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Inventory of fresh fish marketed in the markets of Kinshasa in the democratic republic of Congo (case of the Gambela and Matete markets).

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Abstract

This study is based on the inventory of fresh fish sold in the markets of Kinshasa in the Democratic Republic of Congo, including the markets of Gambela and Matete with the general objective of establishing a list of the species of fish sold in these two markets. The surveys carried out on the two study sites covered 250 fresh fish sellers. After processing and analysis of the data, the results obtained show that the fish sold in the two markets are diversified. A total of 7 orders, 14 families, 16 genera and 20 species of local and imported fresh fish were inventoried. At the order level, our results show that the *Siluriformes* and *Perciformes* orders are the most abundant (with 30.8% respectively) followed by the *Osteoglossiformes* order (15.4%). Concerning families, *Cyprinidae* fishes are the majority (with 17.6%) followed by *Carangidae* (with 11.8%). Concerning the most sold fish species, it emerged that imported fresh fish (*Trachurus capensis* with 53.7% and *Sardina madarensis* with 13.9%) are the most sold compared to local fresh fish (*Protopterus doloi* with 10%, *Parachanna obscura* with 5.33% and *Clarias spp* with 4.89%). In terms of consumption, households consume more than two thirds of the fresh fish sold in the Gambela and Matete markets in Kinshasa.

Keywords: Fresh fish, consumption, nutrition, food self-sufficiency, kinshasa

1. Introduction

Despite the fact that fish are now exposed to several risks of contamination from various discharges of pollutants into aquatic ecosystems (Ngbolua *et al.*, 2018) [12], consumers are increasingly interested in fish and other fishery resources from aquaculture and capture fisheries because of their nutritional value and health benefits (FAO, 2013) [6]. Fish provides a complete set of nutrients with a unique composition, including fatty acids, amino acids, micronutrients (vitamins and minerals) as well as many lesser-known nutrients (Kaushik, 2014) [7]. In addition to their great interest in food, fish are also useful in a variety of other areas. They can be used as bio-indicators (Diomandé *et al.*, 2001) [3].

Employment in the fisheries and aquaculture sector has grown faster than the world population. Approximately 45 million people work directly in the sector. In addition, many people work in important secondary sectors, such as handling and processing, where women make up more than half of the workforce. Overall, taking into account the dependants of these workers, fisheries and aquaculture support the livelihoods of some 540 million people, or 8% of the world's population (FAO, 2011) [5].

In Africa, more than 200 million people consume fish that is regularly fresh, but also smoked or dried (Mananga *et al.*, 2019) [10]. In the Democratic Republic of Congo, three quarters of fish production is consumed fresh, while the rest is smoked, dried or salted before being sold to the country's various markets. The consumption of fish is anchored in the culinary recipes of many ethnic groups in the D.R. Congo and is prepared in more than a dozen dishes. For some Congolese, fish and fish products are important sources of food and essential nutrients. They yield up to 48.8% of the proportion of animal protein (Nzapo *et al.*, 2018) [13], contribute directly to food self-sufficiency and, play an essential role in food security, the fight against poverty and also contribute to social welfare through trade and exports (Lusasi *et al.*, 2019) [9].

There is a diversity of fresh fish sold in the public markets of Kinshasa in the D.R. Congo, but their category, rate of sale and consumption as well as the species sold are less well known. In order to make available the missing information raised in the previous lines on the marketing and consumption of fresh fish in Kinshasa, this study proposes to make an inventory of the fresh fish sold in the markets of Kinshasa in the Democratic Republic of Congo more particularly in the markets of Gambela and Matete

with the general objective of making available the list of the species of fresh fish sold in the two markets studied.

2. Study medium, materials and methods

2.1. Study framework

This study took place in two markets in Kinshasa, the capital of the D.R. Congo. These are the Gambela market located in the commune of Kasa-Vubu and the Matete market located in the commune of Matete (figure 1).

