



ISSN: 2347-5129
(ICV-Poland) Impact Value: 5.62
(GIF) Impact Factor: 0.352
IJFAS 2015; 3(1): 392-399
© 2015 IJFAS
www.fisheriesjournal.com
Received: 20-07-2015
Accepted: 19-08-2015

Abissa Antoine YAO
Ecole Supérieure d'Agronomie
(ESA), Institut National
Polytechnique – Félix
Houphouët – Boigny (INP-HB),
BP 1093 Yamoussoukro, Côte
d'Ivoire

Kouassi Sébastino DA Costa
Centre National de Recherche
Agronomique (CNRA),
Programme Pêche et
Aquaculture Continentales
(PPAC), 08 BP 33 Abidjan 08,
Côte d'Ivoire.

Yéhé Mathieu Dietoa
Université Nangui Abrogoua,
Laboratoire d'Environnement et
de Biologie Aquatique (LEBA);
02 BP 801 Abidjan 02, Côte
d'Ivoire.

Correspondence
Kouassi Sébastino DA Costa
Centre National de Recherche
Agronomique (CNRA),
Programme Pêche et
Aquaculture Continentales
(PPAC), 08 BP 33 Abidjan 08,
Côte d'Ivoire.

International Journal of Fisheries and Aquatic Studies

Small pelagic fish *Pellonula Leonensis* Boulenger, 1916 (Pisces; Clupeidae) fishery in Taabo Lake: Typology, yield and socio-economic characteristics

Abissa Antoine YAO, Kouassi Sébastino DA Costa, Yéhé Mathieu Dietoa

Abstract

Typology and production of *Pellonula leonensis* Fishery in Taabo Lake was characterized. For this purpose, a survey on fishing units and fishmongers was conducted from July 2006 to October 2007. Morphometric data of captured specimens were measured at different climatic seasons. In total, sixteen fishing units and nine fishmongers were registered. They are mainly autochthonous. One fishing unit includes one Captain for three sailors, 1 canoe and 1 shore Seine. Overall, 66.7% of fishermen are 20 to 30 years old. Fishmongers are 15 to 36 years old. Furthermore, *P. leonensis* stocks in Taabo Lake are submitted to a high fishing pressure. This laid to a reduction of this fish specimen size compared to those of Fae and Buyo Lakes. Estimated average production of *P. leonensis* fluctuates from 26.7 to 350.7 t with an average of 132.2 t. The fishing unit owner earn annually 999.8 to 1374.8 USD.

Keywords: *Pellonula leonensis*; Taabo Lake; Fishery typology; socio-economic determinants; Cote d'Ivoire.

1. Introduction

The Ivorian economy is essentially based on agriculture with remarkable performances in crop production (cocoa, coffee, pineapple, banana, cashew, cotton, sugar, crops, etc.), while chronic deficits in aquaculture and fisheries production are observed [6]. This has led Côte d'Ivoire State to define, since the 1970s, strategies for the development of fishing. This expresses, among other things, a strong desire to develop the artisanal productions. For this purpose, more than a dozen billion of CFA went to fisheries and aquaculture projects during the last twenty years [3]. This commitment of the State relies on the potential of Ivorian continental waters plans which fishing yield is around 200 to 250 kg/ha/year [4, 16, 20].

According to this, the National Centre of Agricultural Research (CNRA) conducted, as part of its research and development mission, an assessment of different fisheries observed in Taabo Lake. These include the Bozo classic type and the small pelagic Fish *Pellonula leonensis* fishery.

This study carried out, as part of the Research project's Challenge Program CGIAR/FIS/CNRA No. A/4007-1, focuses on *P. leonensis* and its fishery. In fact, this small pelagic Fish locally named "Mimie la go", is a centre of economic interest due to the developed important fishing activities. This form of commercial exploitation of this small pelagic Fish species that is observed in Lake Taabo is atypical in the environment of lacustrine fisheries` in Côte d'Ivoire. However, this fishery remains few described. Hence, the interest of this work is to present the typology and socio-economic characteristic of *P. leonensis* fishery in Taabo Lake in order to establish referential bases for it development.

2. Material and Methods

2.1 Study area

This work was conducted on Taabo man-made Lake located between 06 ° 20' and 06 ° 40' North latitude, and 05 ° and 05 ° 30' West longitude (figure 1). For this study, five studied stations were considered. These are Taabo port, Taabo dyke, Courandjourou, Teheranga and Taabo city. These are the main fishing areas of *P. leonensis* on the Lake (Figure 1). The physico-chemical characteristics of these fishing areas are indicated in [8].

