

CO-MANAGEMENT IN ABY LAGOON, CÔTE D'IVOIRE

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ABSTRACT

Since 1995, an experiment on co-management of fisheries has been carried out in the Aby Lagoon (Côte d'Ivoire). The process is based on a consensual definition of the rules of management and the setting up of organizational structures (fishing committees) ready to work with government agencies to achieve common goals. The preliminary results show that fishermen are conscious of their duties. They are available to involve themselves in an active and efficient way. The structure of exchange (communication) created for this purpose ensures satisfying participation of all.

The bioeconomic impacts of the co-management can already be seen. Though these positive results are beneficial to the whole community, some fishermen (the owners of beach seines) pay heavy taxes, and that leads to their opposition against the innovation. The process of co-management has favored the supervision of the resources rather than their management in an extensive way. Consequently, women are not consulted in the decision-making process. The takeover of the process by the users (which goes on slowly) to be sustained requires the formalization of enabling instruments such as laws, to strengthen the status of the committees, among other things.

Introduction

The Oceanographic Research Center (CRO) has undertaken some work on Aby Lagoon in order to gather the necessary information to answer the questions asked by managers, decisionmakers, planners and aid donors concerned with fishery development. The focus of these researches was the halieutic biology, i.e., the biology of the species and evaluation of the resource. Fisheries management took into account the resource only. One must recognize that this way of dealing with the problems of fishery management did not present entirely satisfying results. The repeated crisis of over-exploitation (1983 and 1987) and the open conflict (1990) between the Aby Lagoon population and the Project for the Development of Artisanal Fishery are illustrations. The strictly resource-based fishery management seemed to have not considered the social aspect; it was treated as an independent variable (Y. Breton and C.M. Diaw 1992).

Generally, the involvement of the authorities (a strongly centralized administration) in the development process seemed to give an opposite effect since the beneficiaries of the development were very often not consulted. On the one hand, the administration with the backing of the Project's technical services had enough financial resources to impose their own policy of fisheries management. On the other hand, users unilaterally imposed their own way of management. The resultant conflict led to a breakdown in communications between the Aby Lagoon people and the Project for two years (1990-1992), hence interrupting the Project's activities.

In 1992, an analysis of the situation led to the setting up of new strategies to deal with the fisheries management, but this time taking into account the social aspect. That new approach aimed at giving the fishermen real participation in the management of the halieutic resource. Even though this new strategy went on slowly, it responded to the goal of the national policy of decentralization and devolution.

In 1995, participative management was initiated on Aby Lagoon within the framework of the existing fisheries administration which was being rejected by the users (Kponhassia and Konan 1996). Despite initial resistance, the approach was pursued. The present study therefore aims at doing a first evaluation. The document consists of four parts:

- the first part deals with the demographic and physical geography of the Aby Lagoon complex;
- the second part deals with the fishery on Aby Lagoon and the economic characteristics;
- the third part accounts for the actions undertaken in the co-management and the most relevant bioeconomic result;
- the fourth part deals with the durability of the system.

Materials and Method

Three main complementary tools were used to gather both the qualitative and quantitative data.

Documented Information

The Aby Lagoon is one of the most documented Ivorian lagoons. The Oceanographic Research Center (CRO) has been conducting research on it since 1980. The Project for the Development of Artisanal Fishery on Aby Lagoon likewise made many studies on it. All this documentation taken collectively has been used to assist in the present study.

Semi-structured Interviews

The semi-structured interviews have been organized with three social groups: the cantonal fishery committee on Aby Lagoon, three village committees and three groups of women fishsmokers and sellers in three villages.

The three villages have been chosen for the following reasons:

- Etuéboué: very involved in the co-management system because it is the cantonal district and recognized as the main instigator of the 1990s events. Before the beginning of the present co-operation, two tendencies could be distinguished: the youths were totally hostile to the restarting of the activities of the Fisheries Office, whereas the elders were favorable to a reconciliation through a conditioned co-operation (Kponhassia 1994).
- Epleman: fishermen in this village have very often been victims of the 1995 seminar's resolutions. The inhabitants feel oppressed by the rest of the population. It has been noticed that because of that situation, the village fishery committee is very lax.
- Assomlan: the committee of this village has been renewed and works hard. Their bay which was very degraded has since regained its vitality with a rapid reconstitution of the resource within six months. There were immediate financial outcomes for the village.

The choice of the social groups is based on the recognition by the village community of their role in the process of co-management. However, the women who are very isolated in the present process have been interviewed separately from the men. It is worth mentioning that 63 people have been interviewed.

Inquiries

The advantage of the semi-structured interviews is to sort out the tendencies of the dominant groups since the social structures of the lagoon population are based on a very strong hierarchical system and the fact that the gerontocratic power counts a lot. On the other hand, the individual interviews allow for popular expression and is therefore very democratic. They took place in the 12 main villages of Aby Lagoon. In each village, three types of people have been interviewed:

- The fishermen: they consist of two groups, those who directly take part in the management of the committees (5 fishermen) representing 20%, those who are not committee staff members (10 fishermen) representing 40%.
- The notables: five (5) notables representing 20% including the village chief, have been interviewed;
- The “transformers” or processors: five (5) women fishsmokers representing 20% have been interviewed per village.

