BIVALVE MOLLUSKS (*SENILIA SENILIS* AND *CRASSOSTREA TULIPA*) EXPLOITED IN THE MANGROVE ECOSYSTEMS OF THE SALOUM ISLANDS, DIAGNOSTIC OF A CHANGING SECTOR

Abdoulaye Simon Pierre DIATTA
Université Cheikh Anta Diop (Sénégal)
E-mail : simoncephasdiatta@gmail.com

Adama DIOUF
Université Cheikh Anta Diop (Sénégal)
E-mail : adama.diouf@ucad.edu.sn

Claudette Soumbane DIATTA
Université Cheikh Anta Diop (Sénégal)
E-mail : claudettesoumbane.diatta@ucad.edu.sn

&

Malick DIOUF
Université Cheikh Anta Diop (Sénégal)
E-mail : malick.diouf@ucad.edu.sn

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Abstract: Artisanal processing is the oldest form of adding value to agricultural resources. It plays a role in socio-economic regulation. Oysters and arches, which are well represented all along the Senegalese coast, abound in interesting nutritional properties, hence their remarkable use in food. However, the resource is becoming increasingly scarce. As a result, there is little documentation on the rapidly developing oyster and arches industry in Senegal. This study will provide sufficient information to characterize the oyster and arches industry in the commune of Dionewar. Interviews with 100 women processors revealed that arches and oysters are processed exclusively by women, the majority of whom are "Sérères" (98%). Oysters are harvested between January and July and arches between November and July. Over 63.64% of women processors work on both oysters and arches, on sandbanks and interfaces respectively. Processors are present throughout the value chain, from harvesting (92.59% - 95.38%) to marketing (55.56% - 58.46%). In terms of locations, 68.55% and 72.65% of women process oysters and arches respectively near their homes, compared with 31.45% and 27.35% in improved village units.

Drying remains the most common method of preservation. There was also a significant difference between the traditional diagrams used in the artisanal workshops and those used in the improved processing units. This study shows a genuine diagnosis of the sector.

Keywords**:** mollusks, bivalves, oyster, arch, exploitation, processing, conservation.

Résumé: La transformation artisanale est la forme la plus ancienne de valorisation des agroressources. Elle joue un rôle de régulation socio-économique. Les huîtres et les arches bien représentées tout au long de la côte sénégalaise, regorgent des propriétés nutritionnelles intéressantes d'où leur utilisation remarquable dans l'alimentation. Cependant, la ressource se raréfie de plus en plus. Aussi, cette filière des huitres et des arches en pleine évolution est peu documentée au Sénégal. Cette étude permettra de fournir suffisamment d'informations pour caractériser la filière des huîtres et des arches dans la commune de Dionewar. Des entretiens avec 100 transformatrices ont révélé que les arches et les huîtres sont transformées exclusivement par des femmes en majorité Sérères (98%). Les huîtres sont récoltées entre janvier et juillet et les arches entre novembre et juillet. Plus de 63,64 % des transformatrices travaillent à la fois sur les huîtres et les arches, respectivement sur les bancs de sable et les interfaces. Les transformatrices sont présentes tout au long de la chaîne de valeur, de la récolte (92,59% - 95,38%) à la commercialisation (55,56% - 58,46%). Concernant les sites, 68,55% et 72,65% des femmes transforment respectivement les huîtres et les arches à proximité de leur domicile, contre 31,45% et 27,35% dans les unités villageoises améliorées. Le séchage reste la méthode de conservation la plus courante. On note également une différence significative entre les diagrammes traditionnels utilisés dans les ateliers artisanaux et ceux utilisés dans les unités de transformation améliorées. Cette étude montre un véritable diagnostic de cette filière.

Mots-clefs **:** mollusques, bivalves, huitres, arches, exploitation, transformation, conservation.

1. Introduction

In Senegal, the exploitation of fishery products is the 'backbone' of Senegalese food security, covering more than 75% of animal protein requirements (Dème et al., 2019). All along the Senegalese coast and on the islands, shellfish is a cultural product and shellfish farming plays an important role in the human diet, as well as being the main source of income for women.