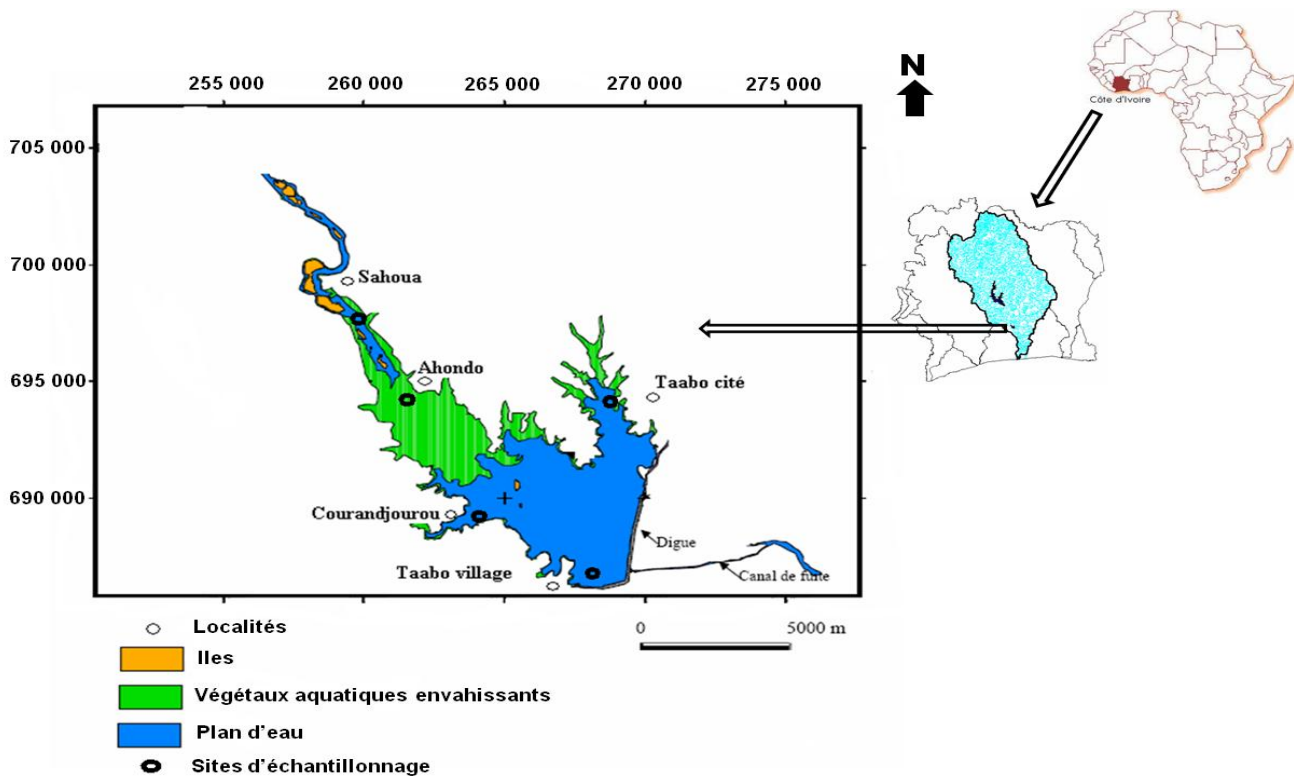


Fig 1: Map of Taabo man-made Lake with the location of sampling sites (Kouassi, 2007 modified)

2.2 *P. leonensis* production assessment

History of *Pellonula leonensis* fishery in Taabo Lake was, beforehand, investigated. Then, fishing areas were identified and fishing activities described by using a village investigator. Investigations concerned fishing gears for the capture of Mimie la go at the main catches landing station (Port) on the East side of Taabo village, and the one adjoining dike (Dyke). The numbers of fishing units and fishing trips were assessed. *P. leonensis* catches by fishing gears used by crews were weighed at different climatic seasons. When catches were landed, the observed Fish specimens were inventoried and identified using [17]. The captured non-target Fish species in Mimie la go seines were separated from lot, counted, and weighed.

The total number of fishing trips by crews and the daily average of the exploited production were used for estimation of the seasonal and annual production. *P. leonensis* production assessment was based on the daily weighing of catches during the seasonal ichthyological trips on Taabo Lake. The considered fishing effort for *P. leonensis* fishery in Taabo Lake is, in one hand, the used fishing power (crew and fishing equipment) for the exploitation of this Fish species stocks by fishing day, trip, unit and, in the other hand, the density of fishing units per fishing area not covered by invasive aquatic plants. In addition, an inventory of the fishing equipments, actors and the time devoted to fishing activities were determined. The daily average of the Fish production of crews allowed to estimate by season, the global production of *P. leonensis* per fishing unit.

2.3 Morphometric measurements

For morphometric characterization, exploited *P. leonensis* specimens were sampled by climate season from catches landed by crews. A total of 500 specimens were examined and

measured by using an ichthyometer, and weighed individually by use of an electronic scale of 3 200 g with 0.01 g scope. A sample of 100 specimens of *P. leonensis* were collected at random per season and analyzed. Their total (TL in mm), standard (SL in mm) length and individual weight (P in g) were determined. Condition factor (K) was assessed by using the formula of Le Cren [12]: $K = P \times 10^5 / L^3$, where P represents the fresh weight in mg and L, the standard length of *P. leonensis* in mm. Furthermore, the distribution and the frequency of captured specimens were determined by size class per fishing season. *P. leonensis* first capture size corresponding to the size of the smallest captured fish [13] was, also, determined. Size classes were established by using Sturge rule [19] according to the following formula: $1 + (3.3 \times \log n)$ for the determination of class number, and $A = (LS_{\max} - LS_{\min}) / (1 + 3.3 \log n)$ for the class amplitude or interval; n is the sample size. With regard to the first capture minimum size of *P. leonensis*, the minimum and maximum values, as well as the standard deviations, were evaluated using SPSS 11.0 software. Finally, the impact of the fishing effort on the size of the specimens of this Fish species in Taabo Lake and the effects of their exploitation on other Fish species were analyzed.