Three hundred (300) questionnaires have since been received and processed by the ACCESS computer software.

The Aby Lagoon

The Aby Lagoon (Figure 1) is one of the three Ivoirian lagoon systems (Ebrié, Grand-Lahou and Aby) which covers some 300 km of the coastline. Each has access to the sea and is connected to one another via channels (Durand et Chantraine 1982).

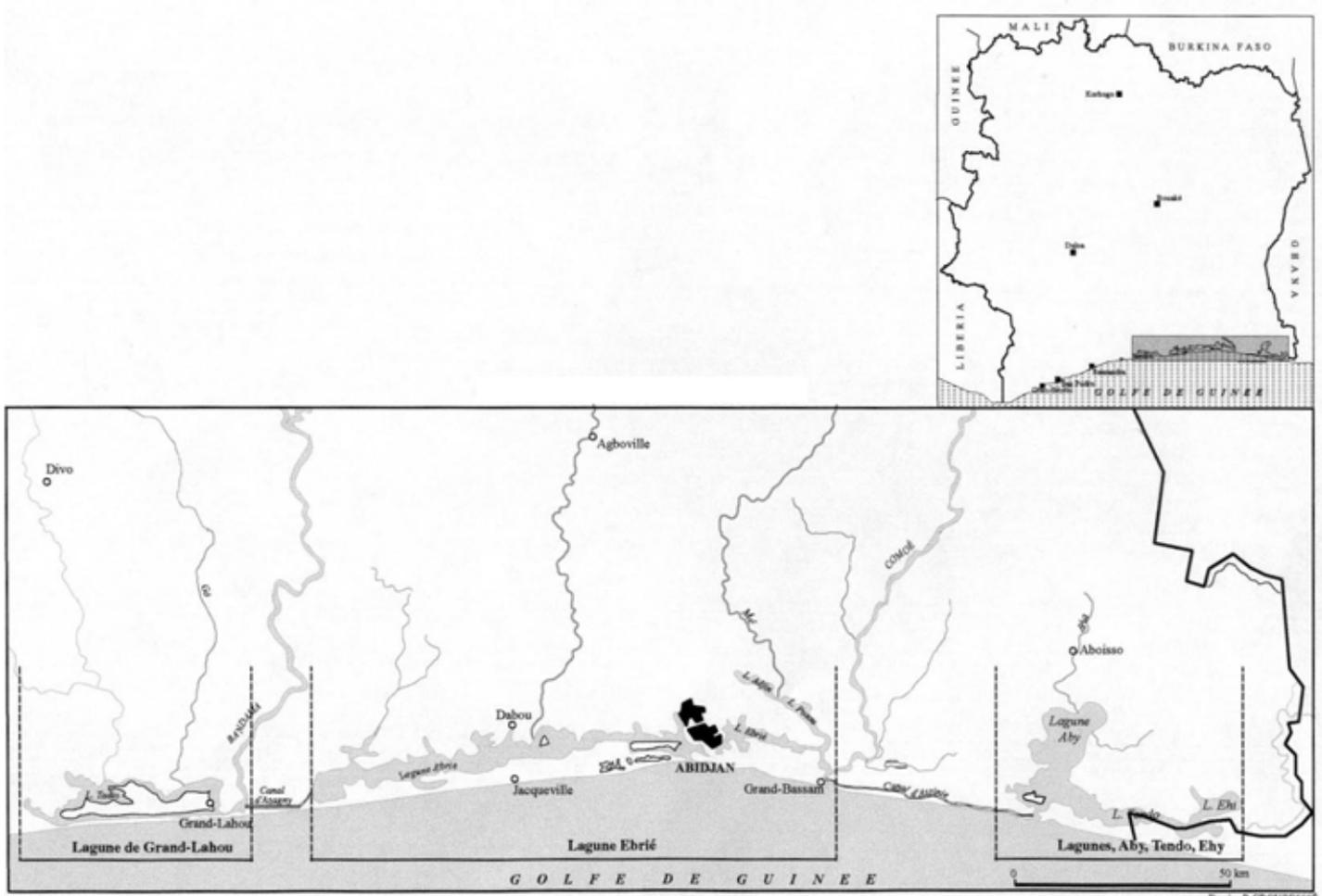


Fig. 1. The three Ivoirian lagoonal system

The Aby Lagoon (Figure 2) is located in the far east of the littoral. Its median part forms a natural border between Côte d'Ivoire and Ghana. It covers 30 km of the coastal line and extends over an area of 424 km². The Aby Lagoon is between longitude 2°51' and 3°21' **on the one hand** and latitude 5°01' and 5°22' **on the other** (Chantraine 1980).

