



ASSESSMENT OF COMMERCIAL FISH CATCHES IN AGHIEN LAGOON (WEST AFRICA, CÔTE D'IVOIRE)

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ABSTRACT

Gears fishing effort, catch per unit effort and fish productions were investigated in Ebrie lagoon (Aghien sector) from March 2020 to April 2021. Samplings were carried out by mean of artisanal commercial fisheries. Six type of fishing gears namely gillnets, cast nets, bamboo traps, traps, hooks and beach seines were used throughout the lagoon. The highest values of fishing effort were recorded with gillnets and traps whereas the lowest values were recorded with hooks and bamboo traps. About 39% of total catches were recorded with gillnets followed by traps with 18% whereas the lowest CPUE were recorded with hooks, and beach seine with 4% and 12% respectively. The most important value of production was recorded with gillnets (63.678 tons / 52.28%) followed by bamboo traps (19.375 tons / 15.90%) whereas the lowest value of production was recorded with hooks (6.219 tons / 5.10%).

Keywords: Artisanal fisheries, Fishing gears effort, CPUE, Fish production, Aghien lagoon.

INTRODUCTION

Coastal lagoons are among the most productive ecosystems in the world (Knoppers, 1994; Duck and da Silva, 2012), sustaining important environmental services such as fisheries (Cañedo-Argüelles *et al.*, 2012). Their importance for biodiversity conservation has been recognized extensively (Isacch, 2008; Soutullo *et al.*, 2010). Pauly & Christensen, (1995) asserted that coastal waters enriched by continental runoff and diverse oceanographic processes are responsible for nearly 10% of world fisheries landings. In fact there are overall, more productive than over ecosystem in term of fisheries yield, due to generally high primary production (Nixon, 1982). The national production remains largely dominated by artisanal fisheries and characterized by a downward trend that began around 2000 and which seem continuing for a long time. Over the period 2000-2010, Ebrie lagoon (Aghien sector) in which the main actors are foreign fishermen, the landings steadily decreased dropping from 81.523 to 40.791 tons i.e a reduction of 50% (Bedia, 2015). The lagoon fisheries are multi-specific and multi-gear and difficult to monitor but in view of the urgency, it is necessary to determine some

production parameters in order to manage the lagoon resources. Thus the present study aims to determine the fishing effort, the catch per unit effort and the fish production at Akoyaté Aghien lagoon).

MATERIAL AND METHODS

Study area

The Ebrie Lagoon system with an area of 566 km², extends in the east on 125 km along the littoral of Côte d'Ivoire. It comprises the Ebrié Lagoon itself (523 km²) and the Aghien-Potou lagoon system (43 km²). Located between 5°15'- 5°27' N and 3°43'-3°56' W (Tastet & Guiral, 1994) (Figure 1), the Aghien-Potou lagoon system extends on 72 km from perimeter and 32 km length from the median axis (Guiral & Chantraine, 1994) (Figure 1). In Potou lagoon, the influence of the intrusion salt works is sensitive in dry season (from January to May), while remaining moderate (< 9), and the water being soft from May to December (Guiral & Chantraine, 1994). The climate of the study zone is an equatorial type characterized by four seasons

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including one high dry season from December to March, a high rainy season from April to July, a small dry season from August to September and a small rainy season from October to November. It is a zone where interannual precipitations rank above 1500 mm. This zone contains a significant hydrographic network, composed of the Bete, Djibi and Me rivers. The Bete and Djibi rivers emerge directly in the Aghien Lagoon whereas me river emerges in the natural channel connecting the Aghien lagoon to the lagoon Potou (Traoré *et al.*, 2012). The Potou Lagoon is characterized by low depths (< 3 m). The most significant depths are recorded on the level of the channels connecting the Aghien lagoons and Potou (5 to 7 m) on the one hand and the Potou sector (7 m) with the remainder of the Ebrie Lagoon on the second hand (N'Guessan *et al.*, 2009).

Data collection and analysis

Data collected from April 2020 to march 2021 involved three major research activities. i) survey designed to obtain information on the active fishing units to assess the fishing potential, ii) survey designed to obtain information on landings and iii) survey designed to get information on fishermen activities conducted on 30 fishing units fixed in advance in Akoyaté sector. The second step concerned survey of daily catches during four days per month per station and per gear type. Total catch of each fisherman and per gear type was weighed. Fish species composition, weight and / or number of individuals per specie were noted. Species were identified according to (Paugy *et al.*, 2003). For each landing, all the catch or 30 individuals when the catch exceeded 10 kg chosen randomly were weighed to the nearest gram.