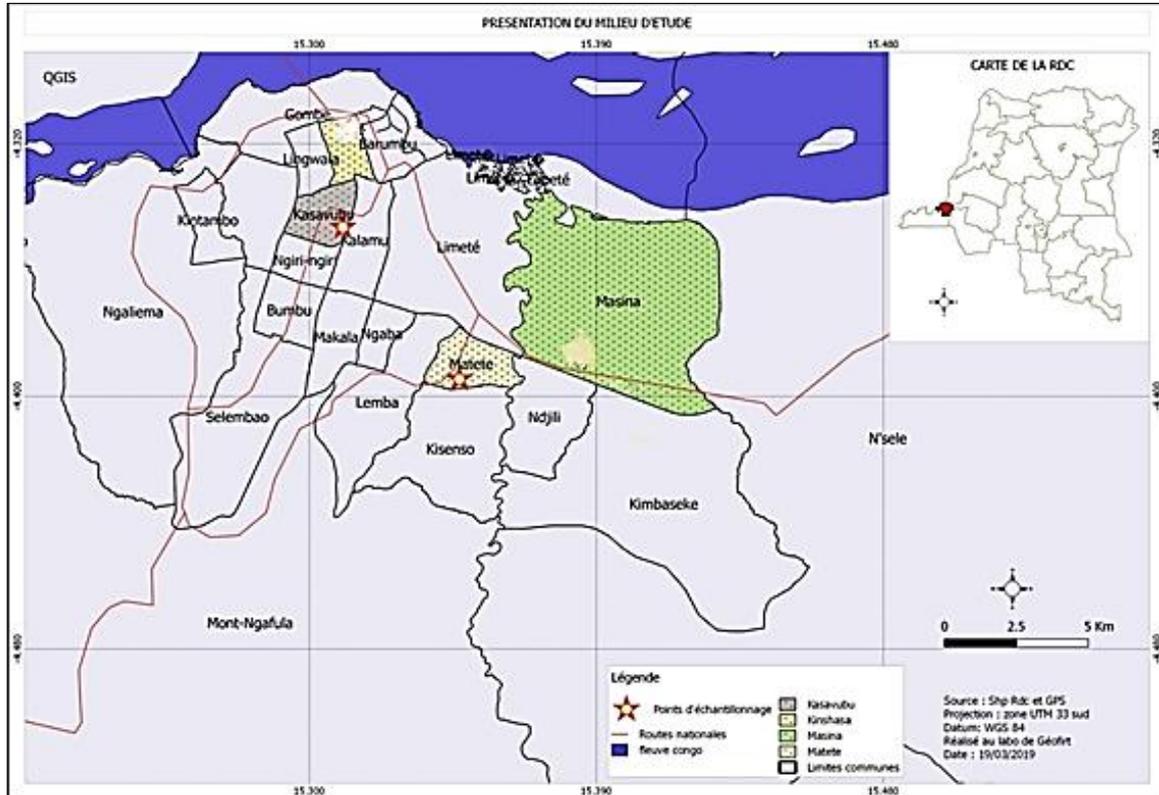


Fig 1: Mapping of Study Sites

2.2. Biological material

The biological material for this study consists of local and imported fresh fish (figures 2 and 3) sold at the Gambela and Matete markets in Kinshasa.



Fig 2 and 3: Fresh local (a) and imported (b) fish sold at the Gambela and Matete markets in Kinshasa (Photo Lusasi S.W., 2019) [9].

2.3. Methods

2.3.1. Surveys

We used the interview technique, based on direct questioning (questions on a specially designed survey form) between us and the target population (fresh fish sellers) to obtain the information we needed about the fresh fish sold in these markets. The information collected covered the profile of the respondents, the categories of fresh fish sold, the frequency of sales from one category of fish to another, the groups of consumers of fresh fish, and the constraints linked

to this activity. In addition to these questions, we also used open-ended interviews for several minutes with sellers who were motivated to tell us more (Lusasi *et al.*, 2019) [9].