The main Aby Lagoon, whose name has been given to the complex, is the most extended and covers 305 km², it has a total shoreline of 24.5 km, and is 15.5 km at its widest. The Tendo Lagoon which is the median part of the complex, is more stretched, with a length of 22 km and varying width of between 1.5 km and 3.5 km. Its surface is 74 km². The Ehy Lagoon which is more towards the eastern side, has a basin form and a surface area of 45 km².

Hydrology

The Aby Lagoon is supplied with fresh water by the rivers Bia in the northwest and Tanoé in the east. These two main coastal river regimes depend on the rainfall of the southern forested region. Both the marine and fresh waters have a common influence on some physical and chemical parameters, including the salinity. This salinity depends on the importance of the water supply which varies according to the season. During the dry season, the marine influence is maximum and the salinity at the surface is higher with an average of 14%. This salinity decreases according to a south-north gradient to subsequently become very weak, even nonexistent at the level of the channel.

The southern part of Aby Lagoon is always high in salinity as a result of direct influence of the sea. The northern area of Aby lagoon is free of salt, even fresh at the level of its encounter with the Bia river. The Tendo area in turn has a salinity that is permanently weak, between 0% and 2%. In Ehy area, under the strong influence of the Tanoé river, the waters remain fresh throughout the year.

The degrees of salinity are low between the months of August to December and high from January to April, with a peak in March-April followed by a second less saline month in August. That spatial variation of salinity explains the distribution of the fish species, especially that of the *Ethmalosa fimbriata*.

Ichthyofauna

The population of ichthyofauna in the Aby Lagoon has been estimated at around 60 species (Daget and Iltis 1965). Thirty-three have been selected (N'Goran 1995), among which the *Ethmalosa fimbriata* is far by the most represented. It constitutes 60% to 80% of the catch on Aby Lagoon. The Aby Lagoon complex presents a great and specific diversity. This rich content is due to its sheer size of 424 km² and its constant exchange with the sea, supplied with fresh water by the Bia and Tanoé rivers (N'goran 1995).

Three groups can be distinguished as follows (Albaret 1990):

The main lagoon species:

- the exclusively estuarian species whose cycle takes place in lagoon (e.g., *Tilapia guineensis*);
- the estuarian species with marine origin which are adapted to the lagoon environment (e.g., *Ethmalosa fimbriata* and *Trachinotus teraia*); and
- the estuarian species with continental origin (e.g., *Chrysichthys* spp)

Species with marine affinity:

- the estuarian marine species; they do not breed in lagoon but come to maturity in it (e.g., *Elops lacerta*),
- the accessory marine species whose presence is restricted to the lagoon (e.g., *Sardinella aurita*), and
- the occasional marine species, very rare and caught in the channel of Assinie (e.g., *Dentex canariensis*).

