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Typology of fishermen and fishing gears from the Solomougou Dam Lake (Korhogo, Côte d'Ivoire)

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Abstract

Waterbodies in northern Côte d'Ivoire are predominantly lakes created from dams. One of them, Lake Solomougou, with an area of 500 hectares, is the largest fishing spot around the city of Korhogo. The present work has been undertaken from October 2018 to September 2019 in order to study demographic structure of fishermen and types of fishing gears used in this fishery. A total of 46 fishermen were recorded during the study period. Among them, 95.65% were of Malian origin and the others were Ivorians. Their ages ranged from 13 to 61 years and 95.74% of them have not had formal education. Also, 45.45% of the fishermen exclusively used gillnets while 9% of them used gillnets in combination with other fishing gears. The other fishermen used traps, sparrow hawks, longlines, seine nets; bamboo trap the was used only by one fisherman. Proportions of traps (47.35%) and gillnets (44.86%) were the highest in this fishery in terms of numbers, while those for bamboo traps and seine nets were 0.31% and 1.25%, respectively. Gillnets used in the fishery had bar lengths ranging from 14 to 40 millimeters. However, according to current Ivorian legislation on the regulation of inland fisheries, 87.5% of them are not regulated in this fishery because they have bar length less than 35 centimeters.

Keywords: Fishermen, fishing environment, fishing gears, solomougou dam lake

Introduction

Waterbodies in northern Côte d'Ivoire are predominantly lakes created from dams. These hydro-systems have been created since the 1970s and their number is estimated today at 190 (Le Guen, 2002) [1]. Their construction has provided local populations with vast expanses of water with multiple uses. Originally built for crop irrigation and livestock rearing (Cecchi *et al*., 2007) [2], they are nowadays exploited for fishing purpose (Da Costa *et al*., 2004) [3].

In this region, as in other parts of the country, imported frozen fish constitutes the most important part of the available fishery products (FAO, 2008) [4]. However, catches from these dam lakes also play a complementary role in population feeding. These catches, sometimes, represent the main protein source for local populations for which imported frozen fish is still not accessible. Consequently, monitoring of fishing on all these dam lakes needs to be increased in order to ensure continuous catches for local community's benefit.

Korhogo department is located in the north of the country. It includes the city of Korhogo and sixteen surrounding localities (INS, 2015) [5]. Solomougou Dam Lake, the fifth largest dam lake in the north areas, is also located in this department (Traoré, 1996) [6]. Catches from this fishery are sources of animal protein and supply many surrounding localities and especially the city of Korhogo. Authorities responsible for fishing monitoring in this fishery report the practice of this activity throughout the year. Unfortunately, very little data is available from this fishery. In the absence of good management policy, fishing could lead to a state of overexploitation of existing stocks. So, the evaluation of fishing activity on the Solomougou Dam Lake with the objective to set up a rational management plan is important in order to perpetuate catches in this fishery. This requires better knowledge of fishing environment, types of fishing gears used and biological parameters of species caught. The present work constitutes the first part of fishing activity assessment in this fishery. It has the objective to study the demographic structure of fishermen and types of fishing gears used.

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Materials and Methods
Study area
Solomougou Dam Lake is located in northern Côte d'Ivoire, precisely in the department of Korhogo (Fig 1). This reservoir, built in 1973, was originally used for agricultural purposes (Traoré, 1996) [6]. Its watershed is located between the meridians 5°30' and 6° W and the parallels 9° and 9°30' N (ORSTOM, 1962) [7]. It covers 250 square kilometers of