2.4 Socio-economic survey

A socio-economic survey on *P. leonensis* fishery was conducted with the help of two village investigators recruited and trained for this purpose. Quiz, interviews and direct observations in the field were used. Only fishermen in activity were submitted to the quiz. This, for assessing the specificity of *P. leonensis* fishery, identifying actors, fragment of the population of Taabo village engaged in this fishery, and its socio-economic indicators. All the resource persons concerned by *P. Leonensis* fishery were taken in account. Then, a general

operating account of the commercial activities of fishing unit's owners and fishmongers were assessed. For the first ones, two cases were considered, as following: fishing gears are amortized or not. When these are not, fishermen receive half the daily production. The proceeds of the sale constitute their daily salary. When fishing gears are amortized, the fishermen perceive two-thirds (2/3) of daily production. The owners of the fishing equipments take in account all the charges. Fishermen are just employees.

2.5 Statistical analysis

The statistical analysis of the data was performed using Excel 2003 and SPSS 11.0 softwares. For these needs, two data matrices were developed, respectively, for production data and for morphometric measurements.

3. Results

3.1 *P. leonensis* Fishery status in Taabo Lake

The exploitation of *P. leonensis* in Taabo manmade Lake is recent and started in 1995, e.g. 13 years after the opening of dam to fishing activities (1981-1982). Initially named gawa in the local ethnic group (Baoule) according to its tiny aspect, *P. leonensis* was recently named «Mimie la go». Due to its small size, this Fish species had no fishing interest, given to the abundance of large Fish species of economic interest in the Bandama River. The exploitation and sale of this Fish species has experienced a boom, with the development of some fishing techniques (shore seines) and locally technological process developed for its preservation.

3.2 Typology of fishing units

All identified *P. leonensis* fishermen are from Taabo Village. They are in majority of the Baoule ethnic group. 78.80% of these fishermen can read and write. Furthermore, 94.12% of them say well living of their revenues. Fishing units are composed, respectively, of 3 to 4 fishermen, whom 1 captain and 2 or 3 sailors. Totally, 16 *P. leonensis* fishing units composed, respectively, of one (1) captain for three (3) sailors. Globally, 10 captains and 24 sailors were recorded. Identified fishermen are young and 20 to 30 years old. With regard to the organisation of fishing activities, each crew works for an individual, notably the owner of the boat and shore seine.

3.3 Characteristics of fishing gears

P. leonensis Fishing gears in Taabo lake are, respectively, shore or beach seines, passive gill nets with simple sheet (Spider), traps, hawks, longlines, bamboos. But the ones used for commercial fishing are beach seines which provide important catches. According to their size, three seine types are observed, notably: large, medium and small. A total of 16 *P. leonensis* seines including 1 large, 14 medium and 1 small sizes were registered. The most used among them are medium size seines. Two seine types were identified according to the mesh. These are unique mesh and mixed ones. These seines have, in common, a brace between the net and the rope. The observed single mesh seines have mesh side of 5 mm, except for the brace whose mesh side is 35 mm. Mixed mesh seines present decreasing mesh sides when evolving towards the bottom of the pocket.

Large seines have a corkline long of 115 m. The reinforcement has a mesh side of 60 mm and a fall of 15 cm. The first slick of 35 m long has a mesh side of 35 mm and a fall of 6.35 m. The second slick, long of 14.30 m, has a side mesh size of 15 mm and a fall of 6.35 m. The third slick of 13 m long has a mesh side of 5 mm and a fall of 6.35 m. Finally, the pocket of 9.10

m long has a diameter of 1.50 m and a stitch side of 5 mm.

Concerning medium size seines, the corkline is of 78 m long. The reinforcement has a side mesh of 20 mm and a fall of 15 cm. The first slick of 30 m-long has a mesh side of 15 mm and a fall of 8.75 m. The second slick of 28 m long has a mesh side of 15 mm and a fall of 8.75 m. The pocket is 5.50 m long and has a diameter of 2 m and a mesh side of 5 mm, then 3 mm.

The observed small seines are characterized by a long corkline of 78 m. The reinforcement has a mesh side of 30 mm and a fall 15 cm. The first slick is 15 m long with a mesh side of 30 mm and a fall of 6 m. The second sheet is 9 m long with a mesh side of 22 mm and a fall of 6 m. The third sheet is 9 m long and has a mesh side of 5 mm and a fall of 6 m. The pocket is 3.70 m long with a diameter of 1.80 m, and a mesh side of 5 mm. In general, seines are produced by ordering. Each purchaser has to buy the equipment necessary for the manufacture.

3.4 Manufacturers and vessels characteristics

To meet the needs of fishermen, carpenters were converted to manufacturers of canoes and fisheries accessories such as paddles. For the capture of *P. leonensis*, fishermen use large canoes of 7 m long and made with planks. It measure 7 m in length and 1.20 m width depth of 45 cm. The draught for empty canoe is of 20 cm; and for loaded one of 35 cm.

3.5 Fishing techniques

There is no specific period or particular ritual for fishing that occurs at any time (7 days a week). Fishermen use exclusively beach or shore seines which is handled by a team of 3 to 4 sailors. Fishing is operated by surrounding the area containing *P. leonensis* shoals with a shore seine. Sometimes; fishermen beat water surface in order to guide fish into the pocket with finer meshes (5 mm and 3 mm). Water bottom and surface serve as natural barrier preventing *P. leonensis* escaping from the space delimited by the net.