The commune of Dionewar is very rich in fishery resources, especially shellfish, and shellfish farming is seen as a traditional activity that dates back some 2,000 years (Carré et al., 2022; Hardy et al., 2016). In the Saloum, shellfish are represented by 40 families comprising around a hundred species of bivalves, gastropods, scaphopods and cephalopods. Among the products exploited in this area are oysters (*Crassostrea tulipa Lamarck, 1819*), arches (*Senilia senilis Linnaeus, 1758*), cymbiums (*Cymbium pepo Lightfoot, 1786 and Cymbium glans Gmelin, 1791*), rocks (*Murex duplex Röding, 1798*) and the black melon (*Pugilina morio Linnaeus, 1758*) (Emerit, 2005).

Artisanal processing of these mollusks is the oldest way of adding value to fishery products. It plays a role in economic and social regulation, and is also of cultural importance. Among processed fish products, bivalve mollusks play a central role in the economy of the Saloum Delta, namely arches or "pagnes" and mangrove oysters or "yokhos". These two species of bivalves represent a significant source of income for women and contribute to the food security of the local population. As well as being used for food, their shells are also put to secondary uses, including house building, floor coverings, lime production and handicrafts for tourism. They are full of highly interesting nutritional properties. Archipelagos and oysters are very low in fat, with an average of one to two grams of lipids (fat) per 100 grams of flesh (Brenier et al., 2009). They are very rich in minerals (copper, selenium, iodine, zinc, iron, etc.) and vitamins (B12, A, D, E, K, PP, B1, B2, etc.) (Doiron, 2008).

In the commune of Dionewar, particularly in the villages of Falia, Dionewar and Niodior, these bivalves are particularly well represented. However, artisanal processing is often regarded as an informal activity, even though it plays a vital role in the economy, food supply and nutrition of the local population. It is also a sector that is little known by a significant proportion of the population (Mbaye, 2005). Despite the high potential for oysters and arches in the commune of Dionewar,

processing techniques have hardly changed since ancestral times. There are also a number of obstacles still hampering development and limiting success in the fight against poverty and food insecurity for these products, which are highly prized by users. The aim of this study is to diagnose the processing sector for two bivalve mollusks (oysters and arches), focusing mainly on characterizing the stakeholders involved in this sector, their value chain for each of the bivalves, and the timetable for their exploitation and use. The said resources, their processing and conservation, as well as their state of evolution in mangrove ecosystems and the technical and economic information on the entire processing process are also addressed.

The study area is located in the Saloum delta, in the commune of Dionewar, which belongs administratively to the department of Foundioune, region of Fatick and arrondissement of Niodior. The villages of Falia (996 inhabitants), Dionewar (6,721 inhabitants) and Niodior (7,808 inhabitants) that make up the commune are mainly populated by Serer Niominka, known as 'people of the sea' (ANSD, 2016; Sarr, 2021). The total population of the commune was 15525, including 7552 women, in Senegal's 2016 general census of population, housing, agriculture and livestock (RGPHAE) based on the 2013 RGPHAE projection. In 2019, the population is estimated at 16,326 (PDC Dionewar, 2019). According to the same source, 74.19% of the population is made up of young people aged under 35.

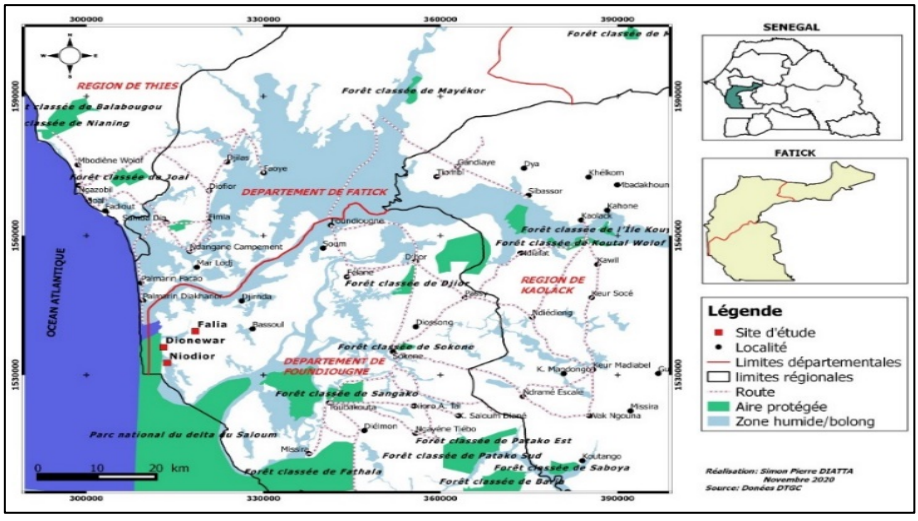

Figure 1: Location of the study site on the islands of Dionewar, Nodior and Falia in the Saloum Delta (Diatta, 2020).

