⁵ It should be noted that the occurrence of health problems due to poor cooking conditions may be underestimated, as many households cannot afford to seek medical attention at a health center.

¹⁶ Three-quarters of households perceive their current method as somewhat effective.

5.3. Drivers of livelihood program success

Multiple interconnected factors exert influence on the efficacy of a development endeavor and can be broadly categorized into three subgroups: the national and supra-national context, community-related elements, and project designs. In this discussion, we will briefly emphasize the significance of crucial facets pertaining to the project design.

Firstly, the project must diligently consider and uphold community dynamics and political intricacies. For example, village chiefs play a pivotal role in fostering cooperation among community members, be it in terms of labor mobilization, adherence to new regulations, or monitoring compliance. As one village chief articulated, “Projects were [...] successful because I pleased and persuaded my people to fully cooperate [...], which they did. I also made strong laws for anyone that fails to cooperate.” However, neglecting to recognize and appropriately integrate town chiefs within the project design may, under certain circumstances, lead to their active obstruction of the project ¹⁷. Furthermore, mismanagement arising from elite capture represents an additional source of project failure. Hence, achieving a delicate and intricate balance between acknowledging local authorities and establishing channels for accountability at the project level is imperative.

Secondly, the lack of community member cooperation has also emerged as a notable cause of project failure. This phenomenon occurs when the populace lacks motivation due to a misalignment between the project’s purpose and their needs, insufficient involvement of influential facilitators, or a lack of clear benefits derived from the project.

Lastly, a critical dimension to consider is the alignment of project objectives with local needs. The project’s success hinges on its ability to effectively address and cater to the specific requirements and aspirations of the local community.

¹⁷ Voors, Maarten et al. 2018. ‘Chief for a Day: Elite Capture and Management Performance in a Field Experiment in Sierra Leone.’ *Management Science* 64(12): 5855–76.

Telephone	463	0.76	-	-	-	-	-	0
Bicycle	463	0	-	-	-	-	-	0
Motorcycle	463	0	-	-	-	-	-	0
Computer	463	0	-	-	-	-	-	0
Refrigerator	463	0	-	-	-	-	-	0
Car	463	0	-	-	-	-	-	0
Fishing net	463	0.64	-	-	-	-	-	0
Non engine boat	463	0.42	-	-	-	-	-	0
Engine boat	463	0.09	-	-	-	-	-	0

(continued)

Variable	N	Mean	Mi n	Q1	Media n	Q3	Max	NA
Electricity	463	0.02	-	-	-	-	-	0
Private toilet	463	0.01	-	-	-	-	-	0
Indoor stove	463	0	-	-	-	-	-	0
Access to drinking water	463	0.45	-	-	-	-	-	0
Descent water sources	446	0.33	-	-	-	-	-	17
Descent sanitation	463	0.17	-	-	-	-	-	0
Bank account	463	0.04	-	-	-	-	-	0
Descent roof quality	463	0.89	-	-	-	-	-	0
Descent wall quality	463	0.16	-	-	-	-	-	0
Descent floor quality	463	0.18	-	-	-	-	-	0
Cash emergency	463	0.7	-	-	-	-	-	0
Access to electricity	39	0	-	-	-	-	-	1
Access to radio frequency	39	0.97	-	-	-	-	-	1
Village cement-drying floor	39	0	-	-	-	-	-	1
Village crop store	39	0.03	-	-	-	-	-	1
Village rize mill	39	0	-	-	-	-	-	1
Income								
Increase in income in the past 5 years	449	0.21	-	-	-	-	-	14
Decrease in income in the past 5 years	449	0.45	-	-	-	-	-	14
Income	463	7163.8	0	280	5150	900	5530	0
		7		5		0	0	
Finance								
Ability to save money	343	0.19	-	-	-	-	-	120
Know orange money	343	0.95	-	-	-	-	-	120
Use orange money to transfer money	326	0.47	-	-	-	-	-	137
Access to micro-credit	463	0.08	-	-	-	-	-	0
Participation in a VSLA	463	0.26	-	-	-	-	-	0
Interest in developing a VSLA	344	0.83	-	-	-	-	-	119
Village saving and loan association	39	0.13	-	-	-	-	-	1
Land ownership								
Farm	463	0.68	-	-	-	-	-	0
Non agricultural land	462	0.57	-	-	-	-	-	1
Farm size (in acres)	315	2.67	1	1	2	3	25	148
Non agricultural land size (in acres)	463	1.66	0	0	1	2	15	0
Agriculture								
Bees	344	0.02	-	-	-	-	-	119