3.6 Fishing effort

Fishing effort has varied, gradually, during this study. Indeed, 10 crews with a total of 34 fishermen were identified during the investigation period. Then, this number reached 13. After the month of June 2007, 16 crews using 16 canoes and 16 shore seines (1 large Seine, 14 medium-sized seines and 1 small purse seine) were registered.

3.7 Rhythm of fishing trips during the monitoring period

Crews work every day in any area of the Lake not invaded by aquatic plants (Taabo Village, Taabo city, Courandjourou and Teheranga) and managed to pull the Seine (Seine area). Fishing activities are usually stopped for various reasons, notably, family needs, health or even tiredness. Crews have two trips per day (morning and night trips). From this result, a total of 4228 trips were recorded during the monitoring period including 2114 in the morning. For all the 13 crews followed, 655 trips were recorded in the long rainy season and 1436 trips during the short rainy season with, respectively, 50.4 ± 5.2 and 33.5 ± 9 trips per crew. During the long dry season, 820 trips were registered, with an average of 63.1 ± 13.1 by crew. In the short dry season, 203 fishing trips were noticed, with an average of 15.6 ± 6.0 .

3.8 Fish Production assessment

During the monitoring period, *P. leonensis* production was 132.2 t for morning landings. Whereas two daily landings, morning and evening, total production can be extrapolated to approximately 264.4 t. The monthly production observed for

morning landings fluctuated between 3.9 and 16.7 t, with a monthly average of 11.0 ± 4.6 t. Medium-sized seines were the most used by the fishermen of Taabo Village. Their number increased from 11 to 14 during the study. During the small rainy season, 28 weights of *P. leonensis* catches with this type of seine gave the value of 1.72 t with an average of 0.06 ± 0.04 t. During the long rainy season, 13 weights gave 0.7 t with an average of 0.05 ± 0.3 t per seine.

3.9 Captured Fish species

In total, 17 Fish species have been inventoried in the *P.*

leonensis seines catches (table I). The most captured specimens of non-target Fish species by these gears are, respectively, *Oreochromis niloticus* (Linnaeus, 1758) (Cichlidae), (32.8%), *Tilapia zillii* (Gervais, 1848) (Cichlidae) (20%), *Distichodus rostratus* Günther 1864 (Distichodontidae) (14.9%) and *Hemichromis fasciatus* (Cichlidae) (8.2%), and *Chrysichthys nigrodigitatus* (Lacépède, 1803) (Claroteidae) (9.0%). These data show that *P. leonensis* seines are very substrings for *Tilapia zillii* and *Oreochromis niloticus* juveniles.

Table 1: Sizes and weights of non-target Fish species recorded in the catches of *P. leonensis* seines

Fish Species	Size and weight of captured specimens		P min (g)	P max (g)	N	%
	LS min (mm)	LS max (mm)				
<i>Alestes baremoze</i>	105	105	17	17	1	0,7
<i>Barbus macrops</i>	60	63	5	5	2	1,5
<i>Brycinus nurse</i>	100	108	31	39	4	3,0
<i>Chrysichthys nigrodigitatus</i>	25	130	2	38	12	9,0
<i>Distichodus rostratus</i>	47	90	2	16	20	14,9
<i>Distichodus rostratus</i>	108	134	25	53	2	1,5
<i>Hemichromis fasciatus</i>	45	115	3	49	11	8,2
<i>Heterotis niloticus</i>	148	165	42	67	5	3,7
<i>Marcusenius senegalensis</i>	130	280	34	242	4	3,0
<i>Mormyrops anguilloides</i>	240	240	95	95	1	0,7
<i>Oreochromis niloticus</i>	30	67	3	11	44	32,8
<i>Schilbe mandibularis</i>	53	53	-	-	1	0,7
<i>Tilapia zillii</i>	35	165	2	226	27	20,1
				Total	134	100

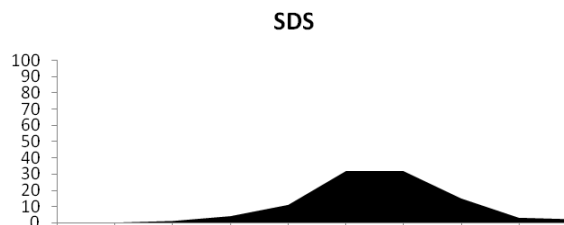
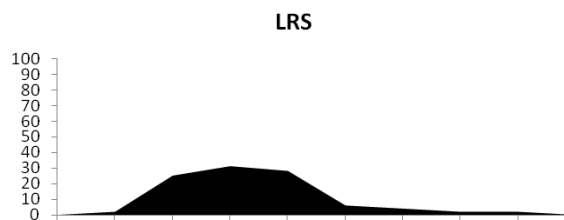
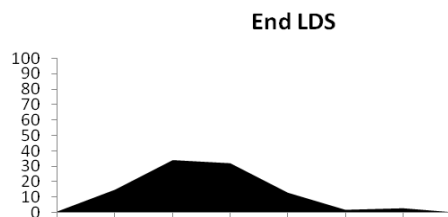
N : Specimen number

3.10 Morphometric characteristics

Throughout the monitoring period, captured *P. leonensis* individual weight was ranged from 0.26 g at 3.22 g, with an average of 0.81 ± 0.44 g. The length varies from 31.67 to 65.35 mm with an average of 43.38 ± 6.31 mm. Standard length varies from 23.00 to 55.50 mm with an average of $36,68 \pm 5.23$ mm. The body height was from 6.20 to 15.90 mm with an average of 9.32 ± 1.78 mm. The modal size of captured specimen frequency peak is observed at the class [32.84; 36.12 [, with 24% (Figure 2).