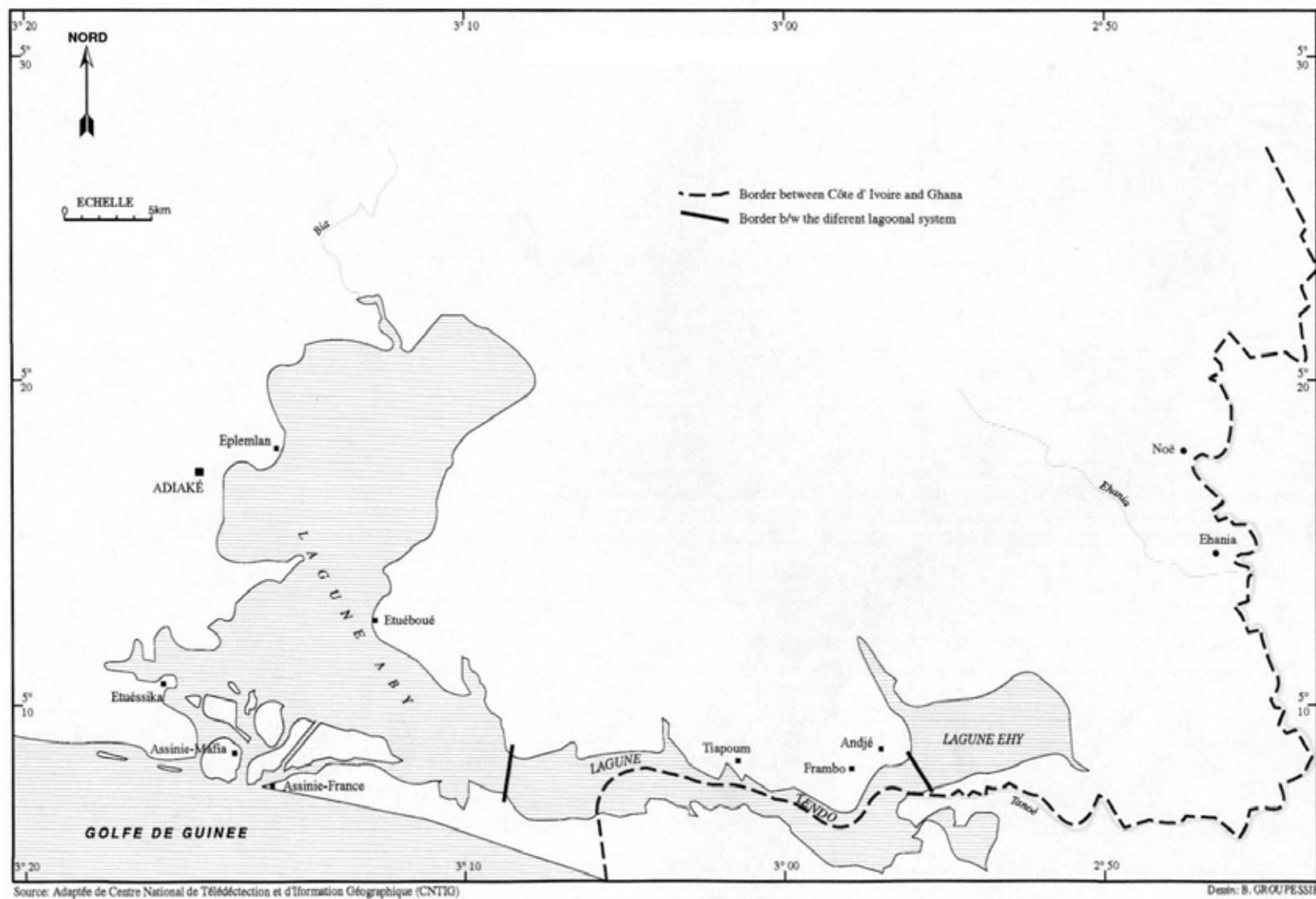


Fig. 2. Aby Lagoonal System

Species with strong continental affinity:

- the continental species with estuarine affinity bearing salinities below 5‰ (e.g., *Hepsetus odoe*), and
- the occasional continental species whose presence is restricted to the lagoon (e.g., *Hemichromis fasciatus*).

The crustaceans consist of crabs (*Callinectes amnicola*) and shrimps (*Penaeus duorarum*) which are more and more important in the landings.

The Aby Lagoon is characterized by seasonal variations of its physical and chemical parameters by a spatial heterogeneity of its hydraulic climate. The lagoon supports a rich marine diversity, allowing the lagoon population to fish continuously.

Lagoon Population

The population of the Aby Lagoon Complex Aby-Tendo-Ehy are classified into four distinct cantons. The cantons Adjouan, Adouvlai, Ehotilé and Essouma are located in the following:

- Aby Lagoon: Canton Adjouan and Ehotilé;
- Tendo-Ehy Lagoons : canton Adouvlai; and
- delta area: canton Essouma.

The social and political organization of the Aby Lagoon population is identical in its major components, because they belong to the same Akan/Ashanti cultural group. In these societies, kinship is the framework, which maintains relationships between individuals via a matrilineal system (Kponhassia 1995)

With regard to social organization, there is a distinct division of labor according to sex. Women generally deal with the actual processing and marketing of agricultural and fishery products while men are engaged in cultivation, as well as fishing. Furthermore, apart from their personal economic activities, the "youth" (from 15 to 35-40 years) are obliged to take an active part in the achievement of community work. As for fishing, the youth are asked, for instance, to undertake the surveillance and control of fishing activities within the village territory.

As far as political organization is concerned, they belong to the categories of societies where chieftains hold central power recognized and respected by all. At district level, a chief of district, sometimes under the authority of a king, holds decision-making power over all questions concerning the whole district. At the village level, the village chief, surrounded by his notables, takes decisions concerning the village, after consultations with representatives of his people. After appointment at the local level, the chieftains are then recognized by the territorial administration on the orders of the "Prefet" (government-appointed Divisional Administrator). It is important to note that discussion is the tool largely used to resolve the conflicts which can sometimes break out between different social groups.

Other individuals, natives of the village and those who conduct their professional activities outside the village (administration or private enterprise executives) are very much involved at different levels of the decision-making process.

But pressures of modernization, education, demographic changes and attachment of monetary value to transactions have led to a certain degree of erosion in the traditional social order. Contradictions, disputes and sometimes power conflicts arise between elders and the young. However this does not mean that these structures have lost their effective role in the shaping of local development policies and especially in lagoon management.

Fishing on Aby Lagoon

The Aby Lagoon covers some 25% of the divisional territory of Adiaké whose surface area is 1 860 km². Fishing plays a very important economic role in generating income and employment. The results

of the inquiry framework (Konan, Kouakou et Kouakou 1997) used in the present study contain very recent data.

Fishermen

There are altogether 3 260 fishermen distributed as follows: 1 100 fishermen (33.7%) working with collective gears (beach seines and union seines) and 2 160 fishermen working with individual gears (gill nets, cast nets and crab pots, etc.)

Table 1. Distribution of fishermen using collective gears per stratum

	Aby	Tendo-Ehy	Delta Area	Total
Number of fishermen	704	308	88	1 100
Percentage	64%	28%	8%	100%

On the use of individual gears, the fishermen are distributed into two types of dominating gears.

