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Socio Economic Characterization and Sustainability of Artisanal Fishing in Grand Lahou Lagoon (Cote d'Ivoire)

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Abstract: This study is an analysis of the socio-economic characteristics of the artisanal fishery in Grand-Lahou lagoon in relation to deviant practices observed in recent years. The proliferation of fishing by poisoning in the lagoon raises the complex issue of sustainability of the activity and the negative economic impact for the populations that exploit it. The causes of these actions have been a subject of research in the area of socio-economics. Therefore, surveys were conducted on 486 fishing units in 12 villages surrounding the lagoon. After a description of the socio-demographic, technical and economic parameters, a multiple correspondence analysis has been applied to 21 variables in order to detect the factorial correlations between them. It was concluded that the average income according to the category of fishermen and to the season is situated between 3525±4 802 F CFA and 24 748±35 761 F CFA per trip. The artisanal fishers are predominantly indigenous people under 35 years old. In this population, professional fishermen have also the greatest farms. Globally, the range of fishermen under 40 years old is poorly integrated into the professional category. They also use equipment with low financial benefits. Thus, it seems like there is a difference in how each generation perceive the use of fishing techniques. This situation can lead to a break in the transmission of know-how in fishing and be a serious threat to the sustainability of artisanal fishing in Grand-Lahou lagoon.

Key words: Artisanal fishermen, fishing techniques, sustainability, lagoon, equipment, Cote d'Ivoire

INTRODUCTION

The renewable natural resources is one of the greatest pillars of sustainable development. In fact, fishing activities play a fundamental role for men, especially as food whether caught in a natural environment or produced in aquaculture (Kapetsky, 1984). There are a variety of areas exploited by fisheries, including lagoons which are transitional ecosystems between the marine environment and the river environment. The lagoons host both species and communities from different environments that border them as well as their own specific communities (Durand and Skubich, 1982).

In Cote d'Ivoire, lagoon systems (more than 1,100 km^2) are divided into 4 lagoons: Fresco, Grand-Lahou, Ebrie and Aby. These lagoons play an important role in the economy of the country through activities related to tourism, transport and fishing (Koffie-Bikpo and D'Ivoire 2006). This latter activity as a whole, hold an important place in the national economy in terms of direct and indirect employment including food security. In fact, Ivorian lagoons offer an annual potential catch estimated at 22000 ton (Anonymous, 2014).

However, these environments are subject to numerous disturbances, the main ones being related to human activities such as overfishing, illegal fishing, discharges of agricultural, domestic and industrial pollutants. Among the Ivorian lagoons, the one of Grand-Lahou is not spared by these threats that seem to negatively impact the catches. From experience, fishermen develop a range of strategies and adaptive responses to deal with fluctuations in yields. Among other things, they are likely to use more efficient or more destructive gears of capture (Cinner *et al*., 2009). According to some reserchers this last alternative, i.e., the use of more destructive gears of capture is observed in the Grand-Lahou lagoon. This area is also known for recording prohibited fishing methods including the use of pesticides (Sankare *et al*., 1994; Paul, 2007). Indeed this

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ecosystem which was relatively spared from this type of pollution at the end of the 1980s is facing the problem of fishing with toxic products in order to increase catches. This situation comes in violation of the laws and prefectural orders made to regulate fishing in territorial waters. Despite these efforts this kind of non-selective fishing which affects both fry and bigger fish is continuing illegally (Vanga, 2013). This only has the effect of harming the health of consumers and reducing the stock of fish living in the Grand-Lahou lagoon (Traore, 2013).

Since, these actions pose serious dangers for the environment and for humans, understanding this illegal fishing is a major challenge for fisheries managers. Knowing that it also, poses a threat to social cohesion becauseof suspicion that arises between families and local communities. However, no study up to date has been conducted on the socio-economics of artisanal fisheries in the Grand-Lahou lagoon, even less, on the relationship between the current socio-economic structure of artisanal fishermen and observed fishing practices (Lae, 1992). In addition, understanding the causes of deviant practices is more important, since, it is established that poison fishing poses a real threat to the sustainability of artisanal fishing activity and to the health of consumers.

Overall this study aims to analyze the current socioeconomic characteristics of fishing activity in the perspective of its sustainability. More specifically, the purpose is to assess the impact that the socio-economic aspects of the fishing activity on this lagoon could have on the fishing practices observed on this area.

MATERIALS AND METHODS

Field of study and data collection: The study took place from January to May 2009 in the villages bordering the Grand-Lahou lagoon (Fig. 1). This lagoon is located between longitudes 5°25'W and 5°10'E and latitudes 5°15'N and 5°11'S (Durand and Skubich, 1982). It extends over a distance of 50 km with a width of 14 km. Its average depth is 3 m with an estimated area of 190 km^2 (Lae, 1992).

By order of magnitude, the Grand Lahou lagoon is composed of 4 small lagoons, the Tadio lagoon (90 km^2) the Tagba lagoon (57 km^2) the Mackey lagoon (28 km^2) and the Niouzomou lagoon (15 km^2) (Fig. 1). The 2 main rivers flow into the Grand-Lahou lagoon; the Bandama River and the Boubo River.