The sizes dynamics of *P. leonensis* specimens caught by small-scale fisheries by climate season shows two periods of occurrence of juveniles in exploited stocks. It is, mainly, at the end of the dry season [end LDS], from March to April (Figure 2), and during the small rainy season, September to October, where a fringe of juveniles (post-larvae) is observed. Periods from November to December (early LDS), from May to July (LRS) and August (SDS) appear to coincide with the period of vegetative growth of the species.

Proportion (%)



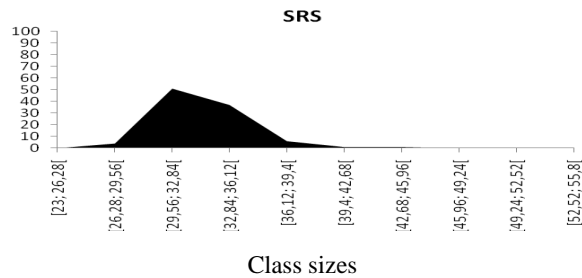


Fig 2: *P. leonensis* specimens sizes frequencies at different climatic periods LDS: Long Dry Season; LRS: Long Rainy Season; SDS: Small Dry Season; SRS: Small Rainy Season

3.11 First capture size

The minimum sizes recorded in the sampled specimens are, respectively, 30.80 mm, 28.10 mm, 31.45 mm, 23 mm and 28.10 mm SL. Across sampling campaigns, the first size capture is, therefore, 23 mm LS for a respective weight of 0.26 g.

3.12 Condition factor

P. leonensis condition factor ranges from 1.35 ± 0.17 during the small rainy season, to 1.72 ± 0.25 at the long rainy season. It takes values of 1.50 ± 0.14 in the big rainy season, and 1.49 ± 0.21 in the long dry season.

3.13 Socio-economic characteristics of *P. leonensis* fishery

3.13.1 Stakeholders

The entire sale process takes place at the moment of landing of the catches by crews. From production to consumption, we note the presence of intermediaries at the level of fresh and smoked Fish, notably: wholesalers, fishmongers and retailers. But, in *P. leonensis* fishery, the same stakeholders play these three roles in the fish marketing circuit. Fishmongers and wholesalers are, also, retailers.

Two categories of stakeholders are registered. These include women living in Taabo Village and men called cashiers using bikes or mopeds for locomotion from surrounding areas to Taabo village. The cashiers not natives of Taabo Village provide distribution of *P. Leonensis* in their villages and neighboring areas. The women are the largest and most active group because of the importance of the collected production. They have direct contact with the fishermen. Both actors, women and men, are not organized. In Taabo Village, 9 women were registered as permanent fishmongers. Most of them are Ivorian. Eight of the 9 recorded have been registered during our survey. Their ages ranged between 15 and 36 years.

3.13.2 Fish marketing

The rule is such that fishmongers have to pay in cash. *P. leonensis* is sold fresh or smoked. Fresh Fish specimens are sold at landing by fishmongers according to the supply and demand. A small basin named locally "GBAGBO" or "COCOTA", with a capacity of 26 kg is used as measure unit or tare (Figure 3). When *P. leonensis* is low, one gbagbo is sold from 3.4 to 4.1 USD, or 3.1 USD. When the offer is significant, the price may decrease to 2.1 USD. The half content of a gbagbo is generally sold between 1.2 and 2.8 USD according to the fishing season. Smoked fish is sold at the market by women in some metal bowl with a capacity of 2200 g, for 1.0 USD (500 F CFA) or in a small bunch for 0.2 USD

(Figure 3). Our survey shows, that *P. leonensis* takes, apart of the Taabo village local market, several destinations. Smoked *P. leonensis* is mainly distributed in several cities, notably, Hire, Divo, Tiassale, Toumodi, Abidjan and Yamoussoukro. The delivery to these locations is done by wholesalers (cashiers) who carry this Fish species in wood boxes fitted for this purpose. Purchased *P. leonensis* production is, then, transported, generally cycling and, sometimes, on a motorcycle. The fishermen are paid in nature according to two types of contracts between the owner of the fishing unit and the crew. When the seine is not amortized, fishermen receive half of the daily production (catches). Once, the Seine is amortized, the distribution of the daily production is one-third for the owner and two-thirds for the crew. It is the last mentioned option which is currently in force according to that all seines are old and amortized.