Cattle	342	0	0	0	0	0	0	121
Sheep	342	0.52	0	0	0	0	10	121
Goats	343	0.94	0	0	0	1	20	120
Pigs	342	0.06	0	0	0	0	6	121
Chickens	344	10.07	0	5	9	13	50	119
Ducks	343	0.27	0	0	0	0	20	120
None	315	0	-	-	-	-	-	148
Upland Rice	315	0.19	-	-	-	-	-	148
Local Wetland Rice	315	0.27	-	-	-	-	-	148
Improved rice	315	0.03	-	-	-	-	-	148
Cassava	315	0.98	-	-	-	-	-	148
Beans	315	0.13	-	-	-	-	-	148
Yams	315	0.17	-	-	-	-	-	148
Maize (Nyueei)	315	0.14	-	-	-	-	-	148
Okra	315	0.1	-	-	-	-	-	148
Pepper	315	0.17	-	-	-	-	-	148
Eggplant	315	0.06	-	-	-	-	-	148
Groundnut	315	0.12	-	-	-	-	-	148

(continued)

Variable	N	Mean	Min	Q1	Median	Q3	Max	NA
Source of food	403	0.35	-	-	-	-	-	60
Fishing gear (acadja)	403	0.23	-	-	-	-	-	60
Poles	403	0.08	-	-	-	-	-	60
Spiritual activity	403	0.05	-	-	-	-	-	60
Charcoal production	403	0.01	-	-	-	-	-	60
Mangrove conservation								
Threat over mangroves	422	0.35	-	-	-	-	-	41
Mangrove cover decreases	439	0.56	-	-	-	-	-	24
Mangrove cover increases	439	0.22	-	-	-	-	-	24
Do you gather mangrove products?	463	0.87	-	-	-	-	-	0
Do you sell mangrove woods	402	0.42	-	-	-	-	-	61
Source of food	462	0.65	-	-	-	-	-	1
Source of raw materials	462	0.94	-	-	-	-	-	1
Source of medicinal resources	462	0.24	-	-	-	-	-	1
Carbon sequestration	462	0.02	-	-	-	-	-	1
Erosion prevention	462	0.4	-	-	-	-	-	1
Moderation of extreme events	462	0.17	-	-	-	-	-	1
Soil fertility	462	0.35	-	-	-	-	-	1
Spiritual value	462	0.06	-	-	-	-	-	1
Habitat for fish	462	0.55	-	-	-	-	-	1
Non material value	456	-0.04	-	-0.14	0.49	0.49	0.49	17
			4.58					
Material value	453	0.45	-	0.04	1.03	1.03	1.03	20
			1.94					
Normative protection belief	473	-0.2	-3.15	-	-0.28	0.19	2.58	0
				0.76				
Second order belief	473	-0.2	-	-	-0.01	0.73	1.46	0
			1.48	0.74				

