

Coastal women shell-fishers using the potential of the mangrove oyster *Crassostrea gasar* (Adanson, 1757) in Sangarea Bay and the Special Zone of Conakry, Guinea

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Abstract

This study was focus on the potential of oyster *Crassostrea gasar*, species abundantly present in the coastal zone of Guinea, exploited by women Shellfishers. The objective of this study is to characterized the study through the socio-demographic parameters of Shellfishers, economical characteristic and importance of oyster exploitation. Socio-demographical and economic data were obtained on the bases of assessment realized near Shellfishers. 60 Shellfishers were assessed in total and among them 62,06% was above 29 years, 93,10% was under 50 years and 6,89% had 50 years old. Importance of this detail is because from 15 to 40 years are consider as procreation age for women, an important target group for health and nutrition initiation. Majority of Shellfishers were women (86.20%). The period of exploitation is from march to September and it included more than 60% of survey population. Among the 5 villages concerned by the study, in the village of Thia, the socio-demographic situation of user population was from 60 to 38% of adults and young and 2% of old person, in the village of Boneya adults was 70%, 29% of young and 1% of old women, in the village of Tenniah 65,5% adults, 34,5% of young and 1% old women; in the village of Dofili 73,5% of adult, 25,5% of young and 1% of old women; and an equality in term of proportion in the village of Faban 49% of adult and young and 2% of old women. Total quantity of annual oyster exploitation is 2160 kg/season. It generated hebdomadary income of 30.000 GNF/kg of drying oyster, 20. 000 GNF/kg of fresh oyster and 5.000 GNF Fries oysters sell into plastic box.

Key words: *Crassostrea gasar*; Shellfishers; Coastal women; Mangrove

1. Introduction

The mangrove zone is located in Lower Guinea, in the western part of Guinea, between 9° and 11°30' North latitude and 13°30' and 15°10' West longitude. It is bordered to the east and north by Middle Guinea, to the west by the Atlantic Ocean and Guinea-Bissau, and to the south by Sierra Leone. The Guinean coastline is 300 kilometers long, bordered to the west by the Atlantic Ocean and to the east by the foothills of the Fouta Djallon highlands. This is an estuarine ecosystem populated by mangroves, composed primarily of *Rhizophora mangle* and *Avicennia nitida*.

The importance of oysters worldwide is undeniable, from a nutritional [8], ecological [15], and economic [2] perspective. This resource is found on the West African coast, its northern limit considered to be around M'bour and its southern limit in Angola [4]. It lives in brackish-salt environments, attached to the stilt roots of mangrove trees, hence its name, the mangrove oyster. It also lives in estuaries, preferably with muddy bottoms and varying salinity. The shell is elongated and very irregularly shaped, and it lives in colonies. It feeds on anything suspended in the water: diatoms, microalgae, detritus, larvae, and bacteria [4].

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Mangrove trees (*Rhizophora racemosa*) are characteristic of mangrove ecosystems, of which there are several genera. These trees, which grow in water, breathe through aerial roots, called stilt roots or rhizophores, or hollow roots, or pneumatophores [3], and constitute the natural habitat of the oyster [10]. Mangrove trees (*Rhizophora racemosa*) are characteristic of mangrove ecosystems, of which there are several genera.

Mangroves are tree-like formations found in the intertidal zone on lagoon and mudflat coastlines in the intertropical zone. However, the use of these trees for building houses and for various domestic purposes has stripped dozens of kilometers of mangroves along the banks. Traditional harvesting practices present drawbacks not only from a health perspective (harvesting is sometimes carried out on polluted sites) but also from an environmental perspective (excessive cutting of mangrove trees, the natural habitat of oysters) [13]. The destruction of this habitat inevitably leads to a decline in the natural recruitment of oyster spat.