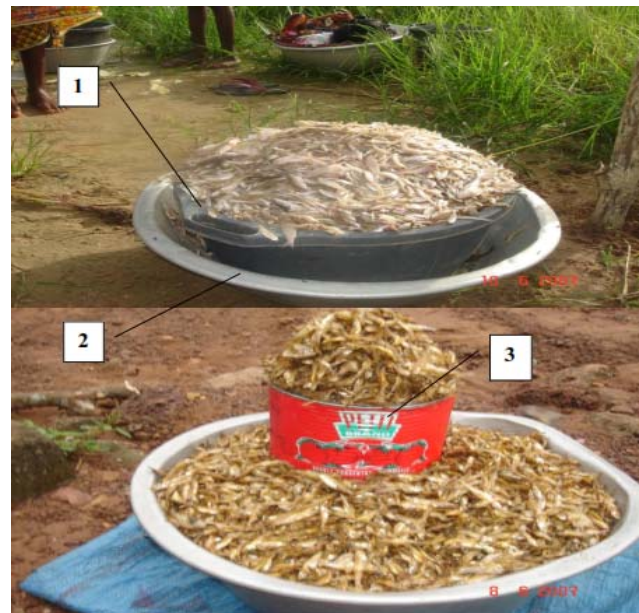


Fig 3: Measurement Units used by fishmongers for the purchase of *P. leonensis* landed by fishermen (1 and 2) and sale on the market (3) 1- Big gbagbo ; 2- Little gbagbo, 3- metallic bowl

3.13.3 Cost of seines and their maintenance

Our survey data showed, that seines manufacturing costs are around 681.4 to 817.6 USD for small seines, 953.8 to 1090.1 USD for medium size ones and 1226.3 to 1362.6 USD for a large ones. Repair or maintenance of the seine is the responsibility of the fishermen. They dry-clean or reinforce the damaged parts. Generally, this requires no few logistics. Just have a needle and thread to the corresponding net. Equipment for repairing canoes is composed of two cotton packs, half a liter (1/2) of moped mixed fuel, five (5) to six (6) pieces of tar and one to two packages of spark plug. The maintenance is done once per year. Tar or spark are used, indifferently, to plug the holes.

Operating expenses for a fishing unit of *P. leonensis* in Taabo during the first year are compiled in the table II. The mentioned value does not take into account compensation for fishermen, because they do not have a fixed salary. They are paid in nature according to their performance.

Table 2: Account of the owner of Mimie la go fishing unit: seine and canoe are not amortized or amortized

Designation	Case 1 : Fishing gears not amortized			Case 2 : Fishing gears amortized		
	Loads (USD)	Products	Total Amount (USD)	Loads (USD)	Products	Total Amount (USD)
Small equipment (knife, torch, batteries, light bulbs)	89,2	Sale	4054,0	89,2	Sale	4054,0
Seine maintenance	3,5			3,5		
Canoe maintenance	4,4			4,4		
Compensation for fishermen	2027,1			2702,7		
Depreciation	0,0			0,0		
* Canoe	34,2			0,0		
* Shore seines	171,1			0,0		
Total 1	2329,4	Total 2	4054,0	2799,7	Total 3	4054,0
		Income	1724,8		Income	1254,3

2.13.4. Financial profitability

P. leonensis fishing activity is quite lucrative for owners of fishing units regardless to the situation, notably, if fishing gears are depreciated or not (table II). The gross profit margin is 999.2 and 1373.9 USD respectively. The peculiarity of *P. leonensis* sale is, that the fishmongers are also retailers. The purchased fish undergoes pretreatment. It is dried and smoked before being sold. The activity of smoking requires a derisory material investment, since the ovens are made with recovered materials: old drums which are placed fences. To this, must be added a large plastic or aluminum bowl used for measurement and a large black plastic tarp for drying process. Thus, the fixed capital represents an average value which does not exceed 13.7 USD. Maintenance is negligible and is done by the replacement of fences. A fence cost 2.1 USD, and n ovens, to $n + 1$ screens. The problem arises at the level of the whole variable capital for smoking *P. leonensis*. It consists, mainly, of the necessary provision for the purchase of fish. Thus, for example, fishmongers must pay in cash at the jetty at the rate of 4.1 to 4.7 USD depending on the period.

The weight of the small bowl, commonly called "little gbagbo" is in average, of 26 kg. The collected *P. leonensis* requires for smoking the purchase of a pile of 4 to 5 wood pieces at the rate of 0.2 USD. The fishmongers need 0.5 USD to smoking an equivalent "Gbagbo" of *P. leonensis*. In Taabo Village, smokers pay no tax. *P. leonensis* production is not yet taken into account and monitored by Taabo Fisheries Administration. On the market, prices are function of supply and demand. But regardless to the period, a compilation of prices on the market indicates that the smoked fish is of a higher price than fresh fish.

The price of a quantity of smoked fish contained in a bowl, as shown above, varies from 0.2 USD to 0.7 USD. The contents of a vial of fresh and smoked fish gives, in average, 11 equivalent bowls sold at 7.5 USD. The profit margin is about 3.0 USD per bowl. This value is evaluated as follows: margin = $7.5 - 4.1 - 0.4 = 3.0$ USD per Bowl. Generally, fishmonger operates a purchase of *P. leonensis* landed in the morning (1 to 3 gbagbos) and another one for the night (1 to 3 gbagbos), making a total of 2 to 6 cups per day; which gives him the opportunity to increase, consequently, its profit margin.

4. Discussion

Our study reveals several points of interest, notably the exclusive commercial fishing of *P. leonensis* by autochthonous populations from Taabo village, the double landings regime of catches, e.g. daytime (7:20 AM – 8:30 AM) and nighttime (7:00 PM – 8:00 PM), and the non-conflictual cohabitation of this fishery with bozo-type.

P. leonensis fishermen are young and stakeholders (fishermen and fishmongers) work at each convenience. *P. leonensis*

commercial exploitation in Taabo Lake is nowhere else observed in lacustrine fisheries in Côte d'Ivoire. Our study should allow, highlighting the fishing practices in this reservoir and to use experiences from countries bordering Kivu, Tanganyika and Kariba Lakes [2, 9, 14, 15], for a better organization of this activity in Taabo lake.