Deforestation concern	463	-0.14	-	-1.35	0.43	1.02	1.02	10
			1.94					
Mangrove governance								
Community ownership over mangrove forests	37	0.81	-	-	-	-	-	3
Rules regulate access to mangrove	38	0.34	-	-	-	-	-	2
Rules regulate when mangrove resources are accessible	13	0.08	-	-	-	-	-	27
Rules regulate how much mangrove resources can be extracted	13	0	-	-	-	-	-	27
Participation in rule-making	0	NaN	-	-	-	-	-	40
Rules monitoring	13	0.77	-	-	-	-	-	27
Existence of sanctions	13	1	-	-	-	-	-	27
Climate change								
Experience flood events	463	0.46	-	-	-	-	-	0
Participation in climate training	463	0.08	-	-	-	-	-	0
Concerns about flood	462	3.61	1	3	4	5	5	1
Severity of past flood experiences	215	3.42	1	2	3	4.5	5	248
Development path								
Mechanized fishing	39	0.22	-	-	-	-	-	1
Sea transportation	39	0.24	-	-	-	-	-	1
Farming program	39	0	-	-	-	-	-	1
Infrastructure program	39	0.03	-	-	-	-	-	1
Vocational training	39	0.24	-	-	-	-	-	1
Financial support	39	0.11	-	-	-	-	-	1
Provision of food	39	0.03	-	-	-	-	-	1
Youth employment program	39	0.43	-	-	-	-	-	1
Women empowerment program	39	0.46	-	-	-	-	-	1
Not interested in livelihood programs	39	0.03	-	-	-	-	-	1
Mechanized fishing	120	0.85	-	-	-	-	-	0
Fishing inputs	120	0.62	-	-	-	-	-	0
Aquaculture	120	0	-	-	-	-	-	0
Oyster harvesting	120	0.04	-	-	-	-	-	0

(continued)

Variable	N	Mean	Min	Q1	Median	Q3	Max	NA
Logging	120	0.07	-	-	-	-	-	0
Mechanized farming	120	0.33	-	-	-	-	-	0
Farming inputs	120	0.69	-	-	-	-	-	0
Raw food processing	120	0.27	-	-	-	-	-	0
Livestock farming	120	0.07	-	-	-	-	-	0
Microfinance	120	0.61	-	-	-	-	-	0
Sea transportation	120	0.06	-	-	-	-	-	0
Land transportation	120	0	-	-	-	-	-	0
Handicraft	120	0	-	-	-	-	-	0

Appendix 2: measurement of the main indicators in the Doughnut plot

Measurement of the indicators used in the doughnut plot

Name	Description
Education	<i>Proportion of children (<17 years old) that does not attend school</i>
Energy	<i>Proportion of respondents without access to electricity</i>
Food	Proportion of respondents being either moderately or severely food insecure
Health	
Income	<i>Proportion of respondents receiving less than 1\$ equivalent per day</i>
Job	<i>Proportion of respondents without formal employment</i>
Voices	<i>Proportion of respondents having rights to vote for the town chief</i>
Water	Proportion of respondents without access to clean water

Appendix 3: summary statistics of the main indicators in the Yawri Bay and beyond

Variable	N	Mean	Min	Q1	Median	Q3	Max	NA
Demographic								
Population	9213	-	-	-	-	-	-	-
Total number of children	4004	-	-	-	-	-	-	-
Total number of young adults (<=30)	2499	-	-	-	-	-	-	-
Total number of adults (>30)	2710	-	-	-	-	-	-	-
Head of households	NA	-	-	-	-	-	-	-
Male	NA	-	-	-	-	-	-	-
Female	1322	-	-	-	-	-	-	-
Sherbro	444	0.34	-	-	-	-	-	0
Mende	444	0.39	-	-	-	-	-	0
Muslim	444	0.89	-	-	-	-	-	0
No leadership status	444	0.87	-	-	-	-	-	0
Land owning families	34	0.46	0	0.2	0.3	0.72	1	3
Families with voting rights	34	0.92	0.5	1	1	1	1	3
Education								
Illiterate	444	0.76	-	-	-	-	-	0
Literate in Mende	444	0.1	-	-	-	-	-	0
Literate in English	444	0.1	-	-	-	-	-	0
Literate in Arabic	444	0.05	-	-	-	-	-	0
Education level (in years)	433	1.52	0	0	0	0	14	11
Distance to primary school	37	1.42	0	0	0.25	1.75	18	0
Distance to secondary school	35	3.15	0	1.75	3	3	18	2