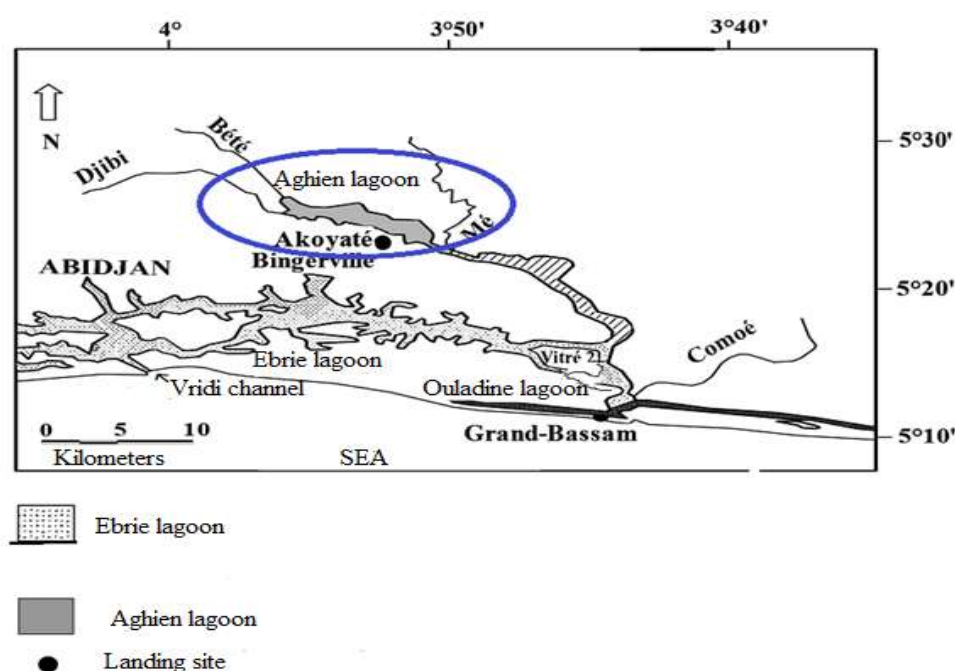


Figure 1. Map of Ebrie lagoon showing sampling zone (Aghien Sector).

Independently daily activity surveys were conducted on 30 fishing unit fixed in advance in the Akoyaté sector. It was carried out every day for two years preferably in the evenings. This survey consisted of obtaining information from fishermen about their fishing location, the type of fishing gear used, the number per category and the mesh size of gears. This survey also gives the number of trip per fishing unit as well as the causes of any absence of activity. The aim of the activity survey is to arrive at a better estimate of the fishing effort. Daily statistics production was also recorded during 15 days per month.

Data analysis

The fishing effort unit considered in the present study is the number of fishing trip (action of lifting at least one fishing gear). It is also the period that elapses between the moment

the boat and its crew set sail and their return to the landing stage. For the six types of fishing gears (gillnets, beach seines, cast nets, pots, bamboo traps and hooks) the number of trips per month was given by the formula below:

$$nt = p \times j$$

With nt = number of trip; P = Fishing unit number by a gear type and j= number of days surveyed in the month

The utilization rate (UR) of gears is the ratio of the number of actual fishing trip per gear during the survey period to the total number of potential trip per gear during the survey period. This utilization rate is given by the following formula :

$$UR = nft / npt$$

nft = number of actual fishing trip by gear during the survey period, npt = total number of potential trip per gear during the survey period. The activity rate (A) is the average number of fishing trip made per month and per fishing unit. (A) is obtain by the following formula :

$$A = UR \times J$$

J : number of fishing days in a given month; AR: utilization rate

Capture per unit effort (CPUE)

The capture per unit effort (CPUE) is the catch of individuals of fish by weight or number related to the defined unit of fishing effort. It is the average quantity of fish caught per unit effort of each type of gear surveyed. CPUE is given by the following formula (Kantoussan, 2007).

$$CPUE (kg/Fx) = CTm / Em$$

CTm = Average total capture of sampled item, Em = Average fishing effort sampled for each gear type.