In the sampling scheme deployed for this study, the location of the villages in relation to the natural potential offered by the environment was considered as a classification criterion. Half of the villages in each zone were randomly chosen and draw as a sample. This approach has identified 3 geophysical areas that are:

The zone of the coast: It is constituted by the part directly adjoining the sea. This band presents singularly a low land reserve. The 7 villages (Alekedon, Zagbalebe, Greguiberi, Kokou, Adjadon, Groguida and Lipkiliassie) were chosen to collect the data.

The inter-space zone: It represents the space contained between two small lagoons. The localities have both an extended fishing area and a greater land availability than the coastline. The villages of Badadon and Ebounou were chosen in this area.

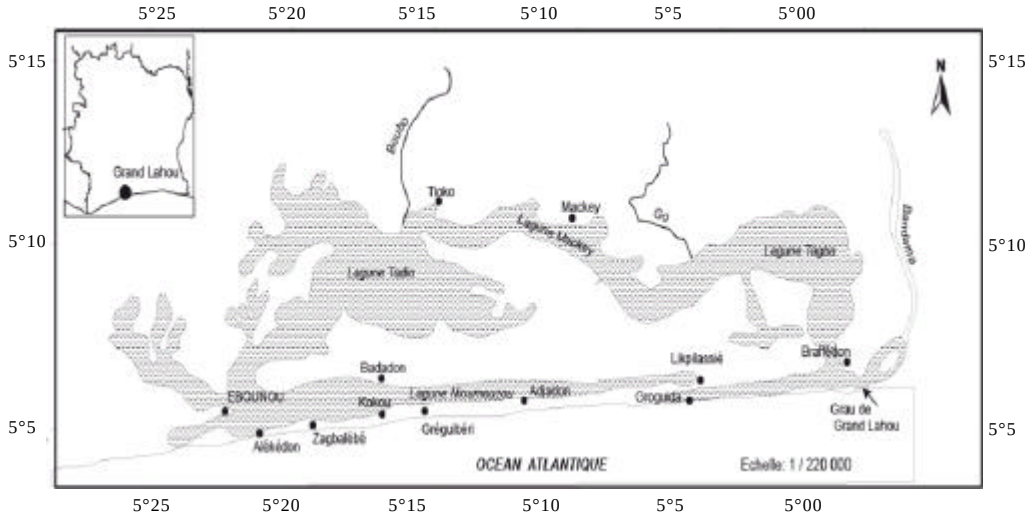

Fig. 1: Location of the fishing villages surveyed surrounding the Grand-Lahou lagoon

The zone of the continent: It is the space completely upstream of the whole body of water. The 3 villages (Braffedon, Mackey and Tioko) have been selected.

Precisely, 12 of the 24 localities in the lagoon area of Grand-Lahou were selected for the survey. The unit of observation is the active Fishing Units (FU) represented by the chief fisherman. The FU is defined as a group consisting of a fisherman and his assistant owning, at least, a functional fishing gear.

After counting 1025 FU in the target villages, an effective sampling rate of 47%, corresponding to a 27% survey for all FU in the lagoon wasapplied (Aktouf, 1987; Ghiglione and Matalon, 1998). In practice, once the number of target households was determined, the investigators conducted a simple random sampling by a draw of the FU to be interviewed.

A questionnaire has been designed for data collection. It is addressed to all types of fishermen in the lagoon. This questionnaire is structured in 4 main parts: the socio-demographic characteristics of the fisherman, the technical characteristics of the fishing units with the seasonal financial performance. The overall activity rate of the fisherman, the strategic direction of the fishery and the status of alternative economic activities to the fishery complete the information in this section.

The survey from declarative type was conducted on evenings and days of rest at the fisherman's home. The operation was conducted in a single passage and interviewed 486 FU unequally distributed over the 12 sites and 3 defined geophysical zones. Finally, the questionnaires were collected and analyzed using the SPHINX 4.0 Software.

Analysis of the field data: Average and standard deviation have been calculated for several variables. These statistics allowed to describe and illustrate the limitations of variation of the analyzed parameters. The Multiple Correspondence Analysis Model (ACM) has been selected to bring correlations between variables and then between factors of different variables (Escoffier and Pagees, 1990; George and Mallery, 2003; Barraud-Didier and Henninger, 2009).

The analysis was made using the SPSS-Statistics Software by optimizing the optional coding. In fact this level of treatment has enabled the correlation of the variables. Subsequently, the FactoMineR package on the RStudio generated the status of correspondence between factors of all variables.

The ACM has linked 21 recorded variables for each of the 486 FU. These variables are: Age classes (ClassAge) number of dependents (Perscharg) origin of fisherman (Origin) agricultural activity practice (Agricult) other activities excepted agriculture (PractHAg) location of the village (Localite) spatial mobility of the fisherman (Mobispace) land reserve property (Terrdispo) the main plant cultivated (CultPrinc) the existence of a savings owned by the fisherman (Epargne) the existence of a real estate investment (Investimo) the minimum gain per trip declared for fishing activity (GainMin) the maximum gain per trip declared for fishing activity (GainMax) the number of years of experience in fishing (AnExper) the main gear used (PrincEngin) the property of the canoe (ProPirog) the education level of the fisherman (Nivinstr) the number of gears used by the fisherman (Nbrengins) professional status of the fisherman (Pechstatut) the number of fishing days in the week (NbjrsPech) history of the fisherman parents with fishing (ParenPech).