2. Materials and methods

This study focused on women who process bivalve mollusks (oysters and arches) from the local federations of GIEs (FELOGIE) in Niodior and Dionewar, as well as those from the local women's union in Falia, 11.65% of whom, making up the sample quota, process bivalve mollusks and gastropods, i.e. 880 active women mollusk processors (sampling base). The study villages were chosen because of the existence of mixed processing methods (traditional and improved).

2.1. Data collection

The data was collected between 09 May 2022 and 09 June 2022. The information collected essentially concerns the social and demographic status of women processors, the oyster and arch value chain, the period of their exploitation, and the forms of processing and conservation to which they are subject. The survey techniques were those used in the social sciences, in particular the participatory approach as defined by Paturel (2015). To this end, a questionnaire was drawn up using the Survey Monkey online survey tool for data collection. Also, and with the help of monitoring sheets prepared using Excel spreadsheets, information was collected on the quantity of raw material before shucking, the mass of fresh meat after shucking, the meat/shell ratio, the quantity of waste (shells), the quantity of material lost during shucking, the drying temperature, the drying time, the quantity of finished product after drying, the drying yield, the selling price of finished products, the production cost and packaging.

To validate the data, a pre-survey was carried out among five women processors belonging to the Falia Local Union. However, as the size of this population was not known, 3 methods were used to determine the sample size. These were the ‘snowball’ method, the non-probabilistic method based on convenience and the saturation method. The snowball method consists of identifying an individual from whom others are contacted and surveyed, while the convenience method consists of deliberately choosing a defined number of individuals to survey. The aim of the snowball method is to find the right people and relevant results. The saturation method, which is also qualitative, involves interviewing targets until the saturation threshold is reached. The saturation threshold is reached when the interviewer obtains less and less information and the same answers are given again and again

(DeSardon, 1995). In this way, the number of women processors interviewed in the commune, raised to 100 individuals, was divided between the 3 villages. The quota obtained for each locality using the saturation method is shown in Table1.

Women processors were interviewed at home, in public places, at traditional processing sites and at improved processing units. The information sought from the women processors concerned the way the mollusk was used, the processing methods applied to these resources, the sources of supply, the methods used to renew the resource, the main products exploited and their socio-economic importance.

Table 1: Sampling in the study villages

Villages	**Sample size per village**
Niodior	50
Dionewar	38
Falia	12
Total	**100**

2.2. Yield calculation

Yield consists of determining the meat/shell ratio. To achieve this, a processing monitoring sheet has been designed. This monitoring takes place at two different processing sites, namely FELOGIE in Dionewar and the local women's union in Falia. It concerns dried oysters and arches (artisanal and improved). The sheet enabled us to document the traditional and improved processing diagrams for oysters and arches.

The meat-to-shell ratio (R) was calculated using the following formula:
R (%) = Mm/Msx100 with Mc: mass of meat and Ms: mass of shell.
The yield (Rt) after drying is calculated using the following formula:
Rt (%) = MDP/MFPx100 where MPS: Mass of Dried Products and MPF: Mass of Fresh Products.

The purpose of these sheets was to find out the processing diagrams applied, and the shucking and drying yields in order to highlight the added values associated with the two types of processing.

To do this, the consumable material was extracted using rudimentary equipment (artisanal processing) and semi-industrial equipment (improved processing), and the fresh meat was dried in the open air (artisanal processing) and using a solar dryer (improved processing).

2.3. Data analysis

Data collected in the field using Survey monkey software and the production monitoring sheet were collected in a Microsoft Excel 2019 spreadsheet (Halim et al., 2018). Results are expressed as mean ± standard deviation and percentage (%). A descriptive analysis was used to describe the socio-demographic characteristics of the women processors surveyed. A statistical and economic analysis was used to characterize yields at the 5% threshold and added values linked to the various production parameters.

3. Results

3.1. Socio-demographic characteristics of women who process bivalve mollusks

Arch and oyster processing activities are carried out exclusively by women, most of whom are Serer women. Most of the women surveyed were married (95%) (Table 2).

Most of the women processors had children (88%), most of whom were aged between 0 and 10 years. The majority of women processors were uneducated (54%). (Table 2).