watershed and a maximum area of 500 hectares of water. The maximum depth of the lake's minor bed is 10 meters (Traoré, 1996) [6]. Climate of the study area is characterized by two distinct seasons. The dry season covers the period from November to April and the rainy one from May to October, during which rainfall is abundant and frequent especially from July to September (Brou, 2005) [8].
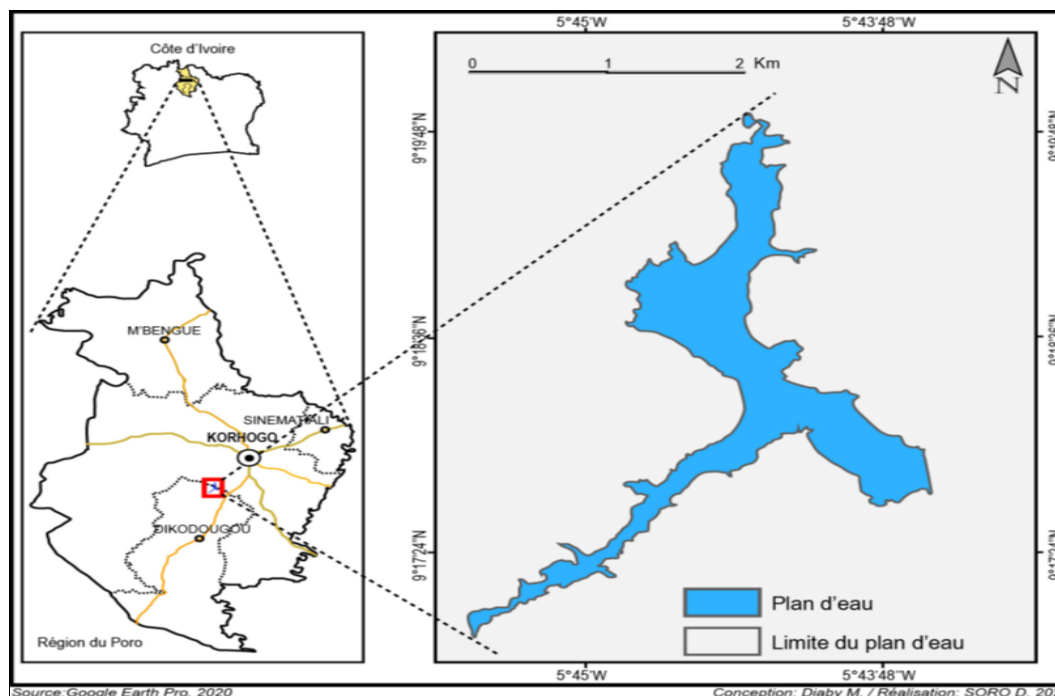

Fig 1: Location of the Solomougou Dam Lake in northern Côte d'Ivoire

Data collection and processing
This study was conducted from October 2018 to September 2019. Field samplings were conducted twice a week during each month. Two types of data were collected. It consisted, on the one hand, of collecting direct observations by meeting fishermen and completing questionnaire with requested information and, on the other hand, of observing fishing practice. Direct observations consisted of identifying and counting all the fishermen frequenting the lake the day of sampling. They were then interviewed directly. Questionnaires we used provided information on their age, nationality, educational level and possibly alternative livelihoods. Types of fishing gears they were using have also been identified and characterized. On fishing nets, measures taken were total length and depth in meters and gillnet's bar length in millimeters. These interviews were supplemented by their observation in the practice of fishing in order to verify the information collected during the interview phase. Data collected has been compiled and processed with excel software to obtain tables and figures.

Results
Number of fishermen and fishing units
On the Solomougou Dam Lake, 46 fishermen were registered in this study including 26 fishermen working individually and 7 teams of 20 fishermen in total. This represents a total of 33 fishing units, fishing unit representing individual fisherman or fishermen in association operating one fishing gear. These 7 teams include 2 teams of 2 fishermen each, 4 of 3 fishermen

each and 1 of 4 fishermen. Teams of 3 and 4 fishermen generally used the seine net, a fishing gear that requires several fishermen to operate. Those with 2 fishermen used a combination of bamboo traps and sparrow hawks.