2.3.2. Systematic fish identification

Thanks to the vernacular (in Lingala) and common (in French) names of the fish collected from the fresh fish sellers at the Gambela and Matete markets in Kinshasa, we were able to identify the orders, families, genera and species of the local and imported fresh fish sold at the two markets. The systematic positioning of the different specimens of fresh fish inventoried was made possible thanks to the keys for systematic identification of fish proposed by Boulenger (1911) [2]; Poll (1939 a et b, 1959) [15, 16]; Poll et Gosse (1995) [14]; Tshibwabwa (1997) [19]; Lévêque *et al.*, (1990, 1992) [8]; Mbega *et al.*, (2003) [11]; Stiansny *et al.*, (2007) [18], available at the Laboratory of Limnology, Hydrobiology and Aquaculture of the Department of Biology of the Faculty of Sciences of the University of Kinshasa.

2.3.3. Sampling method

This study covers the period from April to October 2019, either seven months. Data collection took place twice a month and a total of fourteen field visits were conducted. The survey was comprehensive in that we interviewed almost all vendors of the fresh fish found in the fish sales departments of these two markets. The age and type of food

sold were the two inclusion criteria that were considered. The respondent should be at least 18 years of age and be the person selling the fresh local and/or imported fish in both markets. The exclusion criteria took into account vendors other than those selling fresh fish as well as customers. The sample consisted of 250 respondents in total, 150 in Gambela market and 100 in Matete market. The distribution of the number of respondents by market is based on the size of each market. The Gambela market was larger than Matete market and had a large number of fresh fish sellers.

2.3.4. Statistical processing of data

The information collected from the survey form used was extracted and then entered into the Excel 2013 spreadsheet.

The data obtained was analysed and presented in the form of tables, figures and graphs using Origin 6.1 software. The relative abundance of orders and families, the level of sale of the different species of fish and the type of consumers of the fresh fish sold were expressed in percentage terms with the mathematical formula: $\text{Percentage (\%)} = \text{Fra/Tec} \times 100$ where, Fra expresses the absolute frequency and Tec expresses the sample size.

3. Results

3.1. Profile of respondents

The profile of sellers of local fresh fish and fish imported from the Gambela and Matete markets in Kinshasa is shown in Table 1 below.

Table 1: General characteristics of the fresh fish sellers surveyed (Fra: Absolute frequency)

Variable	Markets		Fra	%
	Gambela	Matete		
Sex				
Male	29	13	42	16.8
Female	121	87	208	83.2
Total	150	100	250	100
Marital status				
Single	39	24	63	25.2
Married	81	56	137	54.8
Divorced	17	9	26	10.4
Widowed	13	11	24	9.6
Total	150	100	250	100
Ages (years)				
18 – 25	25	24	49	19.6
26 – 40	44	46	90	36
41 – 60	75	21	96	38.4
61 and over	6	9	15	6
Total	150	100	250	100

The results shown in Table 1 above show that out of 250 respondents, there are more females (83.2%) than males (16.8%). Regarding the marital status of respondents, the results show that married people are the most representative (54.8%), followed by single people (25.2%), divorced people (10.4%) and widowed people (9.6%). The most represented age group is that between 41 and 60 years old (38.4%), followed by those between 26 and 40 years old (36%), then the age group between 18 and 25 years old

(19.6%) and the least represented age group is that between 61 years old and over (6%).

3.2. Species of local fresh fish sold

The local fresh fish species identified at Gambela and Matete markets in this study are listed in Table 2 below. Here we use the term "local fresh fish", fresh fish from artisanal fisheries and fish farming and "imported fresh fish" refers to sea fish that are imported into the D.R. Congo.

Table 2: Local fresh fish inventoried at Gambela and Matete markets (+: present and -: absent).