In Guinea, oysters, commonly called "Sibola" in the local Susu language, are aquatic resources exploited by coastal communities, generally women. They are harvested using traditional methods all along the coastline. In the channels bordering the mangroves, they are harvested in several locations using the species *Crassostrea gasar*, formerly known as *Ostreum gasar*, then *Gryphaea gasar* [4]. Data is still not recent or readily available because this harvesting takes place in villages, camps, and other locations where statistics are not provided. The quantities harvested are therefore unknown to government agents, who are only present at major landing sites. Up-to-date knowledge of the shellfish harvesting system allows for an assessment of the state of this resource and its sustainable management. This study aims to characterize the *Crassostrea gasar* harvesting system along the Guinean coast, considering its socioeconomic and cultural dimensions.

2. Materials and Methods

2.1. Study Area

The Sangarea Bay, a mangrove area situated between land and sea, is subject to the continental influence of the Konkouré, Bouramaya, and Soumba rivers, as well as the maritime influence orchestrated by the tides. The flow of these rivers can vary rapidly because their coastal watersheds cover a small area; consequently, a sudden change in rainfall patterns is enough to cause significant sedimentary changes in the estuaries (erosion or deposition). This struggle for influence between the continent and the ocean is expressed by a network of channels that meander between halophytic vegetation, the mangroves [5]. It is this rich, varied, complex, but also sometimes hostile environment that humans have exploited for hundreds of years [12].

The 5 villages surveyed in the Prefecture of Boffa and Dubréka and one in the special zone of Conakry were identified and then georeferenced. The villages surveyed are Thia (Geographic coordinates not taken due to the technical problem of the device), Boneya (Latitude N: 9°52, Longitude W: 13°33, Altitude: 25.34 m, Accuracy 5.9m), Bawa (Latitude N: 9°50, Longitude W: 13°35, Altitude: 52.59m, Accuracy: 10.45m), Dofili (Latitude N: 9°48, Longitude W: 13°32, Altitude: 76.94m, Accuracy: 7.5m), and Faban (Latitude N: 9°34, Longitude W: 13°35, Altitude: 74.51m, Accuracy: 18.94m) in the Prefectures of Boffa, Dubréka and the Special Zone of Conakry.

2.2. Data collection

This study was conducted using a systematic survey of Shellfishers in the various villages surveyed. The survey took place in April 2024, and the villages were selected based on their involvement in oyster farming. A focus group was organized in each village using an interview guide. Socio-demographic data, such as gender, age, activities undertaken, and economic data related to marketing and gross income, were collected from Shellfishers. The reasons for choosing this activity were also gathered and categorized according to the method of distributing the pebbles.

2.3. Data Processing

Histograms were plotted to analyze the characteristics of resource users according to age, sex, and education level. Age structures were plotted after grouping age classes into young (18-35 years), adult (36-55 years), and old (≥ 56 years) according to [14]. Furthermore, the surveyed users were categorized as shellfishers and non-shellfishers. Based on the georeferencing of harvesting villages, the geolocation data for each village was generated. The importance of harvesting was assessed by the proportion of the population engaged in the activity in each village, the harvest periods and the frequency of harvesting.

The economic characteristics of oyster harvesting were determined by calculating weekly gross income. Multiple comparison tests of proportions were performed between villages for socio-demographic parameters, and the Mann-

Whitney test was used to compare villages in terms of farming level and income between different categories of farmers. Kendall's concordance test was used to assess the degree of consensus among farmers regarding their reasons for choosing this activity.

3. Results and Discussion

3.1. Characteristics of shellfishers

3.1.1. Socio-demographic characteristics

In total, 60 shellfishers were surveyed, with 12 shellfishers surveyed in each of the 5 villages. Figure 1-A shows the different age groups exploiting the resource in each village. In Thia, adults (30-50 years old) constitute 58.33% and young people (18-25 years old) 25% of those surveyed. The elderly (55 years and older) represent 16.66% of the target population. In the village of Bônéyah, young people make up the majority (50%) and adults (41.66%) of those surveyed; the elderly constitute 8.33%.