Furthermore, bozo and *P. leonensis* fisheries in Taabo Lake are characterized by a pacific cohabitation. Fishermen of these both fisheries use alternatively, the bozo seining areas without any conflict. This may be explained by the fact that bozo fishery is, mainly, focused on the exploitation of large scale commercial Fish species (*Oreochromis niloticus*, *Tilapia zillii*, *Chrysichthys spp.*, *Labeo coubie*, *Lates niloticus*, etc.). So, the socialization of their fishing activities ensures a high exploitation level of *P. leonensis* in Taabo Lake. The estimated annual yield of this Fish species is 264.4 t/year; which value is higher than those recorded with bozo fishery (141 t/year) in the lake [15]. This indication shows the importance of *P. leonensis* fishery which is not taken into account in the national fishery statistics. But, the major problem is the use of small mesh size shore seines manufactured locally for *P. leonensis* fishing activity. Furthermore, shore seines are forbidden by the national fishery policy, because of their non-selective character [1, 7] and its small mesh size of the central pocket [21]. From our catches data, few specimens of large scale commercial Fish species mentioned above are captured by Mimie la go seines. This may be explained by the fact that Mimie la go shore seines are laid by crews around *P. leonensis* benches when they are detected on the water surface. This happen, generally, at around hundred meters from the shore. At this distance, the great depth of water in seining bays (5.4 ± 1.0 to 8.0 ± 1.0 m) (Groga *et al.*, 2012), does not allow the lower headline to lay down on the water bottom at the time of the encirclement of *P. leonensis* benches. What allows escaping the specimens of benthic, mesopelagic and vertical migration Fish species as Siluriformes, Cihlidae and other Fish species. Mainly, *P. leonensis* benches remain trapped. So, Mimie la go seines have a low destructive impact in other Fish species stocks. But, the use of very small mesh sizes seines (up to 3 mm mesh side in the central pocket) increases the fishing pressure on *P. leonensis* stocks. This loads reducing sizes of individuals in catches (31.67 ± 38 to 65.35 ± 38 mm) which are lower than the values observed by [10, 11] in Buyo Lake (36.5-71.5 mm LS), by Da Costa (pers. comm.) in Fae Lake (47-92 mm LS). This situation is critical when we consider that the maximum size indicated by [18, 22] for this Fish species, notably, from 60-80 mm to 120 mm. Furthermore, the almost captured Fish specimens are crystalline and transparent. What is characteristic of juveniles [21]. This means that *P. leonensis* adults and juveniles are both exploited by fishermen. This induce a critical situation for this Fish species. This situation

recommends a control of fishing effort in Taabo Lake. To remedy this situation, the change of mesh sizes ensuring a durable preservation and exploitation of *P. leonensis* stocks should allow the applicability of some specific policy for this fishery as advised by [16]. This would help saving *P. leonensis* stocks which is endangered in Taabo Lake.

With regard to socio-economic aspects, *P. leonensis* fishing activity is a lucrative. But, the absence of statistic data collection on this fishery by the departmental fishery office is a constraint.

The collected data from our study show that the owner of a fishing unit who does not practice himself fishing, and who is engaged in its own activities, has an annual income estimated ranging from 999.2 to 1373.9 USD. Fishermen, exempt from all expenses, are paid in nature at the rate of half or two-thirds of the daily production, depending on whether the equipment is depreciated or not. In this study, their annual average remuneration is between 1614.8 USD when equipment is not amortized and 2152.9 USD when equipment is depreciated. Concerning fishmongers, they take a better advantage of Mimie la go marketing activity. Their profit margin fluctuates between 90.0 to 539.6 USD month. As observed, this activity is a factor of enrichment for fishing communities of Taabo Lake and residents. It appears that, if this activity is well organized and, contrary, to the perceptions of fishermen, it should be a factor of enrichment of riparian populations. However, this requires the establishment of specific rules as recommended by [16]. This would facilitate the development of this type of fishery, as observed in the region of the Great Lakes in Central Africa [2, 9, 14].

5. Conclusion

The present work is a contribution for the study of the small pelagic fish *P. leonensis* fishery in Taabo Lake. As others manmade lakes in Cote d'Ivoire, this reservoir has a potential stocks of this Fish species, which is actually submitted to a high fishing pressure and for which, some measures should be taken for a rational and sustainable management. This fishery is a source of enrichment for the local communities. Taabo *P. leonensis* fishing model should be a starting point to disseminate this type of fishery on the set of manmade lake fisheries in Côte d'Ivoire (Kossou, Buyo, Fae, etc.), where this small pelagic Fish species is represented in major stocks. At least, as observed for coffee and cocoa producers, *P. leonensis* fishermen and stakeholders should be grouped into cooperative societies for a rational and efficient exploitation of this Fish species stock in Taabo Lake.

5.1 Acknowledgements

We address here our acknowledgements to the Committee for the Cooperation in Science and Technology [COMSTech] of the Organization of the Islamic Conference (Islamabad, Pakistan) and the International Foundation for Science [IFS] (Stockholm, Sweden), which funded this study through the project Challenge Program CGIAR/FIS-CNRA No. A/4007-1.