Total production and yield of exploited species

Total production

The monthly production (Pm) of a sector is equal to the product of the average monthly catch per trip and monthly fishing effort (Kantoussan *et al.*, 2009):

$$pm = CPUEm \times Fm$$

The annual production (Pan) of our study is the sum of monthly catches of the sector. It is corresponding to the following formula:

$$Pan = \sum Pm$$

Yield per gear type

The yields of the gears were estimated dividing the total catches of a given gear i by the total catches of all the gears* 100

$$Ygi = TCgi / Tcgrs * 100$$

With Ygi : The yield of a given gear i ; TCgi : Total catches of the gear i ; Tcgrs : total catches of all the gears.

RESULTS AND DISCUSSION

In Akoyaté sector (Aghien lagoon) six types of fishing gears are used by fishermen (Table I). These are traps, bamboo traps, gillnets, beach seines and cast nets. Gillnets are the most used gears in this sector. A fisherman carrying out only fishing activity, owns on average 03 hooks, 209 traps, 239 bamboo traps, 47 gillnets and 03 cast nets whereas fishermen carrying out fishery activity and related activities has on average 01 hook, 188 traps, 462 bamboo traps, 10 gillnets and 01 cast net. In the sector, the beach seine is a collective property of professional and occasional fishermen. The bamboo traps appear to be the dominant (number) fishing gear throughout the sector. The seasonal variation of fishing gears rates in Akoyaté sector are illustrated in (Figure 2). In Akoyaté sector, the fishing gears utilization rates recorded per year were 31%, 24%, 13%, 13%, 11% and 08% for gillnets, traps, bamboo traps, cast nets, hooks and beach seines respectively. During the rainy season, the utilization rates of various gears were 34%, 30%, 22%, 7%, 7% and 0%. During the dry season, the gears utilization rates were 29%, 22%, 16%, 13%, 11% and 9% for gillnets, traps, gillnets, hooks, beach seines and bamboo traps.

Table 1. Inventory of fishing gears used by fishermen in Akoyaté sector (Aghien lagoon, Côte d'Ivoire) from april 2020 to march 2021.

Professional fishermen					Occasional fishermen		
Sector	Fishing gears	gears number	Number of gears users	Mean gear number per fisherman	gears number	Number of gears users	Mean gear number per fisherman
Akoyaté (Aghien lagoon)	Hooks	98	30	3 ± 2	203	207	1 ± 1
	traps	5871	28	209 ± 55	38306	204	188 ± 39
	Bamboo traps	2152	9	239 ± 52	97896	212	462 ± 12
	Gillnets	4123	88	47 ± 12	2575	258	10 ± 4
	Beach seines	1	Collective fishing gear	Collective fishing gear	0	Collective fishing gear	Collective fishing gear
	Cast nets	29	9	3 ± 2	18	23	1 ± 1

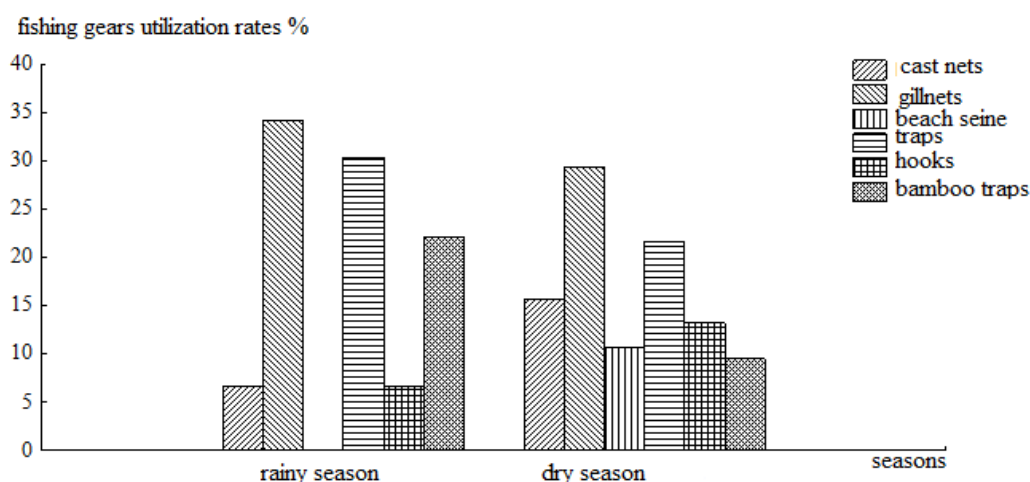


Figure 2. Seasonal variation of gears utilization rates in Akoyaté (Aghien lagoon, Côte d'Ivoire) from april 2020 to march 2021.