Table 2: Socio-demographic characteristics of the women surveyed

Characteristics		Proportion (%)	Number (n)
Marital status	Married	95%	95
	Single	0.00%	0
	Divorced	3%	3
	Widowed	2%	2
Have children	Yes	88 %	88
	No	12 %	12
Number of children	0-10 years	50 %	166
	10-15 years	25 %	84
	15 years and over	25 %	85
Level of education	Not educated	54%	54
	Religious education	7 %	7
	Elementary	35 %	35
	Intermediate	2 %	2
	Secondary	2 %	2
	Vocational	0.00%	0
	Higher education	0.00%	0
Ethnic group	Serer	98 %	98
	Other ethnic groups	2 %	2

3.2. Value chain for two bivalves (oysters and arches)

The studies carried out show that women processors work more with arches (77%) than with oysters (64%) (Figure 2).

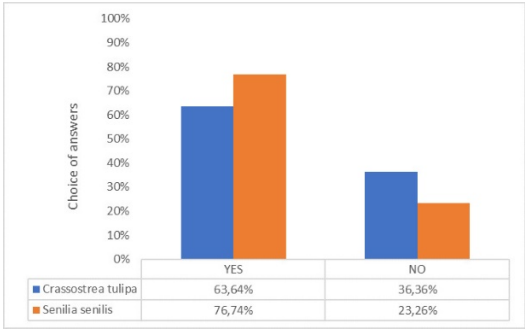

Figure 2: Level of involvement of women in processing oysters and arches

According to the women, the processed product is only used for human consumption. Their source of supply of oysters and arches remains mainly the interface ecosystems. All the women support the idea of the scarcity and seasonal availability of oysters and arches in their area (Figure 3).

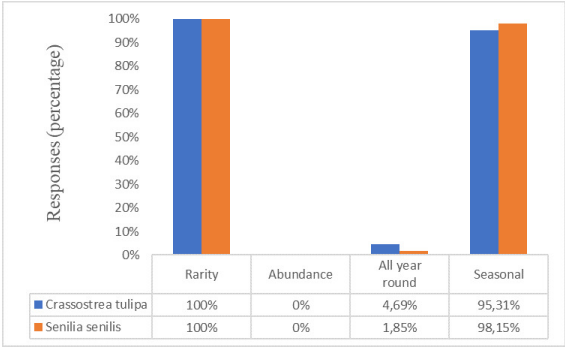

Figure 3: Availability of oysters and arches

Most women processors are active throughout the value chain for these bivalve mollusks, from harvesting (93%) to marketing (56%), via primary processing (94%), secondary processing (81%), tertiary processing (2%) and packaging (41%) (Figure4).

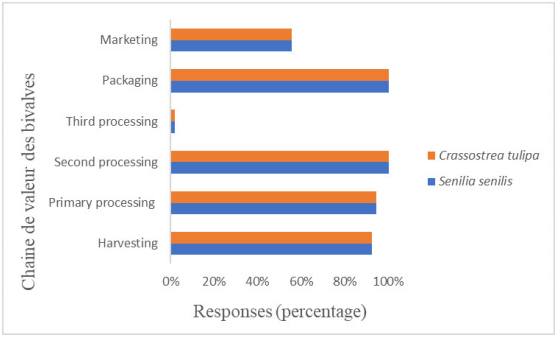

Figure 4: Involvement of women in the oyster and arch value chain

3.3. Oyster and ark harvesting schedule

This calendar shows the harvesting and processing periods. It goes:

- From December to July for oysters, with high numbers between January and March;
- From November to July for arches, with high numbers between February and June (figure 5).

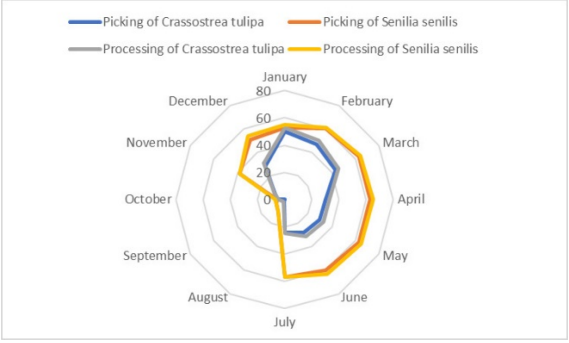

Figure 5: Harvesting and processing period for oysters and arches

3.4. Processing and conservation of bivalve mollusks (oysters and shellfish)

Fewer women processors visit the processing units built in the villages, more specifically the improved workshops (30% on average). However, the majority continue to process oysters and arches around their homes in traditional workshops (71% on average).