In the locality of Teniah, adults make up the majority at 50%, followed by young people at 41.66%, and finally the elderly at 8.33%. In the village of Dofili, adults are the largest group at 58.33%, followed by young people at 41.66%. No elderly people were among those surveyed. In the village of Faban, adults are the majority at 50%, followed by young people at 33.33% and the elderly at 16.66%. In all five villages, the population exploiting these resources is dominated by adults and young people, representing approximately 91.66%.

In the five villages surveyed, the shellfishers population is dominated by women (Figure 1-B). Indeed, they represent 78.33% of farmers in the five villages surveyed, compared to 21.66% for men. There is a significant difference between the proportions of women and men shellfishers resources in these villages ($p < 0.05$).

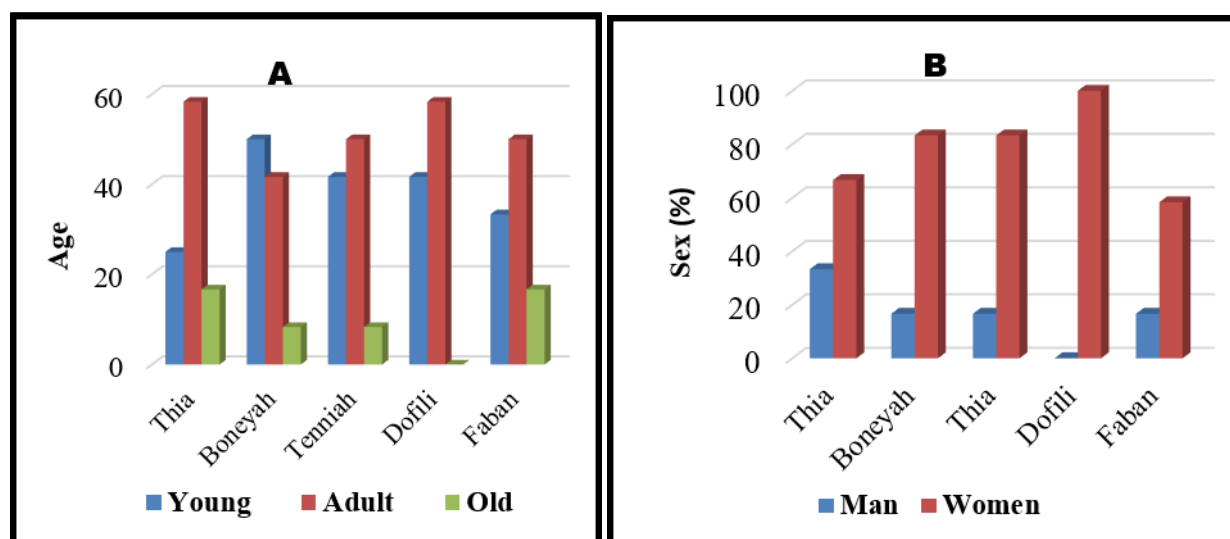


Figure 1 Socio-demographic characteristics of respondents. A: By age; B: By sex

3.1.2. Status of shellfishers

In the five villages where the survey was conducted, 86.20% of the women interviewed were involved in both harvesting and processing oysters (a mixed activity). In contrast, only 13.80% of the men interviewed were solely involved in oyster harvesting (Figure 2). There is a significant difference between the proportions of women and men involved in oyster harvesting ($p < 0.05$).