Orders	Families	Genera	Species	Markets	
				Gambela	Matete
<i>Ceratodontiformes</i>	<i>Protopteridae</i>	<i>Protopterus</i>	<i>Protopterus doloi</i>	+	+
<i>Characiformes</i>	<i>Distichodontidae</i>	<i>Distichodus</i>	<i>Distichodus faciolutus</i>	+	-
<i>Cypriniformes</i>	<i>Cyprinidae</i>	<i>Labeo</i>	<i>Labeo lineatus</i>	+	+
			<i>L. sorex</i>	+	-
		<i>Barbus</i>	<i>Barbus congicus</i>	+	-
	<i>Mormyridae</i>	<i>Campylomormyrus</i>	<i>Campylomormyrus hynchopharus</i>	+	+
<i>Osteoglossiformes</i>	<i>Osteoglossidae</i>	<i>Heterotis</i>	<i>Heterotis niloticus</i>	+	+
	<i>Cichlidae</i>	<i>Oreochromis</i>	<i>Oreochromis niloticus</i>	+	+
	<i>Channidae</i>	<i>Parachanna</i>	<i>Parachanna obscura</i>	+	+
	<i>Clariidae</i>	<i>Clarias</i>	<i>Clarias gariepinus</i>	+	+
	<i>Claroteidae</i>	<i>Auchenoglanis</i>	<i>Auchenoglanis occidentalis</i>	+	-
<i>Siluriformes</i>	<i>Mochokidae</i>	<i>Synodontis</i>	<i>Synodontis spp</i>	+	+
	<i>Schilbeidae</i>	<i>Schilbe</i>	<i>Schilbe mystus</i>	+	+
5	11	12	13	13	9

The data in Table 2 above show that 5 orders, 11 families, 12 genera and 13 species of local fresh fish are sold in the Gambela and Matete markets in Kinshasa. Of the 13 species of fish inventoried, nine are listed at the Matete market and 13 species at the Gambela market.

3.3. Species of imported fresh fish sold

Table 3 below lists the species of imported fresh fish sold at the Gambela and Matete markets in Kinshasa.

Table 3: Imported fresh fish reported at Gambela and Matete markets in Kinshasa

Orders	Families	Genera	Species	Markets	
				Gambela	Matete
<i>Clupeiformes</i>	<i>Clupeidae</i>	<i>Sardina</i>	<i>Sardina madarensis</i>	+	+
<i>Perciformes</i>	<i>Carangidae</i>	<i>Trachurus</i>	<i>Trachurus capensis</i>	+	+
		<i>Lutyanus</i>	<i>Lutyanus goreensis</i>	+	+
	<i>Haemulidae</i>	<i>Pomadasys</i>	<i>Pomadasys rogeri</i>	+	-
<i>Siluriformes</i>	<i>Clariidae</i>	<i>Clarias</i>	<i>Clarias gariepinus</i>	+	+
	<i>Channidae</i>	<i>Parachanna</i>	<i>Parachanna insignis</i>	+	+
	<i>Schilbeidae</i>	<i>Schilbe</i>	<i>Schilbe mystus</i>	+	-
3	6	7	7	5	

Analysis of the data in Table 3 above shows the presence of 3 orders, 6 families, 7 genera and 7 species of imported fresh fish are sold at the Gambela and Matete markets in Kinshasa. Of the 7 species of imported fish, five are present at Matete market while all seven are found at Gambela market.

3.4. Relative abundance of identified fish orders

Figure 4 below shows that the orders *Siluriformes* and *Perciformes* are the most represented (or 30.8% respectively) followed by *Osteoglossiformes* (or 15.4%) and fish belonging to the orders *Ceradontiformes*, *Clupeiformes* and *Cypriniformes* represent a small proportion (or 7.68%).