We also note that an average of 30.5% of women process oysters and arches in both improved and traditional workshops (figure 6).

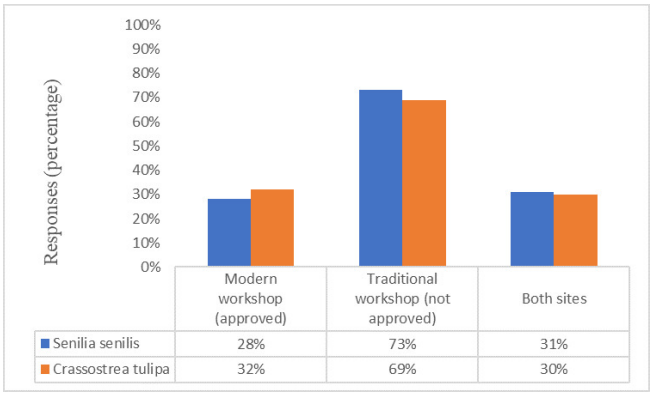

Figure 6: Different processing sites for oysters and arches

In all the villages, women processors use drying as a method of preservation. However, other methods of preservation are used in addition to drying, namely brining the oysters and refrigeration/freezing (Figure7).

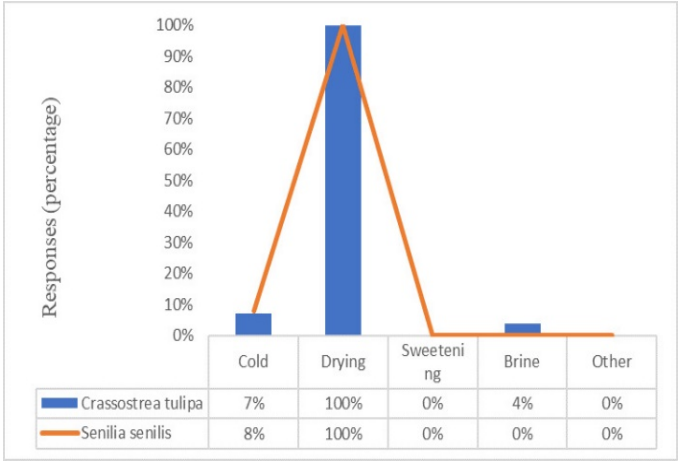

Figure 7: Different ways of preserving oysters and arches

The processing activity monitoring sheet enabled us to draw up the two bivalve mollusk processing diagrams (artisanal and improved) used in the study area (Figure 8).

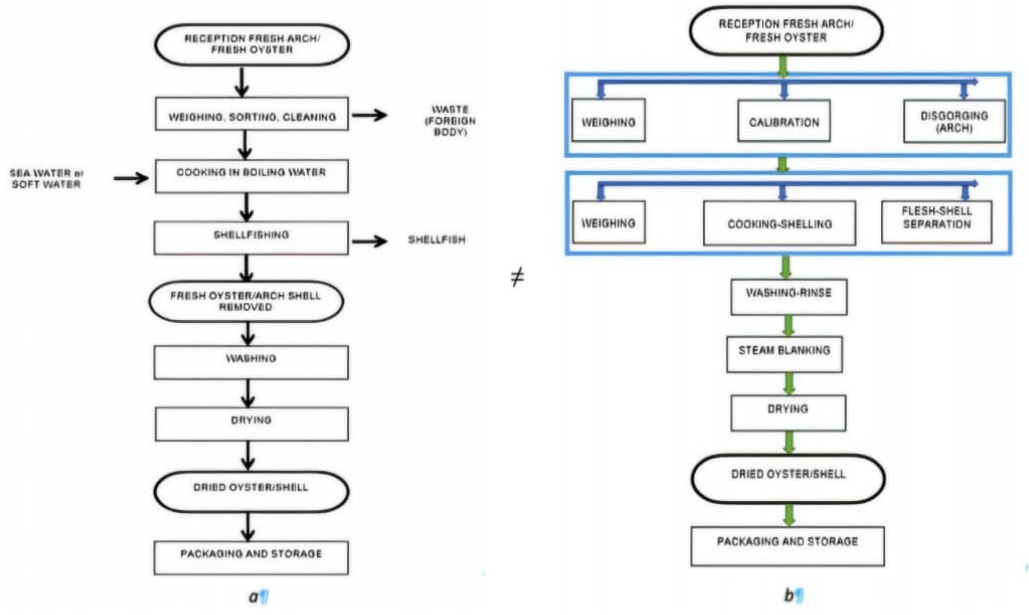

Figure 8: technological diagram of traditional (a) and improved (b) bivalve processing (arches and oysters)