School attendance female 12-14	115	0.49	-	-	-	-	-	348
School attendance female 15-17	84	0.44	-	-	-	-	-	379
School attendance female 6-11	215	0.53	-	-	-	-	-	248
School attendance male 12-14	108	0.39	-	-	-	-	-	355
School attendance male 15-17	74	0.43	-	-	-	-	-	389
School attendance male 6-11	177	0.48	-	-	-	-	-	286
Health								
Number of visit to health center because of cooking conditions	243	0.55	0	0	0	1	5	201
Distance to health center	37	1.9	0	0.75	1.75	1.75	18	0
Geography								
Distance to chiefdom headquarter	37	2.64	0.25	1.75	1.75	3	9	0
Distance to nearest major town	37	2.4	0	1.25	1.75	3	9	0
Distance to nearest market	37	2.95	0.25	1.25	3	3	9	0
Wealth								
TV	444	0.01	-	-	-	-	-	0
Telephone	444	0.73	-	-	-	-	-	0
Bicycle	444	0	-	-	-	-	-	0
Motorcycle	444	0.04	-	-	-	-	-	0
Computer	444	0	-	-	-	-	-	0
Refrigerator	444	0.01	-	-	-	-	-	0
Car	444	0	-	-	-	-	-	0
Fishing net	444	0.49	-	-	-	-	-	0
Non engine boat	444	0.38	-	-	-	-	-	0
Engine boat	444	0.08	-	-	-	-	-	0
Electricity	444	0.02	-	-	-	-	-	0
Private toilet	444	0.03	-	-	-	-	-	0
Indoor stove	444	0	-	-	-	-	-	0
Access to drinking water	443	0.29	-	-	-	-	-	1
Descent water sources	444	0.31	-	-	-	-	-	0
Descent sanitation	444	0.2	-	-	-	-	-	0
Bank account	444	0.02	-	-	-	-	-	0

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Variable	N	Mean	Min	Q1	Median	Q3	Max	NA
Descent roof quality	444	0.92	-	-	-	-	-	0
Descent wall quality	444	0.26	-	-	-	-	-	0
Descent floor quality	444	0.24	-	-	-	-	-	0
Cash emergency	444	0.76	-	-	-	-	-	0
Access to electricity	37	0	-	-	-	-	-	0
Access to radio frequency	37	0.97	-	-	-	-	-	0
Village cement-drying floor	37	0.03	-	-	-	-	-	0
Village crop store	37	0.03	-	-	-	-	-	0
Village rize mill	37	0.05	-	-	-	-	-	0
Income								
Increase in income in the past 5 years	436	0.15	-	-	-	-	-	8
Decrease in income in the past 5 years	436	0.63	-	-	-	-	-	8
Income	444	6440.66	0	2550	5450	8912.5	59580	0
Finance								
Ability to save money	419	0.34	-	-	-	-	-	25
Know orange money	419	0.98	-	-	-	-	-	25
Use orange money to transfer money	411	0.45	-	-	-	-	-	33
Access to micro-credit	444	0.01	-	-	-	-	-	0
Participation in a VSLA	444	0.41	-	-	-	-	-	0
Interest in developing a VSLA	261	0.75	-	-	-	-	-	183
Village saving and loan association	37	0.57	-	-	-	-	-	0
Land ownership								
Farm	444	0.7	-	-	-	-	-	0
Non agricultural land	444	0.51	-	-	-	-	-	0
Farm size (in acres)	313	2.86	1	1	2	3	30	131
Non agricultural land size (in acres)	444	1.16	0	0	1	2	35	0
Agriculture								
Bees	314	0.07	-	-	-	-	-	130
Cattle	314	0	0	0	0	0	0	130
Sheep	314	0.47	0	0	0	0	10	130
Goats	314	1.04	0	0	0	2	10	130
Pigs	314	0.02	0	0	0	0	7	130
Chickens	314	9.92	0	5	8	14	48	130
Ducks	314	0.19	0	0	0	0	9	130
None	313	0	-	-	-	-	-	131
Upland Rice	313	0.4	-	-	-	-	-	131
Local Wetland Rice	313	0.49	-	-	-	-	-	131
Improved rice	313	0.17	-	-	-	-	-	131
Cassava	313	0.87	-	-	-	-	-	131
Beans	313	0.12	-	-	-	-	-	131
Yams	313	0.08	-	-	-	-	-	131
Maize (Nyueei)	313	0.28	-	-	-	-	-	131
Okra	313	0.2	-	-	-	-	-	131