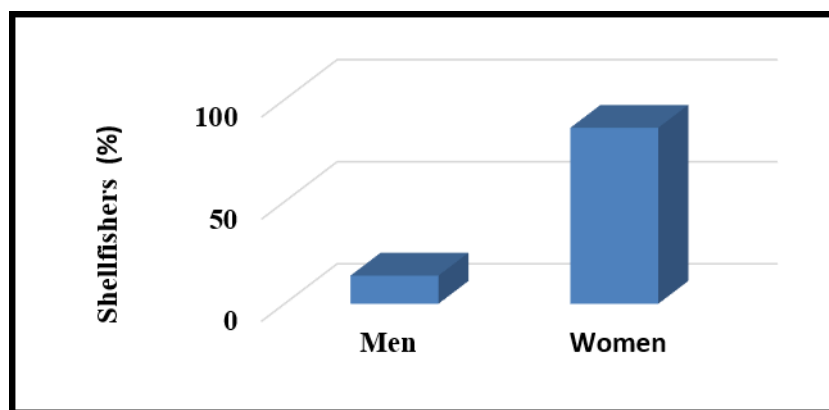


Figure 2 Shellfishers status

3.1.3. Status of non- Shellfishers

In this survey of non-shellfishers, including loggers and fish smokers, 80% of loggers are women, none of whom are involved in oyster harvesting, compared to only 20% of men involved in logging (Figure 3). In the second group surveyed, 100% of fish smokers are women. They do not engage in any other logging or oyster harvesting activities. There is a significant difference between the proportion of women and men involved in non-Shellfishers ($p < 0.05$).

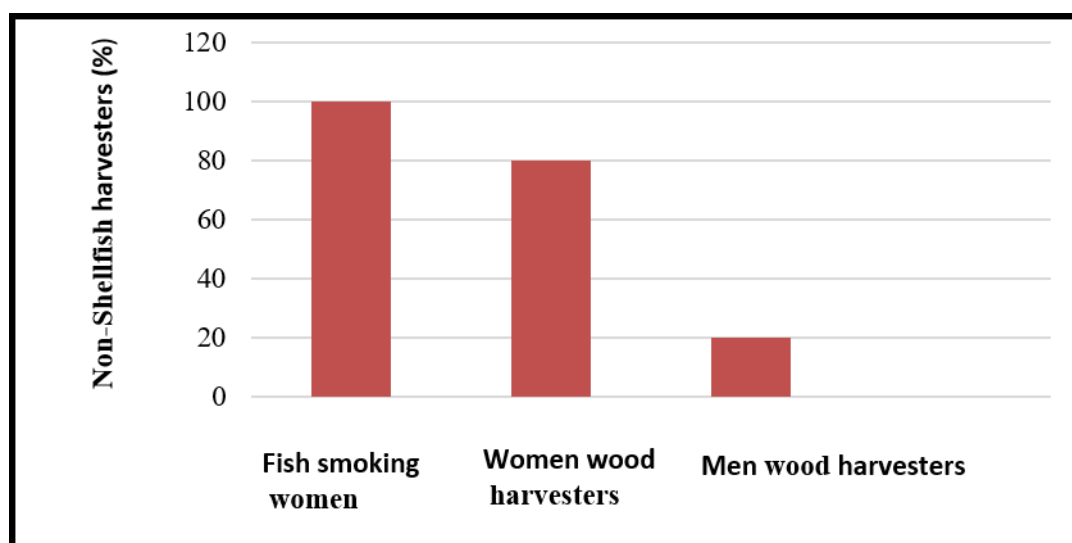


Figure 3 Non- Shellfishers activities



Figure 3 Non-Shellfishers. **A:** Women selling wood at the port of Dixinn. **B:** Women smoking fish at the port of Teminetaye.

3.2. Characteristics of shellfishers in Sangareah Bay

3.2.1. Harvesting Period and Methods

Oyster harvesting in Sangareah Bay lasts six months, harvesting takes place between January and June, or July if the rainy season is late. During the dry season, the frequency of release depends on the abundance of oysters, the ancillary activities of women and their organizational structure. During the first few months, when oysters are most plentiful, the women harvest oysters for two consecutive days and stay one day at the village work site to process them. At the end of the season, they spend one day harvesting and the next processing. They only go out every day if the tasks are shared within their group. The tools and equipment used in this activity are rudimentary and consist of a dugout canoe, a basket, machetes, socks, and gloves. The canoe serves as a means of transport for the oysters. The basket is used to carry the harvested oysters into the canoe, and the machetes are used to cut the mangrove roots exposed around market-sized oysters. The socks and gloves protect the harvesters from injuries caused by oyster shells (Figure 4).