Comparison of the two diagrams reveals the two types of oysters and arch processing workshop that exist in the three villages covered by this study. The results show a difference between the two diagrams by comparison with some elements of the 5 M method (raw material, milieu, workers, equipment and method) at the level of some unit operations between artisanal processing and improved processing. It is clear that there are considerable differences at every level.

It can be seen that most of the general principles of construction and operation are respected in the improved processing workshops (Table 3).

Table 3: Comparison of transformation diagrams using the 5M method

Some 5M principles	Diagram of artisanal transformation	Diagram of improved processing
Production site layout in compliance with standards	*	++
Workshop away from dwellings and reserved exclusively for the processing activity	+	+
Equipment and materials compliant	*	++

Staff hygiene complied with	*	++
Separation of the Healthy Sector and the Dirty Sector or 5 S principle	*	+++
Forward motion respected	*	+++
No crossing of traffic flows	*	++
Maximum mechanization of operations	*	+
Appropriate tidiness, cleaning and disinfection	*	++
Facilities and equipment designed to facilitate cleaning	+	++
Drafting of a cleaning programmed for premises and equipment or a cleaning and disinfection plan	*	*

Legend: * None
+ Present and ineffective
++ Present and slightly effective
+++ Present and effective

Information on the quantity of raw material before shucking, the mass of fresh meat after shucking,8 the meat/shell ratio, the quantity of waste (shells), the quantity of material lost during shucking, the drying temperature, the drying time, the quantity of finished product after drying, the drying yield, the selling price of the finished products, the production cost and the packaging of oysters and arches during their traditional and improved processing provided an overview of the added value of these bivalves (table 4). At the 5% threshold, the results showed on the one hand that there was a significant difference between dried arches and yield and on the other hand that there was no significant difference between dried oysters and yield. We can conclude that the type of processing has an influence on yield only with dried arches. On the other hand, there was more loss of material with artisanal processing. In terms of added value, improved processing saved time, improved the health of women processors, improved food safety for consumers and improved financial health.

Table 4: Determination of technical parameters during the processing of bivalve mollusks (arch and oyster)

General information				
Sites	**Falia**	**Dionewar**	**Falia**	**Dionewar**

Type of product processed	Dried *Senilia senilis*		Dried *Crassostrea tulipa*	
	Artisanal workshop	Improved workshop	Artisanal workshop	Improved workshop
Quantity of raw material before shucking	42kg	20kg	20kg	25kg
Mass of fresh meat after shucking (oyster or arch)	4kg	3,4kg	1,3kg	2,9kg
Shucking yield	9,5%	17%	6,5%	11,6%
Mass of waste (shells) after shucking	35kg	16kg	18 kg	22kg
Flesh/shell ratio	11,4%	21,2%	7,2%	13,1%
Quantity of material lost during shucking	3kg	0,6kg	0,7 kg	0,1kg
Drying temperature	Ambient temperature 37 to 40 °C	45-55°C in a solar dryer	Ambient temperature 37 to 40 °C	45-55°C in a solar dryer
Drying time	2 to 3 days	2 to 4 hours	2 to 3 days	2 to 4 hours
Mass of finished product after drying	2 kg	1,9 kg	650g	1,5 kg
Drying yield	50%	55,8%	50%	51,72%
On-site price per 200g	800 Fcfa	2000 Fcfa	2000 Fcfa	2500 Fcfa

Production cost per 200g	Negligible	1030 Fcfa	Negligible	1965 Fcfa
Margin	-	970 Fcfa	-	535 Fcfa
Packaging	Bags or baskets without labelling		Kraft paper with labelling	