Table 2. Distribution of fishermen using individual gears per stratum

	Aby	Tendo-Ehy	Delta area	Total
Number of fishermen	1 172	98	290	1 100
Percentage	82%	4.5%	13.5%	100

Table 3. Distribution of individual fishermen per gear types

	Owners	Helpers	Total
Tilapia gill nets	512	508	1 020
Ethmalosa gill nets	465	453	918
Crab pots	122		122
Shrimp nets	50	50	100

Profile of a Fisherman

Age of the fishermen: the average age of the fishermen is 38 years. The average years of experience or seniority of service is about 10 years. It is important to note that the fishermen have been working for 3 (31%), 7 (36%) and 21 (33%) years.

Table 4. Percentage of the fishermen per age interval (year)

Age intervals	10 to 19	20 to 39	40 to 59	60 to 80
Percentage	7%	56%	25%	12%

Level of literacy: the fishermen are classified into four categories of literacy levels as follows:

- Illiterate persons, i.e., the category of fishermen who do not know how to read nor write, representing 42.10%;
- Educated at primary school level, i.e., those who attained between Form 1 to Form 6, representing 37.10 %;
- Educated at lower secondary school level, i.e., those who attained between Form 1 to Form 4, representing 16.10%; and
- Educated at higher secondary school level, representing only up to 4.35%.

Those who stopped their studies for different reasons and became fishermen represent 28.4%, whereas those who converted to the fishing profession as a result of a failed first employment represent 32%.

With regards to gear property, fishing gear collectively belongs to all citizens of the Ivory Coast on Aby Lagoon and in the delta area (Assinie). Foreign fishermen are however employed as well. Pertaining to ownership of individual gears, 89% of fishermen who use tilapia nets own them, as opposed to 84% of ethmalosa gill net users. It has been noted that the fishermen who are regularly absent entrust their tools to employed fishermen only. Their proportion however varies from 11% for tilapia net users to 16% for etmalosa nets. On the Tendo-Ehy Lagoon, 88% of the beach seines are collectively owned by both Ghanaian fishermen and traditional authorities of the lagoon villages who jointly negotiate for the fishing areas together.

As in the case of alternative jobs, fishermen try to vary their activities for two reasons, i.e., to generate additional incomes and to secure their incomes during difficult fishing periods. These alternative professions are primarily centered in three sectors, i.e., 22% in food crops (vegetables, cassava etc.), 23% in perennial crops (coffee, cocoa, palm trees, etc.) and 7% in trade, i.e., in lagoon transport, operation of businesses, etc. It is worth noting that about half of the fishermen (48%) obtain their incomes exclusively from fishing. The other 52% vary their sources of income with no corresponding effects on their activity.

Women Fishsmokers

The processing of fish (particularly smoking) is done exclusively by women, numbering some 2 284 individuals. Citizens of the Ivory Coast represent about 79% of the fish processors whereas the remaining 21% of non-Ivory Coast citizens, are largely dominated by Ghanaians (97%). Each woman works with an average of one helper who is very often a relative since the percentage of helpers having a close relationship with the tool owners (smoking rooms for fish) is 92 %.

Table 5. Distribution of fishsmokers per stratum

	Aby	Tendo-Ehy	Delta area	Total
Owners	905	180	61	1 146
Helpers	897	180	61	1 138
Total	1 802	360	122	2 284

On the average, the fishsmokers have four children each, of whom 79% are married against 20.3% singles. With regards to the educational level, 79.7% of the women fish processors are largely uneducated, 17.9% have at least been to primary school, 2.2% have had secondary school education and 0.1% have attained higher levels of education.

Women Sellers of Fresh Fish

The number of women involved in the fresh-fish trade as a main activity is relatively small, numbering only about 136 people. Of these 79.4% are Ivory Coast citizens whereas the remaining 20.6% are foreigners. Their helpers are often relatives (96.24%). Most of them are married (62%). The singles in turn represent 38.34%. These women have three children each on the average. More than half of the fresh-fish sellers are illiterate (59.56%). However, this type of activity seems to attract more young girls who didn't complete their studies. The remaining 31.6% have attained primary school level, 6.6% lower secondary school level and 2.2% higher secondary school level.

Fishsmokers/Sellers of Fresh Fish

There is a group of women who sell fresh fish and smoke fish at the same time, numbering 195 persons. As a matter of fact, this is essentially a group of women who are less "specialized" in their trade, rather "opportunists" who seize possible chances to profit from their trade. Consequently, it

seems that the processors and marketing of the fish products respect a kind of division of work, even specialization. The fishing activities are characterized by a vertical economic integration.

Means of Production

On Aby Lagoon, many types of gear are used. They can be gathered into two categories, i.e., collective gears and individual gears.

Collective gears. Most of the collective gears are concentrated on Aby Lagoon, i.e., about 71% of them, with 66% beach seines.