Figure 4 A: Foot protection against shell injuries; B: basket and handle used for transporting oysters in the dugout canoe and unloading; C: dugout canoe for moving and transporting oysters in the village of Boneyah.

3.2.2. Oyster harvest volume

Reliable information on harvest volume and value was difficult to obtain in this study due to the informal nature of the sector. Total production, which is very difficult to estimate, exceeds 2,000 tons. However, field studies revealed that the harvest volume per individual per day, week, and month, as well as the annual oyster production, was estimated at 45 kg/day. Monthly production is 360 kg, and seasonal production is 2160 kg/season. The average frequency of oyster harvesting in the five villages is five days.

3.2.3. The Economic value of oyster harvesting

Table 2 presents the selling prices of oysters according to size. The units of measurement are buckets, the dimensions of which allowed for the classification of three categories: Small, Medium, and Large. The selling price is proportional to the size of the basket. The selling prices of processed oysters vary according to the final form of the product. Dried oysters sell for 30,000 GNF/kg, raw oysters for 20,000 GNF/kg, and grilled oyster cakes are sold in small plastic bags for 5,000 GNF. These oysters are sold to women living in the harvester's village. The quantities harvested per trip vary from 40 to 50 kg when they go by dugout canoe to 15 to 20 kg when they go on foot. The Mann-Whitney U test revealed a significant difference between the prices of each product ($p < 0.05$).

Table 2 Selling price of harvested oysters per unit of measure

Nature of product	Measure	Price (GNF)
Crus	Panier (Kg)	20 000
Séch�	Bole (Kg)	30 000
Grill�	Plastic bag (unit)	5 000

Furthermore, one of the most striking aspects of these localities is the mounds of shells that dot the landscape near the villages, forming hills. The one at Teniah, a small village in the Bawa district, is quite unique (Figure 5), as enormous excavations are gradually emptying it of shells. At the processing sites, where the mollusks are shelled, the empty shells

are piled up, each marked with a symbol that allows each Shellfisher to identify their own pile. None of the people interviewed (except for the village of Boneyah, which uses the shells for poultry feed) actually use the shells themselves; they simply sell the meat. The usual buyers of these shells are animal feed production centers.

The average gross income generated by shellfish harvesting per week or per season is invaluable, as it is used to meet daily needs. Therefore, it hardly allows for saving. The use of profits, daily expenses are represented by the purchase of rice (its consumption is enormous as it is the daily basis of Guinean cuisine), vegetables, spices, fish, sugar, bread, butter and other categories of expenses which they do not make daily, but which are essential because the money is used to buy medicines, clothes for the family, household equipment, but also to pay the tontine. Virtually all the women spend some, or even all, of their money earned from oyster harvesting.



Figure 5 A: Pile of oyster shells, B: Bagging of oyster shell powder in the village of Teniah