Pepper	313	0.46	-	-	-	-	-	131
Eggplant	313	0.14	-	-	-	-	-	131
Groundnut	313	0.57	-	-	-	-	-	131
Cocoa	313	0	-	-	-	-	-	131
Coffee	313	0	-	-	-	-	-	131
Bananas/Plantain	313	0.03	-	-	-	-	-	131
Oil Palm	313	0.13	-	-	-	-	-	131
Kola Nut	313	0	-	-	-	-	-	131
Coconut	313	0.08	-	-	-	-	-	131

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Variable	N	Mean	Min	Q1	Median	Q3	Max	NA
Food security								
Food secure	444	0.09	-	-	-	-	-	0
Moderately food insecure	444	0.62	-	-	-	-	-	0
Severely food insecure	444	0.29	-	-	-	-	-	0
Livelihood								
Agriculture	88	0.2	-	-	-	-	-	-
Fishing	140	0.32	-	-	-	-	-	-
Herbalist	12	0.03	-	-	-	-	-	-
Other sources	44	0.1	-	-	-	-	-	-
Public sector	37	0.08	-	-	-	-	-	-
Sales of processed farm products	49	0.11	-	-	-	-	-	-
Self employment	65	0.15	-	-	-	-	-	-
Trader	1	0	-	-	-	-	-	-
Wage labour	4	0.01	-	-	-	-	-	-
Non timber forest products								
Fish	444	0.62	-	-	-	-	-	0
Bamboo	443	0.1	-	-	-	-	-	1
Honey	444	0.03	-	-	-	-	-	0
Oyster	444	0.11	-	-	-	-	-	0
Crab	444	0.17	-	-	-	-	-	0
Did you try aquaculture?	276	0.1	-	-	-	-	-	168
Are you open to try aquaculture?	249	0.72	-	-	-	-	-	195
Are aquaculture products available in the market?	263	0.85	-	-	-	-	-	181
Property rights								
Direct rights to harvest bamboo	309	0.9	-	-	-	-	-	135
Direct rights to fish	444	0.99	-	-	-	-	-	0
Direct rights to hunt	410	0.95	-	-	-	-	-	34
Direct rights to harvest non timber forest products	437	0.9	-	-	-	-	-	7
Direct rights to log	444	0.96	-	-	-	-	-	0
Direct rights to clear forest for agriculture	431	0.8	-	-	-	-	-	13
Indirect rights to fish	444	1	-	-	-	-	-	0
Indirect rights to hunt	411	0.95	-	-	-	-	-	33
Indirect rights to harvest non timber forest products	439	0.9	-	-	-	-	-	5
Indirect rights to log	444	0.95	-	-	-	-	-	0
Indirect rights to harvest bamboo	305	0.89	-	-	-	-	-	139
Resource tenure insecurity								
Afraid of losing your rights to fish?	444	0.43	-	-	-	-	-	0
Afraid of losing your rights to hunt?	437	0.4	-	-	-	-	-	7
Afraid of losing your rights to log?	442	0.53	-	-	-	-	-	2
Afraid of losing your rights to harvest non timber forest products	443	0.38	-	-	-	-	-	1
Afraid of losing your rights to extend your farms?	440	0.51	-	-	-	-	-	4

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Mangrove livelihood								
Fuelwood	227	0.9	-	-	-	-	-	217
Construction	227	0.76	-	-	-	-	-	217
Fishing gear (acadja)	227	0.28	-	-	-	-	-	217
Source of cash/income	227	0.27	-	-	-	-	-	217
Source of food	227	0.25	-	-	-	-	-	217
Poles	227	0.02	-	-	-	-	-	217
Charcoal production	227	0	-	-	-	-	-	217
Spiritual activity	227	0	-	-	-	-	-	217
Mangrove conservation								
Threat over mangroves	366	0.39	-	-	-	-	-	78