Table 6. Distribution of collective gears per stratum

Stratum	Beach seines (BS)	Union seines (US)	Total	%
Aby	33	9	42	71
Tendo-Ehy	13	-	13	22
Assinie	4	-	4	7
Total	50	9	59	100

Due to its particular hydrology and relative abundance of *Ethmalosa fimbriata*, the union seines which replace the gill nets are only found on Aby Lagoon.

Individual gears. They are many and varied, as follows:

Table 7. Distribution of individual gears per stratum

Stratum	TG	EG	TrG	SN	CP	LI	EP	CN	BAM
Aby	1 086	3 062	1 082	128	6 039	330	585	135	15 803
Tendo-Ehy	756	185	1	0	60	63	1 036	60	64 183
Assinie	121	145	3	73	36	4	80	27	0
Total	1 963	3 392	1 086	201	6 135	397	1 701	222	79 986

TG: Tilapia gill nets; EG: *Ethmalosa* gill nets; TrG: *Trachinotus* gill nets; SN: Shrimp nets; CP: Crab pots; LI: Longlines; EP: Eel pot (*Tilapia*); CN: Cast nets; BAM: Bamboo.

Each stratum presents one or many dominating gears. However, the Aby Lagoon seems to be the most dynamic stratum as a result of the number and variety of gears in use. Three types of gill nets are dominant there; i.e., 55% of tilapia nets, 90% of ethmalosa nets and 99% of trachinotus nets are found.

Canoes. Two types of canoes are found on the Aby Lagoon complex, i.e., dugout and planked canoes. The dugout canoes, taking into account all sizes number 803 and represent 78% against 225 planked canoes, or 22% of canoes being in use.

Table 8. Types of canoes on the Aby Lagoon Complex

	BDC	MDC	SCD	BPC	MPC	SPC	Total
Number	124	200	479	66	68	91	1 028
Percentage	12	19.5	46.6	6.4	6.6	8.9	100

BDC - big dugout canoes; MDC - medium-size dugout canoes; SDC - small dugout canoes; BPC - big planked canoes; MPC - medium-size planked canoes; SPC - small planked canoes.

Fishsmoking rooms. The fishsmoking activity is also very important in Aby Lagoon. More than 98% of the ethmalosa landed is smoked and sold. The transformation process is achieved through two steps to take into account the fact that the market is opened weekly in the vicinity of the lagoon. The fish therefore goes through a first phase of smoking in either small smoking rooms made with 200-litre

empty barrels or in small barrel-shaped smoking rooms made with baked clay. After this process, the fish is stocked in smoking rooms of bigger capacity (used also for conservation purposes) and heated with a soft fire while awaiting market day

Table 9. Different types of smoking rooms

	BBS	BSC	SMS	SSC	Total
Number	1 065	1 241	3 759	581	6 646
Percentage	16	18.7	56.6	8.7	100

BBS - big barrel-shaped smoking rooms; BSC - big smoking rooms made with baked clay; SMS - small barrel-shaped smoking rooms; SSC - small smoking rooms made with baked clay.

For the first phase in the above mentioned process, women tend to use the smaller 200-liter empty barrels more as these represent 56.6% of the selected smoking rooms. The larger smoking rooms are constructed more with baked clay as opposed to the empty barrels.

Marketing

Post-fishing activities, primarily the marketing of fish is generally done by women.

Fish supply. In general, fish are landed in villages where 94% of the women fish processors make their purchase, whereas 16% of the fresh-fish retailers (secondary sellers) travel in canoes to purchase the fish from fishermen on the lagoon. They travel in either hired canoes (77%), in their own canoes (20%), or in borrowed canoes (3%). That way of having access to the "raw material" concerns the women of the areas where there are no fishery units with beach seines. That is the case of the women fishsmokers and fresh-fish sellers of the town of Adiaké.

Though 58% of them obtain their supplies from any fisherman, an important number of the fish processors and retailers remain attached to some fishermen to secure their supplies. In the fishermen-seller relationship, family links can be helpful. These links are determined more by the supply of the women fishsmokers coming from the villages to which the fishing teams belong (fish are sold first to the family members), and less for the fresh-fish sellers, where only 28 % of their providers are relatives.

Payment mode. With regards to fish purchases, cash payments dominate the relationships between fishermen and the women. However, the number of women who rely on credit with some fishermen seems to reflect a satisfying level of confidence.

Table 10. Fish payment mode to women

	Fishsmokers	Fresh-fish sellers	Fishsmokers/Fresh-fish sellers
Cash payment	57%	72%	70%
Credit payment	43%	28%	30%

The percentage of women who obtain their supply from credit is higher with the fishsmokers (42%) as opposed to fresh-fish sellers. That trend seems to confirm that in the villages, family links contribute to the consolidation of the confidence between fishing teams and the fish processors.

The sale of fish in turn is determined by the nature of the fish produce itself. Fresh fish are sold everyday of the week apart from Wednesdays (fishing is forbidden on Tuesdays) as the trade of smoked fish dominates that day. About 90% of respondents affirmed that they sell the fish to any buyer every day with no distinction of family links, with only 9% of the buyers selling only to family. The sale is done with cash payments (90%) against only 10% on credit.