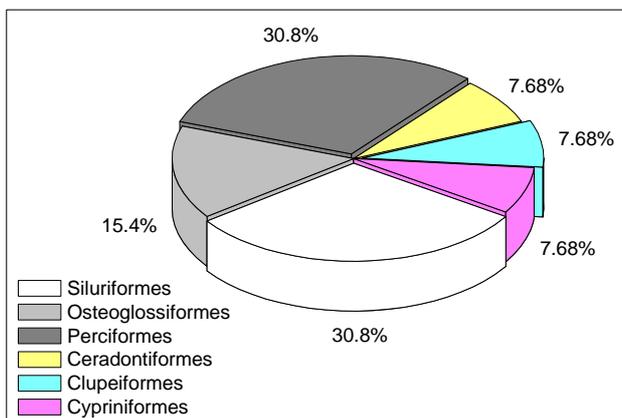


Fig 4: Relative abundance of local and imported fresh fish orders sold at Gambela and Matete markets

3.5. Relative abundance of families of identified fish

The results shown in figure 5 below show that fish of the *Cyprinidae* family are the most numerous (or 17.6%) followed by those of the *Carangidae* family (or 11.8%) and the other fish families are less represented (or 5.88% respectively).

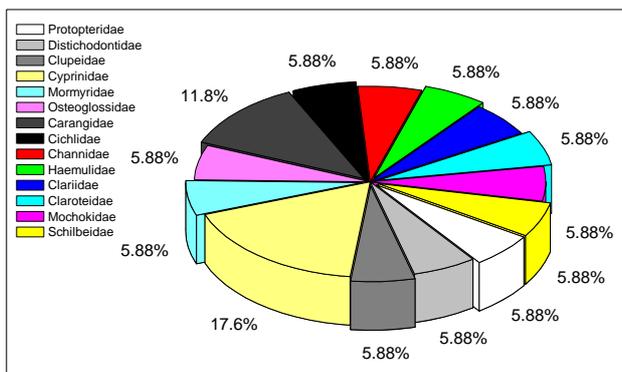


Fig 5: Relative abundance of local and imported fresh fish families sold at Gambela and Matete markets

3.6. Top-selling fish species

Trachurus capensis is the most sold fish species in both markets (or 53.7%) followed by *Sardina madarensis* (or 13.9%), *Protopterus doloï* (or 10%), *Parachanna obscura* (or 5.58%), *Clarias spp* (4.89%) and *Distichodus spp* (or 3.49%). The remnants of fish species are less sold (or 2.79%) (Figure 6).

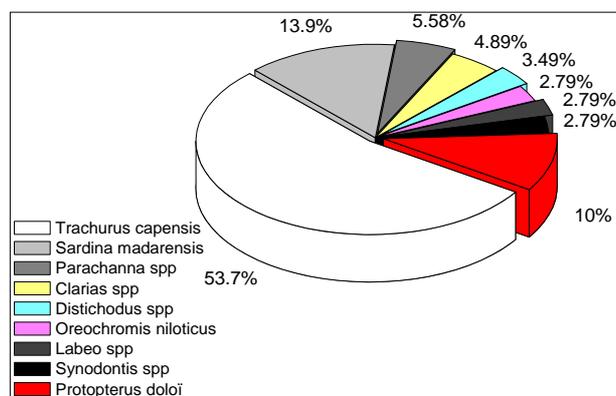


Fig 6: Species of fresh local and imported fish most sold at the Gambela and Matete markets in Kinshasa

3.7. Price of one kilogram of fish according to their category

The information shown in figure 7 below shows that one kilogram of fresh fish from artisanal fishing and fish farming costs more (or 8.500 Congolese Francs) than one kilogram of imported fish (or 4.500 Congolese Francs). 1 USD equivalent to 1.700 Congolese Francs.