6. References

- Amagou S, Diallo A, Kouao DES. Pêcherie de Vridi, débarquement et commercialisation du poisson. Mémoire de C₁, Université Nationale de Côte d'Ivoire, Abidjan, Côte d'Ivoire, 1986-1987, 16.
- Baziramwabo T. La technologie après capture de l'Isambaza (*Limnothrissa miodon*) du lac Kivu et sa commercialisation. In Mubamba R. (Eds.): Papers presented at the symposium on biology, stock assessment and exploitation of small pelagic fish species in the African great lakes region. Bujumbura, Burundi, 25 to 28 November 1992. FAO, CIFA Occasional paper N° 19, 1993, 270.
- BNETD. Etude prospective pour la relance du secteur pêche et aquaculture en Côte d'Ivoire. Période 1990-2000. MIPARH/BNETD, Rapport Expertise, Volet bilan Diagnostic, 2004, 145.
- Da Costa KS, Traoré K, Tito de Morais L. Effort de pêche et production exploitée dans les petites retenues du Nord de la Côte d'Ivoire. *Bull.Franç.Pêche et Pisc.* 1998; 348:65-78.
- FAO. Informations sur l'aménagement des pêches dans la République de Côte d'Ivoire, Rome, FAO, 2004.
- FAO. Vue générale du secteur des pêches national : la République de Cote d'Ivoire. FAO, FID/CP/CIV janvier 2008, 43.
- Gerlotto F, Verdeaux F. La pêche artisanale en Afrique de l'Ouest : Evolution et impact socio-économique à travers l'exemple de la pêche en lagune Ebrié (Côte d'Ivoire). *Cent. Rech. Océanol.* 1978, 13.
- Groga N, Ouattara A, Da Costa KS, Dauta A, Beauchard O, Moreau J *et al.* Water quality and water-use conflicts in Lake Taabo (ivory coast). doi: 10.4236/oje. 2012.21005, 2012.
- Kiyuku A. Situation économique des pêcheries burundaises au cours des douze dernières années. In Marshall B.E and Mubamba R. (Eds.): Papers presented at the symposium on biology, stock assessment and exploitation of small pelagic fish species in the African great lakes region. Bujumbura, Burundi, 25 to 28 November 1992. CIFA Occasional paper N° 19, Rome, FAO 1993, 270.
- Kouamé KM. Alimentation du Clupeidae *Pellonula leonensis* (Günther, 1868) dans le lac de barrage de Buyo (Côte d'Ivoire). Mémoire de DEA, Université d'Abobo-Adjamé, 2004, 48.
- Kouamé KM, Ouattara A, Dietoa YM, Gourène G. Alimentation du Clupeidae *Pellonula leonensis* dans le lac de barrage de Buyo, Côte d'Ivoire. *Cybiuim* 2006; 30(2):145-150.
- Le Cren ED. The length-weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). *J Anim Ecol.* 1951; 20(2):2à1-219.
- Moreau J. Biologie évolution des peuplements de Cichlides (Piscès) introduits dans les lacs malgaches d'altitude. Thèse de doctorat d'Etat. Institut National Polytechnique de Toulouse, France, 1979, 301.
- Mubamba R. The biology and exploitation of small pelagic fishes in Zambia. In: Marshall B.E and Mubamba R. (Eds.): Papers presented at the symposium on biology, stock assessment and exploitation of small pelagic fish species in the African great lakes region. Bujumbura, Burundi, 25 to 28 November 1992. FAO, CIFA Occasional paper N° 19, 1993, 270.
- Mughanda M, Mutamba A. Thirteen years of exploitation of *Limnothrissa miodon* BLGR in Lake Kivu (Rwanda and Zaire). In: Marshall B.E and Mubamba R. (Eds.): Papers presented at the symposium on biology, stock assessment and exploitation of small pelagic fish species in the African great lakes region. Bujumbura, Burundi, 25 to 28 November 1992. FAO, CIFA Occasional paper 1993, N° 19, 270.
- Nugent CG. Assistance en matière de législation portant

- sur les pêches continentales. Rapport sur l'aménagement des pêches continentales. Côte d'Ivoire. Programme de Coopération Technique, FAO., Italie, Rome, TCP/IVC/4553, 1997, 86.
17. Paugy D, Lévêque C, Teugels GG. The fresh and brackish water fishes of West Africa. Volume I & II, Editions IRD, Paris, France, 2003, 458-816.
 18. Poll M. Synopsis et distribution géographique des Clupeidae d'eau douce africains, description de trois nouvelles espèces. Bull. Acad. R. Belg 1974; 60(2):141-161.
 19. Scherrer B. Biostatistique. Québec, Boucherville : Editions Gaëtan Morin, 1984, 850.
 20. Traoré K. Etat de connaissance sur les pêcheries continentales ivoiriennes. Rapport de consultation, Projet FAO TPC/IVC/4553, IDESSA, Bouaké, Côte d'Ivoire, 1996, 131.
 21. Vanga AF, Gourène G, Ouattara M. Impact de la pêche sur la disponibilité en poissons dans les régions des lacs d'Ayamé et de Buyo (Côte d'Ivoire). *Arch. Sc. Cent. Rech. Océanol.* Abidjan 2002; 2:1-12.
 22. Whitehead PJP. Clupeid fishes of the world. An annotated and illustrated catalogue of the herrings, sardines, sprats, anchovies and wolf-herring. Part I - Chirocentridae, Clupeidae and Pristigasteridae. FAO Species Catalogue 7. FAO Fish. Synop. 125 1986; 7(1):303.