Fishermen's demographic profile
The study of fishermen's sociological profile indicated that 95.65% of them operating on Solomougou Dam are of Malian origin, while the others are Ivorians. However, this fishing activity remains exclusively practiced by men. Their ages range from 13 to 61 years old. Finally, concerning their educational level, 95.74% of them have not been to school (Table 1). With regard to their activities outside fishing, two groups of fishermen are to be noted. Majority of them (44 out of 46 registered) do not have alternative livelihoods, only two practice trading and butchering in addition to the fishing.

Table 1: Distribution of fishermen by nationality, age and educational level

Characteristics of fishermen		Number of fishermen	Frequencies (%)
Nationality	Ivoirians	2	4.35
	Malians	44	95.65
Age group	10 - 20	3	6.52
	20 - 30	12	26.09
	30 - 40	16	34.78
	40 - 50	14	30.43
	> 50	1	2.17
Educational level	No	44	95.65
	Primary	2	4.35
	Secondary	0	0.00

Characteristics of types of fishing gears

Six fishing gear types have been identified in the fishery during the study period. These were Sparrow hawk, longline, trap, bamboo trap, seine net and gillnet. Figure 2 shows pictures of some of them. Descriptively, they do not differ significantly from current models in literature.

Sparrow hawks

The constituent net of these fishing gears is in monofilament (nylon) with bar length of 20 to 60 millimeters. Their opening diameters vary from 3 to 5 meters (Fig 2a).

Longlines

The main line of longlines is 300 to 500 meters long, on which are attached hooks spaced generally 10 centimeters apart. Each longline is therefore equipped with at least 3000 hooks (Fig 2b).

Traps

Traps are mostly made by weaving liana. Their average height is 1 meter with an opening of 20 to 30 centimeters in diameter in the upper part (Fig 2c).

Bamboo traps

Bamboo traps are made up of 1 meter long hollowed china bamboo pieces with a minimum diameter of 10 centimeters. They are mounted on a 500 meters long rope which often crosses the lake (Fig 2d).

Seine nets

Seine nets are classic models. However, all of the seines had nets with bar length of 16 millimeters, their total lengths ranging from 500 to 800 meters.

Gillnets

Gillnets with bar length from 14 to 40 millimeters are used by fishermen (Table 2). The most used have 30 millimeters (31.94%) followed by 20 millimeters ones (22.93%). These two categories represent together 54.87% of gillnets used. Another classification indicates that gillnets with bar length smaller than 20 millimeters represent only 22.91% against 32.64% for those having meshes between 20 and 30 millimeters. In addition, lengths of gillnets used vary between 50 and 200 meters with depth from 1 to 2 meters. However, the most used gillnets have lengths greater than 100 meters. Finally, the great majority of fishermen (67.36%) use gillnets with height between 1.10 and 1.50 meters.
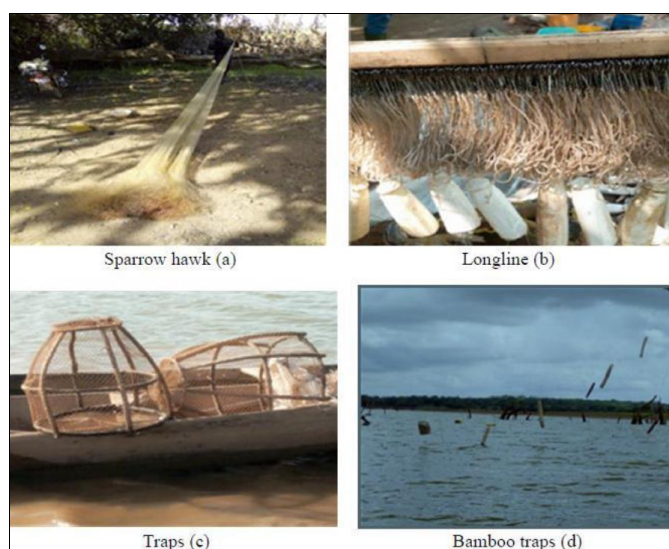