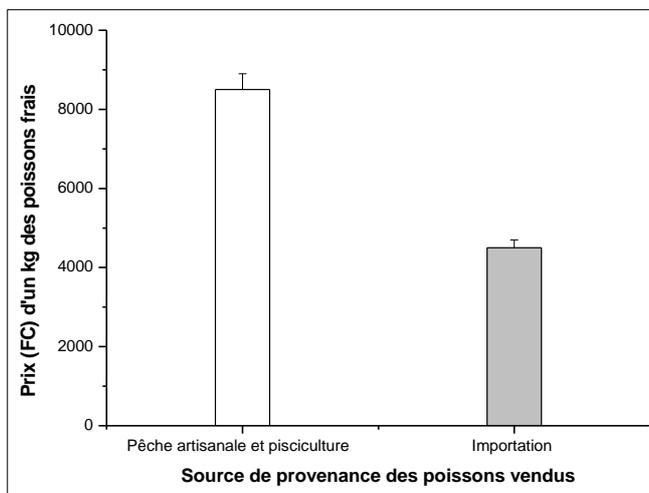


Fig 7: Price of one kg of fresh fish sold at Gambela and Matete markets

3.8. Potential consumers of fresh fish sold at Gambela and Matete markets

The results in Figure 8 below show that households consume a high proportion of the fresh fish sold in Gambela

and Matete markets (71%) followed by retail consumers (13%), restaurateurs (9%) and wholesale buyers of local and imported fresh fish represent a small proportion (7%).

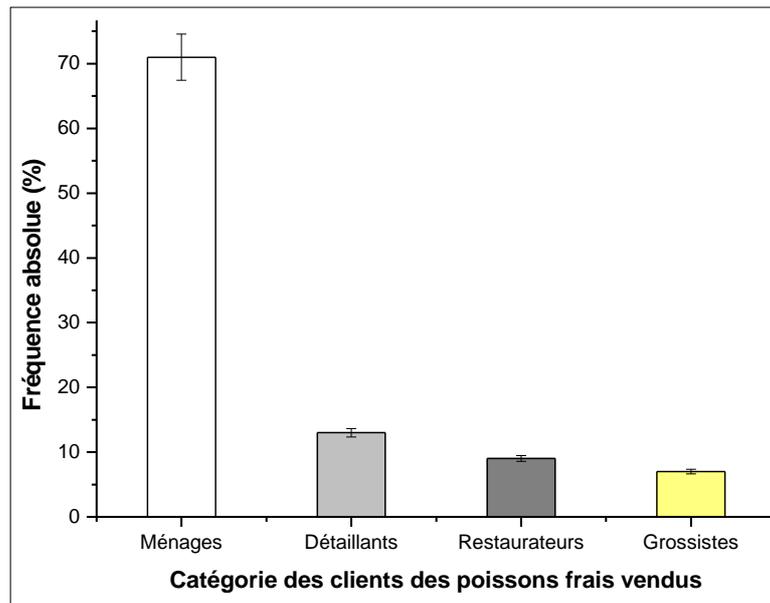


Fig 8: Potential customers for local and imported fresh fish sold in the two markets surveyed

3.9. Opinion of sellers on their choice of the type of fresh fish to be sold

The opinions of sellers of local and imported fresh fish marketed at the Gambela and Matete markets in Kinshasa in

relation to the choice of source of fresh fish sold are recorded in Table 4.

Table 4: Notices from vendors related to the choice of fish sold

Source of origin	Advantages	Disadvantages
Artisanal fishing and fish farming	<ul style="list-style-type: none"> - Minus losses ; - Appreciated by the majority of the population ; - All sizes of fish are available ; - Good nutritional quality ; - Excellent organoleptic quality. 	<ul style="list-style-type: none"> - Fishermen's ports away from the market; - Are scarce at other times; - High purchase price ; - High cost of transport ; - Expensive ; - Little interest after sale ; - Sell slowly ; - Can be contaminated by various pollutants discharged into aquatic ecosystems.
Import	<ul style="list-style-type: none"> - Lower selling price ; - Cold rooms are on the market ; - Risks related to after-sales losses are very low ; - Easily sold out. 	<ul style="list-style-type: none"> - Nutritional quality of the Chair questionable ; - Poor storage conditions ; - Decomposes easily ; - May be contaminated by various pollutants discharged into aquatic ecosystems.