For the sale of smoked fish, it must be noted that fish processors are fishsellers as well; and 81% of fishsmokers sell their products at the weekly market. Fish are sold to buyers without any distinction

(82%) made for family members. The percentage of regular buyers is relatively weak (14%) as well as preferences for relatives (3%) and partners (0.8%). Very few fishsmokers sell their fish on credit (7%), as most of them sell strictly on cash terms (93%).

Table 11. Selling of fish products

	Fishsmokers	Fresh-fish sellers	Fishsmokers/Fresh-fish sellers
Every day	19%	90%	75%
Weekly market	81%	10%	25%

Selling of the smoked fish. The most important weekly market around the Aby Lagoon complex is that of Adiaké, followed by Tiapoum and then Eboué and Mowa. The profile of the buyers (essentially people who do not dwell at the place of production, but purchase the fish to retail them inside the country) will be analyzed using inquiries made in the Adiaké market. Women dominate the sector with 117 regular traders, i.e., 89% against 11% men. The number of retailers in turn has decreased 19% from 1997 to 1998.

The most representative age interval is between 31 and 55 years, that is 86 women (74%) and 11 men (73%)

Table 12. Distribution of retailers by sex and age

Age interval	1996		1997		1998	
	Women	Men	Women	Men	Women	Men
16 to 30	18 (18%)	1 (11%)	21 (13.8%)	2 (20%)	14 (11%)	1 (7%)
31 to 55	72 (72%)	7 (89%)	115 (75.6%)	7 (70%)	86 (74%)	11 (73%)
56 to 75	10 (10%)	1 (11%)	16 (10.5%)	1 (10%)	17 (15%)	3 (20%)
Total	100 (91.7%)	9 (8.3%)	152 (94%)	10 (6%)	117 (89%)	15 (11%)
Total	109		162		132	

It is a market where many sellers and buyers meet each other, marked by the scattering of places of exchange around the lagoon (six market-days per week around the vicinity of the lagoon).

Economic Considerations

In 1996, the team of the Project for the Development of Artisanal Fishery in Aby Lagoon completed a study on the costs and incomes of the fishery units. Three fishery units (beach seines units, union seines units and ethmalosa nets) were compared.

Table 13. Economic indicators of three fisheries units (in US\$*)

	Beach seines	Union seines	Ethmalosa gill nets
Investment	20 000	7 000	420
Turnover (TO)	23 300	8 793	3 255
Intermediary consumption			
- Care	540	54	99
- Self-consumption	2 330	169	221
-Total intermediary consumption	2 870	223	320
Amortization (equipment)	2 000	416	144
Net Added-Value (NAV)	18 443	7 877	2 650
Opportunity Cost of Job	8 433	1 067	800
Opportunity Cost of Capital	3 428	1 179	538

Rent	6 581	5 631	1 312
NAV/TO	79%	90%	81%
NAV/fisherman	802	1 969	1 325
Rent/TO	28%	64%	40%

*US\$1 = 600 f cfa

Investments. Of the three fishing gears, the beach seine requires the highest capital with an initial level of US\$20 000, followed by the union seine with US\$7 000 and the Ethmalosa net costing US\$400. The craftsmen provide their own funds.

Benefits. The rate of profitability (net product/invested capital) is about 20.7% for beach seines, 52.2% for union seines and 334% for Ethmalosa nets. The individual operator with a low level of investment presents the highest rate of benefit, explaining thus the economic rationality of the individual fisherman who gives up the less profitable gears and reacts with much dexterity to the variations in the economic and ecological environment.

Employment. The collective fishing employs some 1 100 fishermen against 2 160 fishermen for individual fishing. The cost of employment in collective fishing is four times higher than individual fishing.

Wealth creation. The value-added rate that is retained as a criterion of evaluation of the resources is about 90% for beach seines. It is followed by the fishing units with Ethmalosa nets, which have a value-added rate of 81%, equal to the one recorded by union seines. It is worth noting that for unequal investments, fishing units relatively create the same level of wealth.

Rent. The rent corresponds to the benefits acquired once the work and capital have been paid at their relative costs. It can be noticed that fishing units with beach seines get a low rental rate of 28% contrary to the union seines, with a relatively high rate of 64% and the Ethmalosa nets with 40%.

In summary, fishing on Aby Lagoon is characterized by its diversity. It has very quickly evolved since the 1980s from subsistence-level fishing to commercial fishing, marked by a low level of self-consumption by the fishers, a relatively high cost of investment; and exploitation strategies have turned towards research for benefits.

Table 14. Self-consumption per type of fishing gears

	Beach seine	Union seine	Ethmalosa gill net
Self-consumption (% of catches consumed by the fisherman and his family)	4%	2%	4%

Co-management and Bioeconomic Impacts

The search for local participation in the management of Aby Lagoon's halieutic resources has always been the concern of the Aby Lagoon Complex managers. However, the lack of a clear strategy and strong will did not permit realization of the expected goals. The ongoing test capitalizes past experience and relies on the will of the population to safeguard their patrimony.