The monthly fishing effort recorded with the six types fishing gears are shown in figure 3. The highest fishing effort (559 trips) was recorded in December followed by March (554), april and may (with gillnets whereas, the lowest value of effort (0 trip) was obtained in october-november. With bamboo traps, an effort value of 0 trips was recorded from March to december. The total fishing effort values recorded by gear type in Akoyaté (aghien

lagoon) were summarized in table II. Values recorded were 4817 (41.5%), 1456(12.5%), 1697 (14.5%), 1714 (14.8%), 980 (8.5%) and 919 (8%) trip/percentage with gillnets, cast nets beach seine, traps, hooks, and bamboo traps respectively. The mean monthly fishing trip number recorded was 965.25 ± 29 . The fishermen density at Akoyaté lagoon was estimated at 13/ km².

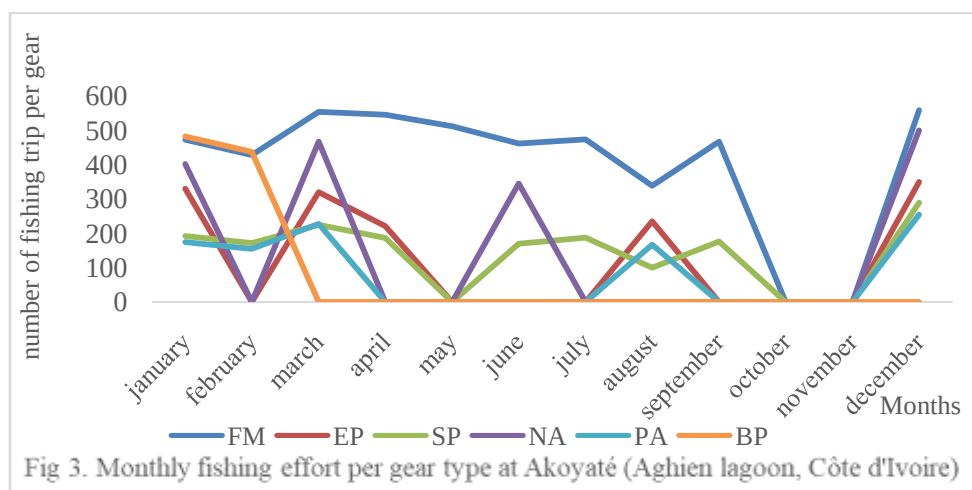


Fig 3. Monthly fishing effort per gear type at Akoyaté (Aghien lagoon, Côte d'Ivoire)

Figure 3. Monthly fishing effort per gear type at Akoyate.

Table 2. Global effort of the six fishing gears types used in Akoyaté (Aghien lagoon, Côte d'Ivoire) during the sampling period from march 2019 to april 2020. FM : gillnets ; NA : traps ; EP : cast nets ; SP : beach seine ; BP : bamboo traps ; PA : Hooks.

	FM	EP	SP	NA	PA	BP
Fishing effort /gear/year	4817	1456	1697	1714	980	919
Total fishing effort (%) /gear/year	41.5	12.5	14.5	14.8	8.5	8
Gears total effort (trip)	11583					
Mean monthly fishing trip	965.25±29					
Fishermen density/ km ²	13					

At Akoyaté, the annual CPUE recorded by gear type are summarized in (Figure 4). CPUE recorded are 133kg/trip, 62 kg/trip, 54 kg/trip, 43 kg/trip, 41 kg/trip and 15 kg/trip for gillnets, traps, cast nets, beach seines, bamboo traps, and hooks respectively. The average monthly CPUE per gear type were 11 ± 9 kg/trip, 5 ± 3 kg/trip, 4 ± 2 kg/trip, 4 ± 2 kg/trip, 3 ± 2 kg/trip and 1 ± 1 kg/trip for gillnets, traps, cast nets, beach seines, bamboo traps and hooks respectively. Catches per unit effort were lower with hooks

at Akoyaté. About 39% of the total catches were obtained with gillnets. Thus gillnets were the most used gears followed by traps and cast nets. The monthly CPUE of overall the gears was 29 ± 4 kg/trip. The temporal variations of CPUE of fishes at Akoyaté showed a significant differences (Kruskall-wallis test: $p < 0.05$). Monthly CPUE during the long rainy season (3.58 ± 1.25 kg/trip) were lower than the values of the long dry season (25.58 ± 3.25 kg/trip).