Fig 2: Pictures of types of fishing gears from Solomougou Dam Lake

Table 2: Distribution of gillnets used by bar length, length and height

Gillnet's Characteristics		Number	Frequencies (%)
Bar length	14mm	5	3.47
	16mm	12	8.33
	18mm	16	11.11
	20mm	33	22.93
	25mm	14	9.72
	30mm	46	31.94
	40mm	18	12.50
	Total	144	100
Length	50 – 100 m	47	32.64
	101 – 150 m	58	40.28
	151 – 200 m	39	27.08
	Total	144	100
Height	1,00 m	11	07.64
	1,10 – 1,50 m	97	67.36
	1,60 – 2,00 m	36	25.00
	Total	144	100.00

Proportions of fishing gear types registered

A total of 321 fishing gears, used by fishermen, have been enumerated during the study period. In terms of relative proportions, traps (47.35%) and gillnets (44.86%) are dominant ones in the fishery representing over 90% of fishing gears deployed. The least used is the bamboo traps, preceded by the seine nets with respective proportions of 0.31% and 1.25% (Fig 3).
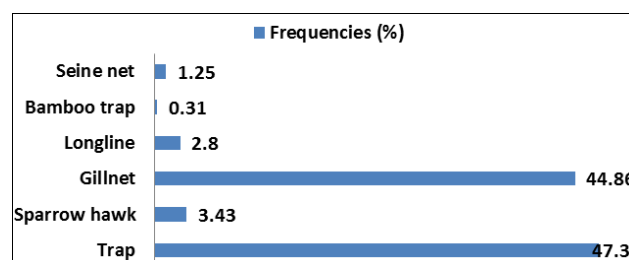

Fig 3: Relative proportions of fishing gear types

Proportions of fishing gear types per fishing unit
As it was explained above, 46 fishermen have been registered including 26 fishermen working individually and 7 teams of 20 fishermen, which represents a total of 33 fishing units. Figure 4 shows that only 15.15% of the fishing units operating on the Solomougou Dam use more than one fishing gear type. In any event, gillnets remain the most widely used by fishing units. In fact, 45.45% of them used it exclusively while the other 9.09% use it in association with other fishing gears. So, in the altogether, more than 50% of the fishing units use this fishing gear. The other ones are less used, the bamboo traps being used only by one fisherman.
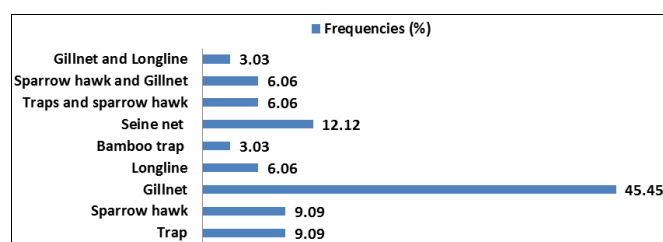

Fig 4: Proportions of fishing gear types per fishing unit

Discussion
On the Solomougou Dam Lake, 95.65% of fishermen are of Malian origin. This strong presence of foreign fishermen of Malian origin has also been noted on small dam lakes of northern Côte d'Ivoire (Da costa *et al*., 2004) [3]. These fishermen are mainly Bozos, a Mandingo population from West Africa living mainly in Niger and Mali along the Niger River, for whom fishing has always been a traditional activity (Bagayoko *et al*., 2017) [9]. Thus, the transmission of this know-how over generations could be related to the low educational level in their community, 89.19% of these Malian fishermen registered in Solomougou's fishery have not been to school. In their exploration of fishing sites, the under-exploitation of hydro-systems in northern Côte d'Ivoire becomes an opportunity for them. As for the low representation of Ivorians among these fishermen, this reality could be explained by the fact that the indigenous populations, represented mainly by the Senoufo and secondarily by the Dioula, do not practice fishing. In fact, the first ones are mainly farmers, using these dam lakes for crop irrigation, while the latter are more engaged in trade and transportation activities (Sinaly, 1978) [10].