RESULTS AND DISCUSSION

Socio-demographic characteristics of small-scale fishermen in lagoon: The 486 respondents are mostly indigenous (80%) mainly fishermen from Avicam (61%) and Dida (19%) ethnic groups. Table 1 shows the relative frequencies of the nationalities and the ethnic groups of persons surveyed.

Non-natives, who are poorly represented (6%) are not really dominated by any ethnic group of the country. Apart from Baoule (1.44%) almost all non-native people come from coastal areas. As for the non-indigenous, Beninese (6%) and Malians (6%) are the most encountered among foreigners. Concerning the Beninese, they are for the most part, shrimp fishermen in the lagoon. Otherwise, Malian respondents are from the Bozo ethnic group. They are fishing under a customary authority who daily receives fee ranging between 1000 and 5000 F CFA according to the season and the locality. Age classes were formed to determine age group representations. Figure 2 shows the percentages obtained for each class.

Table 1: Origin of the fishermen of the Grand-Lahou lagoon

Origin/Population	Number	Percentage
National		
Aboure[2]	1	0.21
Adjoukrou[2]	6	1.23
Ahizi[2]	6	1.23
Alladjan[1]	1	0.21
Appolonien[2]	7	1.44
Avicam[1]	298	61.19
Baoule[2]	7	1.44
Bete[2]	1	0.21
Dida[1]	92	18.89
Foreigners		
Ghaneen[3]	8	1.64
Malien[3]	29	5.95
Beninois[3]	30	6.16
Togolais[3]	1	0.21
Total	486	100

[1]Natives; [2]Non-natives; [3]Non-indigenous

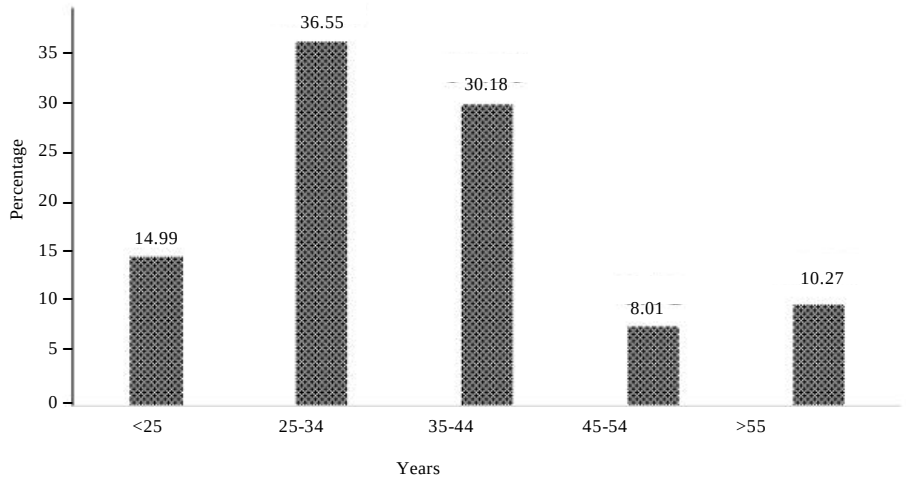

Fig. 2: Representation of the fishermen age groups in the Grand-Lahou lagoon (n = 486)