4. Discussion

4.1. Bivalve mollusk value chain (oyster and arch)

According to our results, the processing of oysters and arches is carried out exclusively by indigenous women, most of whom are uneducated. These women are mostly married and generally have children under the age of 10. They are involved in the entire value chain of these bivalves (from fork to fork) and frequently use them in their children's diets, as these bivalves are reputed to be the second most important source of protein after fish. This sector therefore has a high socio-economic value on these islands, some of which are landlocked. Added to this is the scarcity of products (oysters and arches) in almost all the Saloum islands, which can be explained by the strong pressure on the resource (lack of diversity in economic activities), poor harvesting practices (growing interest in processing) and the adverse effect of climate change associated with the degradation of mangrove ecosystems (silting up of mudflats). There is also the seasonal nature of farming, which inevitably has an impact on women. From a socio-economic point of view, solutions have been developed, ranging from the definition of a harvesting schedule to the replanting of mangroves (reforestation), via the populating of mudflats and oyster farming.

These results corroborate those of Laubier (1971), who states that bivalve mollusks (or lamellibranchs) include a very large number of species exploited by man. They certainly play a very important role in the food economy of many island and coastal populations in developing countries in the tropics. These bivalves have been exploited by humans since the dawn of mankind, as evidenced by the heaps of shells left by prehistoric island and coastal populations in West Africa (Kloff, 2007). They are exploited for their significant commercial value in several countries. They are used to produce pearls (Gervis et al., 1992; Fernandez et al., 2003), as a source of calcium in animal feed (Bouyé et al., 2013), and as a source of protein in human food (Seurat, 1929).

According to USAID (2021), in West Africa, harvesting and processing activities are managed by women, who account for 80% of farmers.

In Senegal, the exploitation of bivalve mollusks (oysters and arches) plays an important socio-economic role, mainly for women, who perpetuate a two-thousand-year-old tradition (Salem, 1987; Dog, 2004) and continue to represent an important food source, mainly for island and coastal populations. According to Descamp (1999) and Hanzen (2012), artisanal shellfish harvesting in Senegal is mainly carried out by women.

Ndour et al. (2022) have also defended the idea that bivalve mollusks play an important role in Senegal's mangrove ecosystems. Bivalves (oysters and arches) are an important part of the animal protein consumed in the coastal zone. Most oyster harvesting takes place between January and June, and can extend into July and even August in years when the winter season starts very late, such as 1983. Basically, harvesting stops with the first rains and does not resume until after the farming season. February, March, April and May are the months when harvesting activities are intense and the oysters are larger (Salem, 1987). These results corroborate our findings.

Studies have also been carried out along the same lines as our results on the scarcity of resources. They support the idea that the Saloum estuary is home to mangrove plant formations, which perform multiple functions including fixing the coastline by trapping sediments, reproduction of fish fauna and the supply of a variety of products (wood, oysters, fish, arches). These functions allow for a multitude of activities and exploitation strategies, in line with the vital needs of populations in a naturally unstable environment (Marius, 1995; Diop, 1998). These growing needs for resources threaten the ecological balance of these areas and the well-being of the local populations. In fact, these needs have been accentuated by the demographic surge that the coastal zone has experienced in recent years. This situation is helping to reinforce the degradation of the coastal environment, leading some observers to talk of over-exploitation of resources in mangrove ecosystems (Ndour, 2005).

The conservation of mangrove landscapes and resilience to climate change have become major concerns for environmental stakeholders. Almost everywhere in the world, mangroves are deteriorating (Roche et al., 2015). In Senegal, particularly in Basse

Casamance, it declined dramatically during the dry period between 1970 and 1990 (Salem, 1992).

According to Bertrand Plus (2010), the mangrove, which ranges in width from 500m to 2km and is criss-crossed by bolongs, with its unique ecosystem, is central to the activities of the Niominka people of the Sine Saloum (fishing, oyster and cockle gathering, firewood and construction) and to its high tourist potential (environment, wildlife and birdlife, fishing, hunting, etc.). The mangrove is currently under threat from overexploitation of its wood and an increase in surface water salinity, with some studies reporting values close to the lethal threshold for mangroves (Dacosta, 1986; Diémé, 2018; Pages et al., 1987; Marius, 1979; Albaret, 1987; Diémé, 2018).

Studies have also shown that climate change leads to changes in aquatic ecosystems, particularly through the migration of certain species; more global changes (crisis in agricultural systems, globalization of trade, increase in populations, etc.) result in strong pressure on fisheries resources, leading to a decline in stocks. According to Ka et al. (2009) and Diouf et al. (2010), resources are finding it difficult to renew themselves in the face of this human pressure.