3.3. Income-generating activities of shellfishers

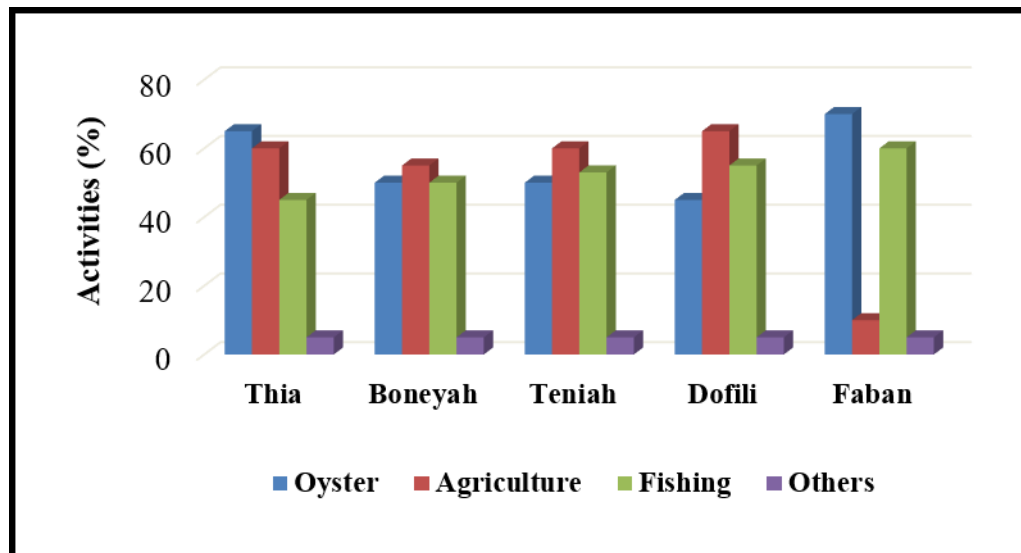


Figure 6 Proportion of income-generating activities

Figure 6 presents the activities identified as income-generating in the five villages. In total, four activities were identified; these are oyster harvesting, agriculture, fishing activities and other income-generating activities (small trade in the village etc.). In all five localities, the main activity throughout the year is oyster harvesting (100% of respondents). The secondary activity is agriculture; this is the case in Thia (approximately 65%), Boneyah (approximately 50%), Teniah (approximately 50%), Dofili (approximately 45%), and Faban (approximately 70%). Agriculture accounts for approximately 60% of the activity in Thia, 55% in Boneyah, 60% in Tenniah, 65% in Dofili, and 10% in Faban. During the peak shellfish harvesting season (dry season), fishing is the third most important activity in these areas: approximately 45% in Thia, 53% in Boneyah, 50% in Tenniah, and 55% in Dofili, except in Faban, where it is the second

most important activity (60%). Agriculture low ranking is due to its absence in the area. Other activities are carried out by approximately 5% of those surveyed in Thia, Boneyah, Teniah, Dofili, and Faban. No significant differences were found between the five villages for each activity ($p > 0.05$).

3.4. Motivations underlying oyster harvesting

constraints on local communities. This resource is very abundant and less exploited in these mangrove forests compared to the potential of the shellfish that abound on the Guinean coast. Among these populations, five motivations justifying the choice of harvesting and selling mollusks were identified (Table 3). This refers to:

- **Traditional activity:** This indicates that oyster harvesting is an activity passed down from one generation to the next. It constitutes the first professional skill acquired by oyster harvesters;
- **Additional income:** Oyster harvesting is a secondary activity which serves to substantially increase the income generated by the activity;
- **Scarcity of fish and availability of oysters:** The activity of harvesting and marketing oyster constitutes an alternative to the reduction of the fish stock;
- **Profitability:** The exploitation of oyster constitutes a very important source of income;
- **Subsistence income:** The activity allows one to meet maintenance needs to the extent possible.

The primary reason cited by the majority (52.03%) of respondents for choosing oyster harvesting is its profitability. The second motivation is supplementary income, which is ranked in this position by 27.21% of the Shellfishers surveyed. The third reason, mentioned by 26.42% of respondents, is the income it provides for subsistence of shellfishers.

The traditional nature of the activity was the fourth most popular choice among the population, with 24.67% and 27.05% of shellfishers unanimously citing the scarcity of fish and the availability of oysters as the last priority. Table 4 presents the results of Kendall's concordance test. The Kendall concordance coefficient obtained ($W = 0.2$) reveals a low level of consensus regarding the reasons for choosing oyster farming. Furthermore, the associated chi-square statistic is highly significant ($p < 0.05$).