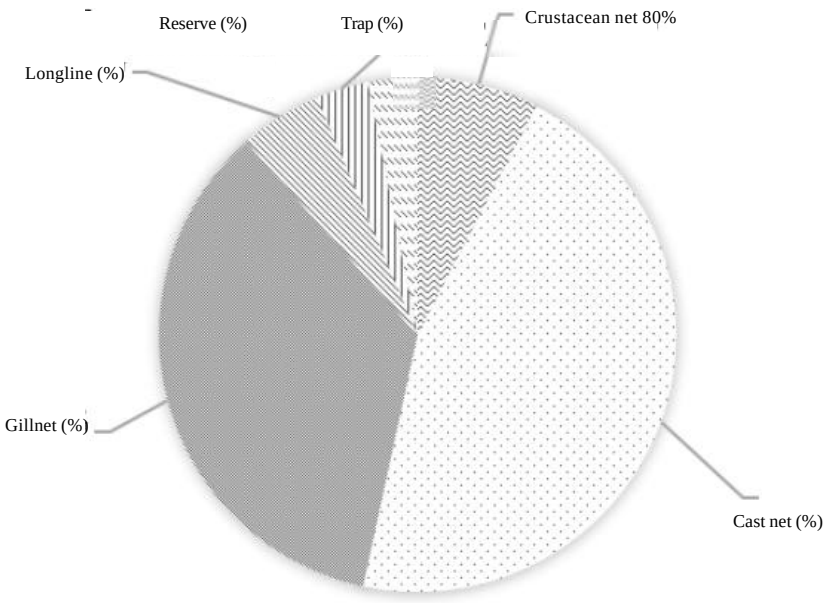

Fig. 3: Diversity of gears according to their importance in the catching system

Most fishermen (67%) are between 25 and 44 years old. Of these, more than half are between the ages of 25 and 34. The percentage of the population aged over 45 reveals that fishing activity is less practiced by aging people. Regarding the origin of fishermen, the average of the age is the same for native (36±12 years old) foreign (36±14 years old) and non-natives (36±9 years old). In addition, professional fishermen have an average age equal to 42±13 years while occasional are 32±12 years old. The level of education of the respondents was assessed through their ability to read and write. Globally, 60% of fishermen can read and write. They have for the most part, a level of study situated between the primary classes and high school's third level. None of them had post-graduate studies. Almost foreigners (12%) and non-native fishermen (5%) cannot read nor write.

Fishing effort in lagoon of Grand-Lahou: The catching techniques used by the fishing units are conceived from the fishing gear that constitutes the fisherman's heritage. In general, they are used in combination according to the target of the fisherman and according to the fishing season. The diversity of gear used is shown in Fig. 3 taking into account their main function in the fishing

system. The fisherman's catch strategy is moreover, built around this main equipment to which he associates some useful gears. The types of gear reported by the respondent are: the cast net, the gillnet, the longline, the line, the trap and the reserve.

The cast net is the most used gear (46%) by the fishermen. This type of gear is followed by gillnets (35%). As far as the net is concerned, the meshes vary from 25- 30 mm. In this set of fishing equipment, the "reserve" stands out from other forms of gear, since, it is more comparable to a fishing area reserved for the family. In general, the management of the fishery is entrusted to a chief or to persons exercising any power delegated by the customary authority. Access to this resource is seasonal or by event. Catches which come out are subject to a key of distribution favoring the whole community and the major families founding the village.

The activity rate for this study is considered as the number of fishing trips per week. Aiming more precision, only professional fishermen are taken into account (n = 292). Table 2 shows that the rates vary little according to the origin of the fisherman.

Gross income and multiple activities of fishermen in Grand-Lahou lagoon: The minimum and the maximum income respectively correspond to the bad and the good fishing seasons. The daily income average contained in Table 3 shows that the recipe is between 3 524±4 802 F CFA and 24 748±35 761 F CFA depending on the origin of the fisherman.

Table 2: Average of activity rates according to the origin of the professional fishermen (trips)

Origin	Average of activity rates
Non-Natives (n = 38)	5.64±0.95
Foreigners (n = 68)	5.35±1.49
Natives (n = 186)	4.84±1.26
Total	4.96±1.30

The most productive trips are recorded among the natives located on the continental part of the lagoon (33 261±58 035 F CFA) while the lowest recipes per trip are found among the foreigners of the continent (1760±2 128 F CFA). Overall with a number of respondents fourteen times lower than that of local fishermen (n = 29 against n = 390) non-natives reported the highest turnover (28896±27 920 F CFA) followed by natives (26.065±37.806 F CFA). The standard deviations are on the other hand, quite large, confirming the strong variability of the fishing yields within the same season. Indeed, the standard deviations are almost always greater than 100%. In addition, the minimum gross revenues are substantially similar when the observation is based on the origin of the fisherman. This is different when the location of the village is considered. It suggests an influence of the fisher's location on the seasonal performance of his activity. The crossing between the location of the fisherman's village and his professional status was also made on the gross income variable reported by fishing trip (Table 4).

The average income according to the category of fishermen is between 3525±4 802 F CFA and 24 748±35 761 F CFA. The most productive fishing trips are recorded among professionals located on the continental part of the lagoon (38 284±63 565 F CFA) while the trips with the lowest incomes are recorded from occasionals of the inter-space (3 187±4 988 F CFA). In terms of proportion, the turnover of occasionals is almost half that of professionals. Fishermen from the villages situated in the inter-space are the least financially productive (15 903±15 543 F CFA). In addition, there is a relatively small difference between the turnovers in case of bad fishing in both categories of fisherman (>1000 F CFA). The standard

Table 3: Gross income reported by fishing trip according to the fishermen's origin (in F CFA)

Variables	Limit	(n = 29)	Foreigners (n = 68)	Non-Natives (390)	Total
Continent (n = 182)	Max	28.440±29192 (n = 25)	13.079±11629 (n = 19)	33 261±58035 (n = 138)	30 491±52096
	Min	4.158±6.556 (n = 25)	1.760±2 128 (n = 19)	3.539±4.965 (n = 138)	3.438±5.018
Inter-space (n = 119)	Max	-	14.159±21238 (n = 47)	17.042±10293 (n = 72)	15.903±15543
	Min		2.808±5.026 (n = 47)	2.718±1.781 (n = 72)	2.753±3.429
Coast (n = 186)	Max	31.750±21109 (n = 4)	67.500±88388 (n = 2)	24.158±20250 (n = 180)	24.787±21619
	Min	2.625±1.702 (n = 4)	27.500±17.678 (n = 2)	3.874±4.542 (n = 180)	4.101±5.264
Total	Max	28.896±27920	15.426±23372	26.065± 37806	24.748±35761
	Min	3.946±6.119	3.241±6.446	3.542±4.351	3.524±4.802