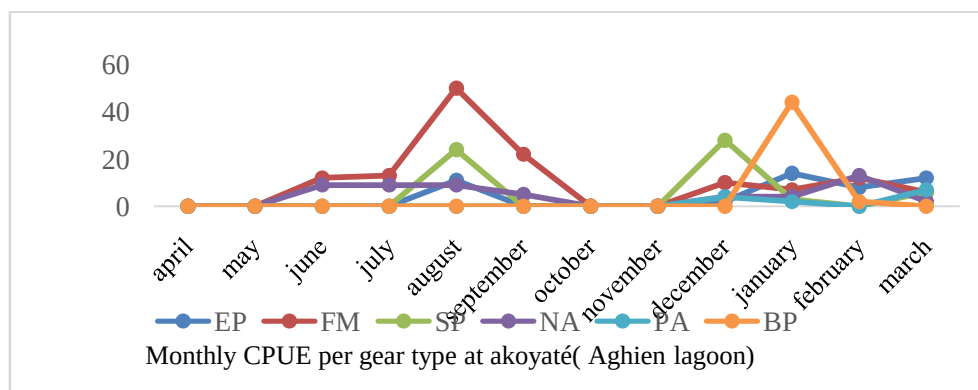


Figure 4. Monthly CPUE per gear type at Akoyaté.

Table 3. CPUE of the six fishing gears types used in Akoyaté sector (Aghien lagoon, Côte d'Ivoire) during the sampling period from march 2019 to april 2020. FM : gillnets ; NA : traps ; EP : cast nets ; SP : beach seine ; BP : bamboo traps ; PA : Hooks ; LRS : long rainy season ; LDS : Long dry season.

	FM	NA	EP	SP	BP	PA
CPUE/gear/year	133	62	54	43	41	15
Monthly CPUE average /gear	11 ± 9	5 ± 3	4 ± 2	4 ± 2	3 ± 2	1 ± 1
Monthly CPUE	29.16 ± 4					
Monthly CPUE (LRS) kg/trip	3.58 ± 1.25					
Monthly CPUE (LDS) kg/trip	25.58 ± 3.25					
CPUE (%) / gear	39	18	15	12	12	4

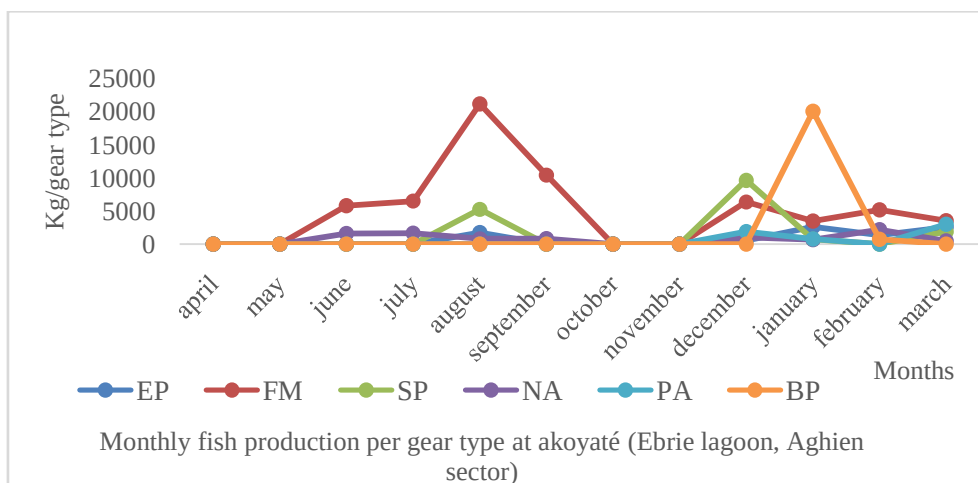


Figure 5. Monthly fish production per gear type at akoyaté.

Table 4. Fish production of fishing gear types used in Akoyaté sector (Aghien lagoon, Côte d'Ivoire) during the sampling period from march 2019 to april 2020 : FM : gillnets ; NA : traps ; EP : cast nets ; SP : beach seine ; BP : bamboo traps ; PA : Hooks ; LDS : long dry season ; LRS : long rainy season.