The analysis of the results in Table 4 above shows that the most determining factors in the choice of the category of fresh fish for sale are: the purchase and sale price, the accessibility of the fish to the places of purchase by the sellers, the interest rate after the sale, the appreciation of the fish by the population and the availability of the fish in the places of supply.

4. Discussion

The general objective of this study was to list the species of fish sold in the Gambela and Matete markets in Kinshasa. The results obtained showed the presence of 7 orders, 14 families, 16 genera and 20 species of fresh local and imported fish inventoried in the two markets. In terms of the relative abundance of the fish orders identified, it emerged

that the *Siluriformes* and *Perciformes* orders were the most abundant (representing 30.8% respectively) followed by the *Osteoglossiformes* order (with 15.4%) and fish belonging to other orders were less representative (with 7.68% respectively). At the family level, *Cyprinidae* was the majority (17.6%) followed by the family *Carangidae* (11.8%) and the remnants of the families were poorly represented. All these observations are in line with those made by FAO (2009) ^[4]; Lusasi *et al.*, (2019) ^[9] which also indicated the importance of the fish orders and families mentioned above in several markets in the country. Mananga *et al.*, (2019) ^[10] also made the same observation as us in their study on the evaluation of the marketing and consumption of smoked fish in two of the markets in Brazzaville in the Republic of Congo.

With regard to the best-selling fresh fish species, it has been shown that imported fish (*Trachurus capensis* with 53.7%, *Sardina madarensis* with 13.9%, etc.) are the best-selling while local fish are less sold (*Protopterus doloï* with 10%, *Parachanna obscura* with 5.33%, *Clarias spp* with 4.89%, etc.). The selling price of fresh fish varied from one category to another. One kilogram of artisanally caught and farmed fish was more expensive (8.500 Congolese Francs) than imported fish (4.500 Congolese Francs). These results are in line with those obtained by Binama (2017) ^[1] in his study conducted at the Alivia and Liberté de Masina markets in Kinshasa on the inventory of fresh fish sold. Lusasi *et al.*, (2019) ^[9] also pointed out that one kilogram of imported fresh fish costs less (3.500 Congolese Francs) than one kilogram of local fresh fish (6.000 Congolese Francs). Of all consumers of fresh local and imported fish sold in Gambela and Matete markets, households were the largest (71%), followed by retail consumers (13%), restaurateurs (9%) and wholesale buyers of fish represent a small proportion (7%). These observations confirm the observation made by FAO (2009) ^[4] according to which: "Fish is an important source of animal protein accessible to low-income households, especially in developing countries where the price of meat remains beyond the reach of the average consumer".

5. Conclusion

This study focused on the inventory of fresh fish sold in the markets of Kinshasa in the Democratic Republic of Congo, more precisely the Gambela and Matete markets. The results obtained after the analysis of the data from the interviews with 250 respondents revealed that there is a diversity of local and imported fresh fish sold in these two markets. A total of 7 orders, 14 families, 16 genera and 20 species of local and imported fresh fish were identified.

It has been shown that the most sold fresh fish species are those that are imported such as *Trachurus capensis* (with 53.7%) and *Sardina madarensis* (with 13.9%) to the detriment of local fresh fish such as *Protopterus doloï* (with 10%), *Parachanna obscura* (with 5.33%) and *Clarias spp* (with 4.89%) and, households being the biggest consumers of these fish.

The observations raised in this study sufficiently show that fishing resources play an important role in the fight against hunger and malnutrition as well as in the social stability of several households in the country. For this reason, sustained attention should be focused on the way in which the aquatic ecosystems of the D.R. Congo and their resources are managed, taking into account their social well-being but also to avoid possible health problems linked to the consumption of fish taken from polluted aquatic ecosystems.

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