Table 4: Gross income reported by fishing trip according to the fisherman category (in F CFA)

Variables	Limit	Occasional fisherman (n = 194)	Professional fisherman (n = 293)	Total
Continent (n = 182)	Max	16.795±10494 (n = 66)	38.284±63565 (n = 116)	30.491±52096
	Min	2.235±1729 (n = 66)	4.123±6053 (n = 116)	3.438±5018
Inter-space (n = 119)	Max	12.583±5641 (n = 48)	18.147±19319 (n = 71)	15.903±15543
	Min	3.187±4988 (n = 48)	2.460±1704 (n = 71)	2.754±3429
Coast (n = 186)	Max	17.875±8433 (n = 80)	30.004±26572 (n = 106)	24 787±21619
	Min	3.547±3357 (n = 80)	4.521±6319 (n = 106)	4.101±5264
Total	Max	16.198±8859	30.409±44675	24.748±35761
	Min	3.012±3465	3.864±5491	3.525±4802

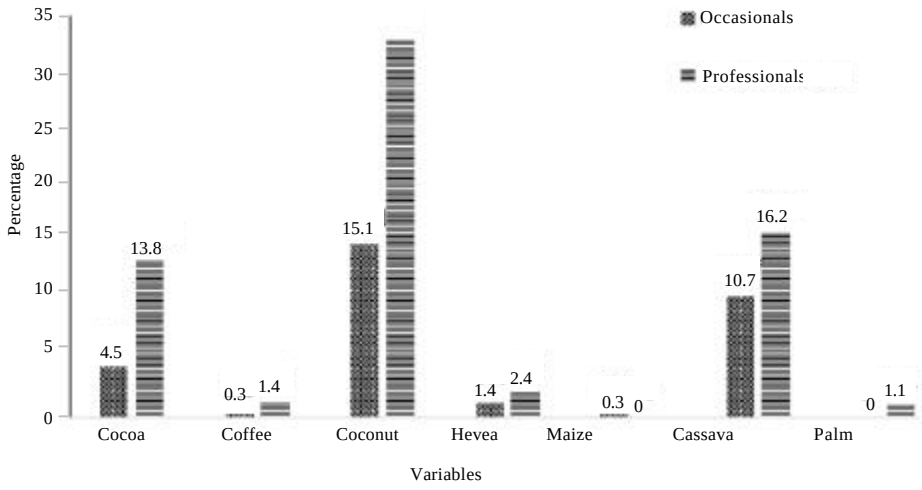

Fig. 4: Importance of agricultural production by fisherman category (n = 291)

Table 5: Average areas of main crops by village (ha)

Main crops	Continent	Inter-space	Coast
Coconut	2.81±2.37 (n = 33)	3.17±2.14 (n = 24)	3.9±2.38 (n = 83)
Cassava	0.63±2.44 (n = 42)	1.13±2.14 (n = 16)	1.1±2.41 (n = 20)
Cocoa	2.02±2.47 (n = 29)	3.12±1.5 (n = 16)	2.19±2.5 (n = 8)

deviation of gross income among professionals is around 150% while it is around 50% for occasionals. There is therefore, a strong variability of the average turnover per trip among professionals compared to occasional fishermen.

In the area of Grand-Lahou, agriculture is the main alternative activity that fishermen engage in. In fact, the results show that in addition to fishing, 59% of the respondents practice agricultural activities on their own account. Of these, 32% are occasional and 68% are professional fishermen. Professionals are therefore, the most involved in agricultural activity. The percentage of agricultural crops, cited as main in the production system of the fishermen is shown in the Fig. 4.

It appears from this pattern that seven crops are dominant in the department of Grand-Lahou. Coconut, cassava and cocoa are the most cited. Indeed, coconut cultivation is the most practiced by fishermen in the area. It alone accounts for 48% of cultivated crops. Professional fishermen owning coconut plots are twice as likely as occasionals (33% versus 15%). Table 5 gives more details according to the fisherman's village location. The largest average areas are those of coconut, the maximum of which is found on the coast (3.9±2.38 ha). The smallest areas are cassava with a minimum of 0.63±2.44 ha on the continent. Overall this part of the lagoon has the smallest crop area for all 3 types of speculation.

Table 6: Summary of the ACM Model

		Represented variance		
Dimension	Cronbach alpha	Total (Eigenvalue)	Inertia	Percentage of the variance
1	0.96	14.02	0.67	66.78
2	0.88	6.17	0.29	29.36
Total		20.19	0.96	
Average	0.95[a]	10.09	0.48	48.07

[a]Significant Cronbach alpha

Correlations between the socioeconomic and technical parameters of fishermen in the Grand-Lahou lagoon: Table 6 presents the parameters of the ACM Model defined along axes 1 and 2. The average Cronbach alpha (0.95) based on the average eigenvalue is < 0.90. It means that the model has a strong internal consistency of the introduced variables. Indeed, 67% of the convergences between variables are made along axis 1 and 30% along axis 2. On average, about 48% of the global variance is captured by the ACM Model along axes 1 and 2. Figure 5 allows to define 3 groups of variables of which 2 are discriminant.