	FM	NA	EP	SP	BP	PA
Annual production /gear (tons)	63.678	10.173	10.002	12.332	19.375	6.219
Production (%) / gear type	52.28	8.35	8.21	10.12	15.90	5.10
Total production (tons)			121.779			
LDS production (tons / %)			31.80 / 35.25%			
LRS production (tons / %)			21.07 / 26.65%			
Production/ unit area/year kg/ha/year			55			

The lagoon monthly fish production per gear type (Figure 5) showed highest values for gillnets (around 21 tons) in august, followed by bamboo traps (20 tons) in January. The lowest fish productions values were recorded in october and november with overall the gears (0 ton). Table 4 shows the annual fish production at Akoyaté. The fish production was estimated at 121.779 tons. The highest value of production (31.80 tons/ 35.25% was recorded during the long dry season whereas the lowest value (24.07 tons /26.68%) was obtained during the long rainy season. The most important value of production was recorded with gillnets (63.678 tons / 52.28%) followed by bamboo traps (19.375 tons / 15.90%) whereas the lowest value of production was recorded with hooks (6.219 tons /5.10%).

Gillnets are among the most widely used fishing gear in the study maybe due to its simplicity, high operability and catch efficiency. Moreover, owning a gillnet is for a young fisherman a mean of belonging to his community and above all a way of asserting himself. The gillnet has been identified in many studies as the most commonly used fishing gear (FAO, 1991 ; Coulibaly, 2018). According to the temporal variation of fishing gear utilization rate, more gears were used during the dry season in comparison with the rainy season. The observation can be explain by the fact that some fishing gears are not often use during the rainy season due probably to some problems on fishing activities. However, during the dry season, the use of fishing gear is more almost free from any disturbance on fishing operations. In the present study, the common fishing effort unit valid for all the gears is the fishing trip because it takes into account both changes in fishing technicals and improvements in the estimation of effort defining a unit effort proportionally. The mean monthly fishing effort estimates (965.25 ± 29) trip is higher at Akoyaté and could be justified both by the free access of fisherman to resource and the intensity of fishing activity and the large number of occasional fishermen often ivoirien. A fishing effort value with gears, less than the one obtained in the present study was noted by Coulibaly *et al.*, (2018) in Grand-Lahou lagoon exploited by artisanal fisheries. Thus the measurement of fishing effort has always been fundamental part of fisheries science (Taylor, 1985). Fishing effort is a amount of fishing gear of a specific type used on the fishing ground over a given unit of time spend to fish (e.g

hours trawled, number of tablecloths, number of hooks) (FAO, 1997). The fishermen density value (13 fishermen/km²) recorded in the present study is higher than the standard value defined by Ecoutin *et al.*, (1994) which is 9 fishermen/km² in Aby lagoon. Such a density of fishermen in Aghien lagoon at Akoyaté could suggest a very high fishing pressure on the resource. Regarding the monthly catch per unit effort (CPUE) the value of 29.16 ± 4 kg/trip recorded at akoyaté was very lower than 132.6 kg /trip obtained in Potou lagoon by Bédia (2015). In this case, fishing pressure seems to be the main cause of the decrease in CPUE value. Such results were observed by differents studies (Jenning & Blanchard, 2004). Spatial and temporal variations in CPUE in Aghien lagoon (Akoyaté sector) can be explained first by the variations due to changes in the physical environment corresponding to the seasonal cycle and variations linked to the species biology. Overall CPUE are lower during the long rainy season than the long dry season. In fact, during the long rainy season, fishes are dispersed in the water column and then become less accessible and vulnerable to fishing gears which reduces the catch per unit effort. However, during the long dry season, the water recedes and then decreases the dispersal of fishes making them more vulnerable to fishing gears and thus inceases CPUE. In comparison with other similar studies Akoyate is among the zone with lowest production per unit area 55kg/ha/year. This value is below the reference value of 113 kg/ha/year (Laë *et al.*, 1994). According to the authors, out of 107 coastal lagoons with differents exploitation levels have an average of 113 kg/ha/year was recorded. Akoyate value remains very low.

CONCLUSION

Six gear types gillnets, cast nets, traps, bamboo traps, beach seines and hooks were used in the sector during the fishing activities. Gillnets perform best with the highest values of CPUE and fish production. The CPUE values recorded during the dry season were higher than those of the rainy season.

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