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Variable	N	Mean	Min	Q1	Median	Q3	Max	NA
Mangrove cover decreases	406	0.38	-	-	-	-	-	38
Mangrove cover increases	406	0.52	-	-	-	-	-	38
Do you gather mangrove products?	444	0.52	-	-	-	-	-	0
Do you sell mangrove woods	230	0.23	-	-	-	-	-	214
Source of food	410	0.25	-	-	-	-	-	34
Source of raw materials	410	0.75	-	-	-	-	-	34
Source of medicinal resources	410	0.12	-	-	-	-	-	34
Carbon sequestration	410	0.02	-	-	-	-	-	34
Erosion prevention	410	0.53	-	-	-	-	-	34
Moderation of extreme events	410	0.11	-	-	-	-	-	34
Soil fertility	410	0.29	-	-	-	-	-	34
Spiritual value	410	0	-	-	-	-	-	34
Habitat for fish	410	0.71	-	-	-	-	-	34
Non material value	426	0.04	-4.58	0.49	0.49	0.49	0.49	18
Material value	427	-0.47	-1.94	-0.95	-0.95	0.04	1.03	17
Normative protection belief	444	0.21	-3.15	-0.28	0.19	0.67	2.58	0
Second order belief	444	0.22	-1.48	-0.74	0.73	0.73	1.46	0
Deforestation concern	441	0.15	-1.94	-1.35	0.43	1.02	1.02	3
Mangrove governance								
Community ownership over mangrove forests	35	0.91	-	-	-	-	-	2
Rules regulate access to mangrove	35	0.74	-	-	-	-	-	2
Rules regulate when mangrove resources are accessible	26	0.35	-	-	-	-	-	11
Rules regulate how much mangrove resources can be extracted	26	0.23	-	-	-	-	-	11
Participation in rule-making	4	0.25	-	-	-	-	-	33
Rules monitoring	26	0.96	-	-	-	-	-	11
Existence of sanctions	26	1	-	-	-	-	-	11
Climate change								
Experience flood events	444	0.3	-	-	-	-	-	0
Participation in climate training	444	0.04	-	-	-	-	-	0
Concerns about flood	444	3.38	1	2	3	5	5	0
Severity of past flood experiences	133	3.69	1	3	4	5	5	311
Development path								
Mechanized fishing	37	0.14	-	-	-	-	-	0
Sea transportation	37	0.43	-	-	-	-	-	0
Farming program	37	0	-	-	-	-	-	0
Infrastructure program	37	0	-	-	-	-	-	0
Vocational training	37	0.1	-	-	-	-	-	0
Financial support	37	0	-	-	-	-	-	0
Provision of food	37	0	-	-	-	-	-	0
Youth employment program	37	0.57	-	-	-	-	-	0
Women empowerment program	37	0.48	-	-	-	-	-	0

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Not interested in livelihood programs	37	0.05	-	-	-	-	-	0
Mechanized fishing	488	0.89	-	-	-	-	-	0
Fishing inputs	488	0.71	-	-	-	-	-	0
Aquaculture	488	0	-	-	-	-	-	0
Oyster harvesting	488	0	-	-	-	-	-	0
Logging	488	0	-	-	-	-	-	0
Mechanized farming	488	0.84	-	-	-	-	-	0
Farming inputs	488	0.75	-	-	-	-	-	0
Raw food processing	488	0.83	-	-	-	-	-	0
Livestock farming	488	0.01	-	-	-	-	-	0
Microfinance	488	0.6	-	-	-	-	-	0
Sea transportation	488	0	-	-	-	-	-	0

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Variable	N	Mean	Min	Q1	Median	Q3	Max	NA
Land transportation	488	0	-	-	-	-	-	0
Handicraft	488	0	-	-	-	-	-	0

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