Six fishing gear types were used by fishermen, namely trap, Sparrow hawk, gillnet, longline, bamboo trap and seine net. With the exception of bamboo trap, the same fishing gears had already been reported on small dams lakes in northern Côte d'Ivoire (Da costa *et al*., 2004) [3]. This diversity is an indicator of specialization of some fishermen in the use of a given fishing gear type. Indeed, our results indicate that 84.85% of fishing units use only one fishing gear type. In addition, this diversity can also be related to the categories of species sought. As an example, Traoré (1996) [6] mentioned in his report on the state of knowledge of the Ivorian inland fisheries that longlines mainly catch benthic fish and are therefore complementary to gillnets. As for traps, they mainly catch *Chrysichthys*, together with predators attracted by other fish and to a little extent tilapia. Sparrow hawks catch particularly *Heterotis niloticus* while bamboo traps are very selective with females of *Chrysichthys*. Legendre and Lévêque (2006) [11] noted for this purpose that, in Ivorian lagoons, hollow bamboos of one meter length are generally used for the capture of *Chrysichthys* seeking cavities to spawn.

In terms of relative abundance of fishing gear types, gillnets are the most used. Results indicate that 45.45% of fishing units use only this fishing gear while 9.09% use it in combination with other fishing gears. In sum, 54.54% of fishing units use it on the lake. Several reasons could explain this preference for gillnets. These nets are not expensive and the method for their assembly is relatively simple. The net is mounted on ropes with floats on the surface and sinkers below. Also, these fishing gears do not require bait to catch fish as it is often the case with traps and longlines. In addition, their use requires practically no physical effort to deploy contrary to sparrow hawks and seine nets. Also, taking into account the ratio of floats and sinker's weight, these nets can be used in pelagic or benthic areas, thus capturing surface and bottom fish. Gillnets could have great nuisance in fisheries. Attingli *et al*. (2017) [12] noted that these fishing gears have more destructive force on fish stocks because they can catch species of all sizes and of all critical maturity stages. This can be harmful for stock renewal. Current Ivorian legislation on the regulation of inland fisheries limits the exclusive use of 6 fishing gear types, including fishing lines, traps, longlines, sparrow hawks, seine nets and gillnets. But for gillnets, the legislation prohibits the use of nets with bar length less than 35 centimeters (Anonymous 1984) [13]. These fishing gear types are the same used by fishermen on the Solmougou Dam Lake. However, 87.5% of gillnets are not regulated in this fishery because they have bar length less than 35 centimeters. This probably reflects a lack of checks carried out by competent authorities on the great majority of fisheries in the north since political crisis of 2002 (YAO *et al*., 2013) [14].

Concerning the other fishing gear types, Ahouansou Montcho (2011) [15] observed that traps and sparrow hawks have a mean nuisance force. As for longlines, they have a low nuisance, not because they do not catch specimens at critical maturity stages or small species, but because their catches composition are very little variable. Considering gillnet's risk of nuisance on fish stocks and the high rate of representativity of this fishing gear (44.86% of fishing gear types used on Solomougou Dam), supervisors of fishing activities should therefore regulate its use in this fishery to ensure the balance of the ecosystem. Small fish are generally the first targets of fishermen when the catch level of large specimens becomes lower.

Conclusion
The Solomougou Dam Lake is nowadays exploited for fishing purpose throughout the year. Most of fishermen are of Malian origin (95.65%) with ages ranged from 13 to 61 years and 95.74% of them have not received formal education. Six fishing gears are used by fishermen including gillnets, traps, sparrow hawks, longlines, seine nets and bamboo trap. Proportions of traps (47.35%) and gillnets (44.86%) were the highest in terms of numbers. Gillnets used had bar lengths ranging from 14 to 40 millimeters. However, according to current Ivorian legislation on the regulation of inland fisheries, 87.5% of them are not regulated because they have bar length less than 35 centimeters.

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