4.2. Processing and preservation of bivalve mollusks (oysters and shellfish)

According to our results, processing and preserving bivalves is an ancient practice that has been passed down from generation to generation. Women do more primary and secondary processing and generally use drying as a preservation technique. These processes have been carried out in artisanal processing workshops for generations, enabling women to provide for themselves and their families. Our results also showed that women processors in traditional processing workshops use rudimentary equipment and inappropriate materials (non-food plastics, unsuitable metal) to process arches and oysters. Women processors cook in oxidizable and corrosive iron pots, and cleaning products are often non-existent or of uncontrolled quality and effectiveness. With the evolution of technology, infrastructures and equipment adapted to the activity have been developed in the villages of the commune of Dionewar. The aim has been to improve and diversify preservation methods and processing techniques, and to add more value to the products and the people involved. However, a large

number of women are not using the new infrastructure, even though they are convinced of its importance in terms of sustaining the resource, improving product quality and reducing women's workload. This reluctance can be explained partly by the lack of a wealth-creation mechanism and organizational dynamism, and partly by the fact that most women are resistant to the paradigm shift, preferring to work in the old way for cultural reasons. Our results also showed that the use of the improved workshop would have an impact on yield, save working time, improve the health of women processors, ensure food safety for consumers and improve the financial health of stakeholders.

These results corroborate those of Ndoye et al. (2010), who argue that the harvesting, processing and marketing of shellfish are activities exclusively carried out by women and are an integral part of West African heritage. According to the FAO (2012), bivalves feature prominently in statistics on food-borne diseases. To avoid these risks, appropriate processing methods need to be applied. The demand for safe, additive-free food with a fresh taste and extended shelf life has also led to the use of high-pressure (HP) processing for bivalves, particularly oysters. This treatment has the potential to improve microbial quality without compromising sensory and nutritional quality according to Farkas et al (2000) and Caballero et al. (2000). According to Descamps (1989), arches and oysters are dried by traditional methods after being cooked in a little water over a wood fire for fifteen to thirty minutes (if the cooking time is too short, there is a risk of food poisoning). According to Diouf et al. (2015), processing techniques in the commune of Dionewar are almost the same in all three villages. There are differences in the washing of shellfish, the addition of substances to kill microbes or preserve the product between women who sell pre-packaged products and those who sell unpackaged products, which can affect the quality of both products.

Given the current situation and the scarcity of fish in the waters, it is imperative that people turn to shellfish farming as an alternative. Hence the need to recommend solutions in the Saloum islands by organizing the industry. According to Salem (1989), the collection of aquatic products (oysters, shellfish, fish) is the source not only of elaborate production reports but also of advanced environmental management. Women do not exploit mangroves in an anarchic and irrational way.

5. Conclusion

In the Saloum islands, there has been a marked change in the role of arches and oysters in the local economy (previously, people collected mainly for food, either directly or by bartering; nowadays, they collect to earn money). Nowadays, food supplies, especially fish, are scarce. This is having an impact on bivalve mollusks, which are under considerable pressure because they have become a source of food and income for the women processors in Niodior, Dionewar and Falia.

The results of this study showed us that oysters and arches are mainly harvested and processed by women; they also enabled us to highlight the scarcity of oysters and arches in these localities and the fact that women processors do not use the modern processing workshop. We also noted that it is advisable to have modern, standardized processing units to guarantee the safety of processed products and thus protect the consumer. There is also a variation in drying yield between products from the two types of processing.

Given the socio-economic and nutritional importance of these bivalve mollusks (oysters and shellfish), which guarantee food security in landlocked and vulnerable islands, new directions are needed to better organize this sector. Women processors need technical support, including training in collection techniques, good manufacturing practices, good hygiene practices and compliance with national and international regulations (product labelling). We also need to continue to raise awareness of the need to preserve resources and the importance of working in a place that guarantees a satisfactory state of health and complies with the hygiene standards required to carry out this activity.

The dynamism of this sector depends to a large extent on the technological, organizational, socio-economic, environmental and human efforts that will be made. There is a need for greater supervision of the players in this sector to ensure sustainable management of these natural resources. It would also be interesting to modernize processing by opening up to new, innovative products with high added value, such as *Tagelus adansonii*, which has very appreciable food value compared with the two bivalves (oysters and arches) most widely exploited by women in the area (Diouf *and al.,* 2023); this will make it easier to promote these products on the national and international markets.

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