Group 1 contains the sociodemographic, geographic and activity variables. They are six and are represented at a near equidistance of axes 1 and 2 (Table 7). These are AgeClass, Locality, Origin, Agricult, PersCharg and Mobispace. This last variable is more clearly projected on the axis 1, even if it is indicated in this category. This grouping reveals that there is a strong correlation between the first five variables. However, the Mobispace variable is moderately correlated with the other variables. These results thus show a clear correspondence between sociodemographic data, geographical data and the practice or not of agricultural activity by fishermen. In addition, spatial mobility in the context of fishing, also

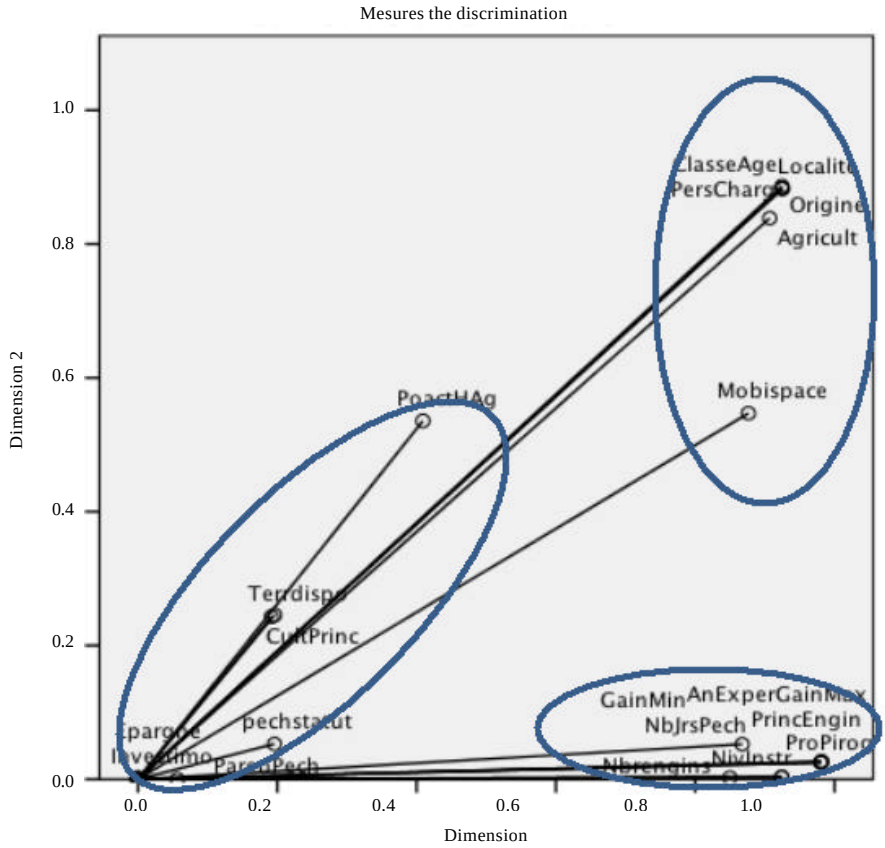

Fig. 5: Multiple correspondence diagram of variables

Table 7: Correlation coefficients of the variables along axes 1 and 2

Variables	Axe 1	Axe 2	Average
Localite^{G1}	0.92	0.88	0.90
ClasseAge^{G1}	0.93	0.88	0.90
Origine^{G1}	0.92	0.89	0.91
PersCharg^{G1}	0.93	0.88	0.90
NivInstr^{G2}	0.92	0.00	0.46
Nbrengins^{G2}	0.92	0.00	0.46
PrincEngin^{G2}	0.98	0.03	0.50
ProPirog^{G2}	0.98	0.03	0.50
GainMax^{G2}	0.98	0.03	0.50
GainMin^{G2}	0.85	0.00	0.43
AnExper^{G2}	0.98	0.03	0.50
Mobispace^{G1}	0.88	0.55	0.71
ParenPech^{G3}	0.06	0.00	0.03
NbJrsPech^{G2}	0.87	0.05	0.46
Agricult^{G1}	0.91	0.84	0.87
CultPrinc^{G3}	0.19	0.24	0.22
Terrdispo^{G3}	0.20	0.25	0.22
PoactHAg^{G3}	0.41	0.54	0.47
Investimo^{G3}	0.00	0.00	0.00
Epargne^{G3}	0.00	0.00	0.00
Pechstatut^{G3}	0.20	0.05	0.12
Active variables	14.02	6.17	10.09
% of variance	66.78	29.36	48.07

G1: Group 1; G2: Group 2; G3: Group 3

depends on the origin, the place of residence, the family load and the fisherman's involvement in agricultural activities.