Table 3 Hierarchy of motivations underlying oyster harvesting

Motivation	Rank				
	1	2	3	4	5
Profitability	52,03	33,06	37,06	40,09	16,04
Supplemental income	32,35	27,21	22,60	10,29	7,08
Subsistence income	11,21	14,72	26,42	16,36	27,77
Traditional activity	7,23	20,06	6,20	24,67	30,75
Fish scarcity and oyster availability	5,06	12,35	20,06	24,12	27,05

Table 4 Results of Kendall concordance test

Settings	Value
K	65
N	5
W	0,20
χ^2	51,13
P	< 0,00

4. Discussion

The exploitation of the mangrove oyster *Crassostrea gasar* in the coastal area of Guinea involves a large population, the surveyed sample of which consists of two ethnic groups: the Susu and the Baga [11]. One of the most important socio-demographic characteristics of oyster harvesters is the high proportion of women among those surveyed. This observation has already been made in the coastal lagoon of Benin [9], where mangrove oyster harvesting is the preserve of women. Similarly, the harvesting of the river oyster *Etheria elliptica* in the Pendjari River is dominated by women [1]. In Casamance, Senegal, oyster harvesting, from harvesting to sale, is an exclusively female activity [7].

On the Guinean coast, from oyster harvesting to sale is an almost exclusively female activity because among the five villages surveyed, only Faban has a proportion of male farmers; the male sex seems to have little interest in the activity in the other villages. It is highly likely that this very low level of male involvement in these villages is due to their geographical location, where agriculture and fishing are primarily dominated by men. Indeed, all these villages are situated in the area of the Sangarea Bay channel, which connects to the sea. The diversity of fish fauna there is significant. Given that the environment experiences the migration of several marine species, as well as the fertility of the arable land, these fishing and agricultural potentials could therefore be a greater asset for the people who live there. The oyster harvesting activity comprises two parts: gathering and processing. This study revealed that both oyster harvesting and processing are exclusively carried out by women. Indeed, the harvesting method which consists of going down into the mud with one's basket, one's machete and detaching the oysters from the rhizophores directly into the basket; once it is full, and returning to the canoe, requires a deployment of strength of an intensity and frequency which is undoubtedly limiting for the elderly (men and women). The harvesting sites are well suited to the conditions for oyster development, as salinity is a determining parameter in the distribution of mangrove oysters [6].

The first criterion for assessing the importance of the operation is the proportion of the population involved in the activity in the 5 villages surveyed; it is more than 60% of the population and thus demonstrates the interest in oyster harvesting. Similarly, the average harvest and marketing frequency of 5 days clearly demonstrates the time dedicated to the activity. This observation is all the more true given that the hierarchy of motivations shows the supplementary income from the activity to be the primary motivation for choosing it. Oyster harvesting in the Guinean coast lasts about 5 months; the 6th month depends on late rainfall conditions, with the successful harvest taking place between February and June. Another criterion for the importance of this activity is the gross daily income recorded at the shellfishers level. Shellfishers have an average daily income of 25,000 to 30,000 GNF per basket after sale. This demonstrates the scale of the operation and could justify the fact that this activity, which takes place throughout the year, is nevertheless the main one recorded among the respondents. The present study revealed that harvesting activities are largely dominated by women. This female dominance is shared with observations made in the coastal lagoon [9], the Pendjari River [1] and in Casamance in Senegal [7].

5. Conclusion

This study on oyster harvesting has made it possible to characterize this activity in the Guinean coastal zone. This activity sees strong involvement from women who find in it a supplementary source of income. Some women, however, brave the difficulties associated with harvesting and carry out both activities, this increases their profit margin. Harvesting takes place during the dry season, with the productive harvest period beginning in February and ending in June. This period corresponds to the high salinity conditions in these areas. Thia, Boneyah, Tenniah, Dofili, and Faban are the five oyster harvesting villages included in the study. These villages, located along Sangarea Bay, have channels characterized by high salinity, which are preferred habitats for oysters that live only in mesohaline environments.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

No conflict of interest to be disclosed. The authors declare that they have no financial, professional, or personal conflicts of interest that could have influenced or biased the results, interpretation, or writing of this article.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study. We, the undersigned Issa BANGOURA, Ousmane II CAMARA and Yamoussa Salifou CAMARA, certify that we have reviewed the information regarding the research project « Coastal Women Shellfishers Using the Potential of the Mangrove Oyster *Crassostrea gasar* (Adanson, 1757) in Sangarea Bay and the Special Zone of Conakry, Guinea » and consent was obtained from all individual participants included in the study.

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