Group 2 includes the variables GainMin, AnExper, GainMax, Propirog, NbjrsPech, PrincEngin, Nbrengins, Nivinstr. They are strongly correlated with axis 1 which means that they have strong links with each other. These variables are essentially technical (Propirog, Nbrengins, PrincEngins, NbjrsPech) economic (GainMax and GainMin) and human capital variables (AnExper, Nivinstr).

Group 3 consists of the non-discriminating variables like Epargne, Investimo, Parenpech, Pechstatut, Terredispo, CultPrinc, PoactHAg. These variables have low correlations within their category and also with others.

The results in Table 7 confirm the aggregation levels of the variables along axes 1 and 2. The processing of the collected data made it possible to obtain a correlation diagram of the factors. Figure 6 shows the positions of these factors in a single frame.

The factors displayed in frames A-D have been interpreted. The factors which are disposed at the origin of the diagram are non-discriminating for the data of the survey. For the readable elements, the following observations can be made.

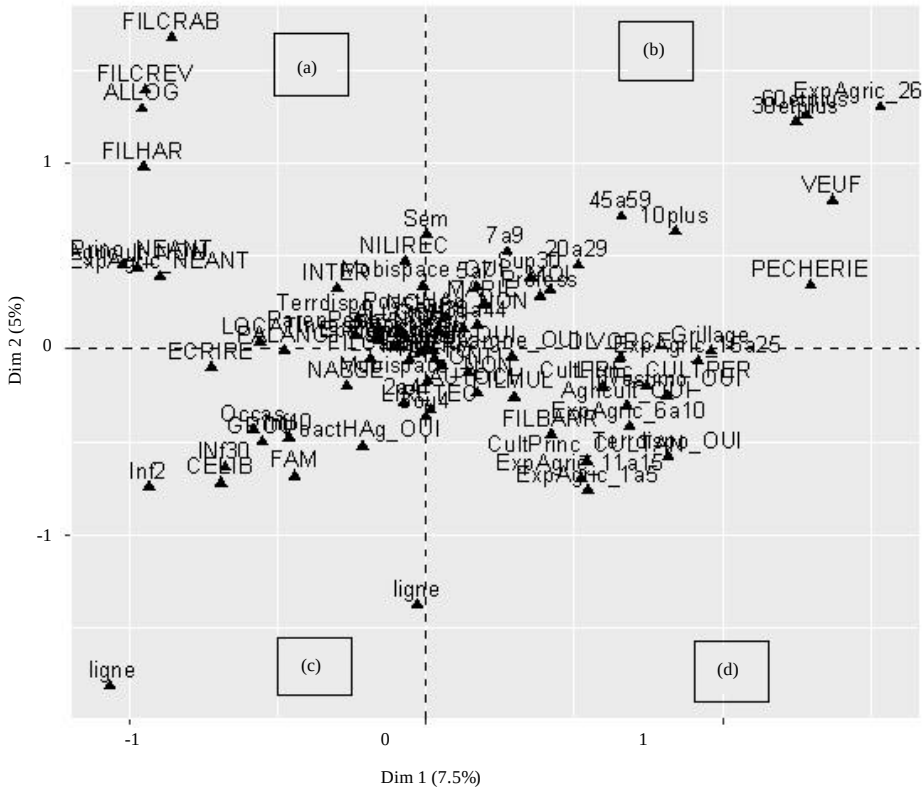

Fig. 6: Multiple correspondence diagram of factors

In frame A: The foreign fishermen use specific gears such as crustacean nets (crabs, shrimps) and herring nets. They are not farmers. The fishermen of the inter-space have a sustained mobility with a rate of activities close to the full week. They almost can't read and write.

In frame B: The almost professional fishermen are married without other activities except agriculture and fishing. They declared a maximum daily gain higher than 30 000 F CFA. They own their canoe and are between the ages of 30 and 59 with at least 7 dependents in general. This charge can go up to 10 people. They also have a proven spatial mobility. Fishermen over the age of 60 have important experience in agriculture. The reserve system has special links with fishermen over 45 years old.

In frame C: it appears that occasional fishermen are almost single and have a maximum daily gain of less than 30,000 CFA francs. They can read and write. In these, the canoe belongs to the group (consisting of 4-6 persons) or to the family. This category of fishermen has at most 2 gears in its fishing heritage. They own mainly longline, line, trap and do not use spatial mobility in their fishing strategies. They are also, engaged in other income-generating activities apart from agriculture and fishing.

In frame D: The natives are the users of gillnets (mule, carp). They are farmers and exploit both perennial and annual crops. On the other hand, they are not characterized by spatial mobility in fishing activity. This category also has land in reserve for possible use.

The results showed a higher occurrence of natives Avicam and Dida ethnic groups among the lagoon fishermen of Grand-Lahou. Around 73% of the artisanal lagoon fishery in Cote d'Ivoire is conducted by native people, thus corroborating the results of our study (Gerlotto *et al*., 1976; Lae, 1992). This situation breaks with most of the work done on the configuration of artisanal fishermen operating throughout Cote d'Ivoire's coastline. In fact, several censuses recorded a very high predominance of fishermen of Ghanaian origin throughout the coast, although, there are about 80 fishing ethnic groups in West Africa, including 10 in Grand-Lahou lagoon (Delauney, 1995). In addition, there appears to be a big difference between the origin of the fishermen depending on whether they fish in a maritime or lagoon environment. This is explained, on the one hand by the existence of a village regulation, applied to the lagoon area. this aimed at controlling its access in order to maintain fishing effort at an acceptable level, especially,

towards foreign fishermen and secondly, the excellent profitability of sea fishing (Weigel, 1985). The diversity of gears is greater in Ebrie lagoon than in Grand-Lahou lagoon (Gerlotto *et al*., 1976).

Concerning the catch system, cast net and gillnet are the gear around which most fishing strategies are built. Technically, the recurrent choice of the combination between cast net and gill net, reveals fishing strategies based on the search for a balance between investment for profitability and subsistence fishery for household's self-consumption. Considering all the mobilized gears it appears that the logic of money accumulation observed in the maritime artisanal fishery and in many sectors of the Ebrie and Aby lagoons is not pronounced in the case of Grand Lahou lagoon (Haakonsen, 1992). In addition, there is a spatialization of the main gear, namely the gill net for the fishermen from continental location and the cast net for those of the coast, explains the difference between the average gross income per fishing trip according to the location of the village. Indeed, gill nets require investments 5-6 times larger than the cast net with consistent catch per unit of effort (Cormier, 1983). As for the average activity rate among professionals it remains slightly higher than that announced in the context of inland fisheries and lower than the surveys carried out on the Grand-Lahou and Ebrie lagoons, i.e., 6 or 7 days for some foreign fishermen (Lae, 1992; UEMOA., 2014). These differences, although, not very important, indicate a general decline of activities in the Grand-Lahou lagoon. The significant reduction of the activity rate which is an essential component of the fishing effort, probably means a reallocation of available working time to other activities, including agriculture. In fact, agriculture is practiced by more than 2/3 of professional fishermen. There is, therefore, a risk management strategy through the diversification of economic activities. This observation confirms the common thought in fishing villages that "There is no inheritance in water". It is then implied that fishermen invest in the sector which guarantees an inheritance to the offspring.

In addition, there is a direct and exclusive relationship between the technical parameters related to the fisherman and the economic results of his activity. This means in particular that the strong domination of the native people in fishing does not make them the most successful fishermen. The customary regulations and the underlying regulation in favor of native fishermen do not guarantee good performances in the fishing activity. In fact, indigenous communities tend to promote an ecological approach based on the preservation of the common resource rather than an economic logic of capital accumulation (Verdeaux, 1986). After the multiple correspondence of the factors it appears that the structure of the fishermen population reveals the weak integration of a large part of the fishermen whose age is lower than 44 years in the professional category. Indeed, a generational fracture is perceptible through the techniques used according to the age groups. This anthropological phenomenon has been observed among artisanal fishermen in the Breton region in France (Delbos, 2006). According to, this study the fracture occurs with the disintegration of the household as a productive enterprise to ensure the transmission of technical knowledge and resources needed for investment between father and son. In the current case, the large group of under 44s has mainly gear whose yields are much lower than those of gillnets. As a result, they earn little in fishing activity and are paradoxically, focused on subsistence crops, especially, cassava for agricultural activity. The latter could find themselves in a situation of financial precariousness. Thus, the socio-economic structure of fishermen in the lagoon of Grand-Lahou reveals a factor justifying deviations in fishing practices. It is the existence of a segment of this population whose potential for halieutic and agricultural production are quite low in the face of a relatively large family burden. Sustained over the long term this situation would significantly compromise the sustainability of the fishing activity.

CONCLUSION

This study shows a number of results concerning fishing in the Grand-Lahou lagoon. In fact, the fishermen in this lagoon are mostly natives from the Avicam and Dida ethnic groups and more than half of them are under 35 years old. In general, they use small mesh gillnets and cast nets as capture gears. Fishermen located on the continental flank of the lagoon have the gill net as the main gear while those located on the coast have rather the cast net. There is therefore, a spatialization of trades and gross income per trip on the lagoon. This indicative income is one and a half times higher on the continent than on the coast and about twice as large among professional fishermen than among occasionals. Regarding fishing effort, the number of days of fishing per week is slightly lower than the weekly attendance rate 40 years ago. Also, more than half of the fishermen practice agriculture in parallel with their catching activity. Coconut, cocoa and cassava are the most cultivated crops. In this multi-activity, professional fishermen also have the largest acreage of crops. In terms of resource allocation, a transfer of working time and money generated by production activities is plausible from

fishing to agriculture and vice-versa. In the end it appears that a significant proportion of fishermen under the age of 44 are poorly integrated into the professional category. The main gear analysis reveals that they use materials with relatively low financial returns. There is therefore, a generational gap in terms of techniques and probably income from fishing within the populations exploiting the Grand-Lahou lagoon. This situation is a threat to the sustainability of artisanal fishing activity.

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