History of the Fisheries Management

From the 1950s onward, the fishing techniques began changing with the substitution of the nets made from natural fibers with nets made with cotton reels, followed by nylon, and finally with industrially-manufactured yarns. These new gear types enabled them to increase their catch, and as the fishing effort developed, it changed the distribution of fisheries' wealth to the benefit of seine owners.

During the 1960s and 1970s, the fisheries sector generated more important capital. This development was evident within the Ivory Coast's socioeconomic context, which was characterized by strong economic growth which favored the emergence of investors, and inclination of youths towards agriculture. The rural exodus phenomenon is expressed through an increased engaging of the Ghanaian

fishermen for the collective fishing with beach seines. In the late 1970s, a more pronounced division between two types of fishing was observed on the Aby Lagoon as follows:

- Modern collective fishing (beach seines, purse seines, etc.), targeting profit-oriented production;
- Individual traditional fishing (gill nets, cast nets and long lines) gradually becoming a form of subsistence fishing.

The outcome of this division was a weakening of traditional fisheries management systems, which relied on the issuance of access rights as a control over fisheries.

The end of the 1970s and beginning of the 1980s marked the first cycle in the recent evolution of fisheries on Aby Lagoon. This period coincided with an unfavorable economic climate in Côte d'Ivoire. The degradation of the macroeconomic indicators was evident of a crisis in the agricultural sector (falls in the price of raw materials of coffee, cocoa), low agricultural production, and the destruction of many plantations following drought and bush fires). All this undoubtedly increased fishing pressure around Aby Lagoon.

During this period, a new fisheries development policy evolved within a global framework aimed at achieving food self-sufficiency. This policy was based on the promotion of the cooperative movement, and especially the Cooperative Oriented Groups (GVCs). Thus, from 1979 to 1980 the National Bureau of Rural Promotion (ONPR), in collaboration with the National Bank for Agricultural Development (BNDA), initiated a loan program for Aby Lagoon GVC fishermen to enable them to acquire motorized purse seines. The ONPR worked with the fisheries project office set up in Adiaké since 1966. The first cycle of the program coincided with an exceptional year at the halieutic resource level, with the program accelerated and 20 GVCs equipped within two years.

In 1979 the first institutional tool for fisheries management on Aby Lagoon was established with the implementation of a follow-up program for compiling catch statistics by the Oceanographic Research Center (CRO). This project was in collaboration with the Fisheries Office.

At the beginning of the 1980s, fishing on the lagoon was characterized by debt-ridden artisanal method and fishermen needed to increase their fishing effort to cover not only important fixed costs, but also escalating costs in intermediary consumption such as fuel. There was a gradual bioeconomic decline in fisheries with social drawbacks affecting the whole lagoon.

From the period between 1982 to 1984, several events occurred which led to low production, i.e., 1980 (6 030 t), 1981 (3 630 t) and 1982 (2 130 t), evidently showing the limits of a traditional system of regulation and conflict resolution in the lagoon area. The fishermen were the first to request for state assistance for their traditional fisheries management system and as a result, in 1982, all relevant parties convened and agreed on the following terms:

- Closure of the fishing season for six months;
- Institution of a fishing license;
- Reduction of seine length from 1 200 meters to 600 meters; and
- Enlargement of the mesh size from 28 mm to 60 mm;

Nevertheless, several setbacks were evident from application of the above measures such as the following:

- The mesh reduction concerns only the pocket, a measure quickly avoided by the fishermen;
- The minimum mesh size was reduced to 50 mm instead of 60 mm and not applied in spite of the earlier decision made;
- The net length remained unchanged at 1 200 m; and
- The fishing license system was hardly applied despite being maintained.

In 1985, the Project for Artisanal Fishery funded by FIDA and executed by the African Bank for Development initiated its activities. Its targets were oriented towards the organization and development of the fisheries. In 1986, signs of the resource over-exploitation were recorded again, declining from 6 090 t in 1986 to 1 190 t in 1987, recalling a similar period that preceded the last decline in stocks in 1981. A new closing of fishing activities was decided again in 1987. It was a total closing that concerned all the gear types.

The 1988-1990 period in turn marked the break between the administration and the fishermen. On opening the fishing season, a notable change in the Aby Lagoon fishery form was noticed as follows.

1. Fishing for all the seines had been commonly decided and that decision was respected.
2. Fishing for all seines was forbidden, and applicable especially for motorized seines which were no longer profitable. As a result, the fishermen partly changed to purse seines and gill nets. Under the pressure of Etuéboué and Erokoan fishermen, the Project was obliged to tolerate some beach seines whose number increased until April 1988.
3. The influence of traditional authorities was reinforced as far as the fishing rights enjoyed by foreigners was concerned. Fishermen from Mali were forbidden whereas Ghanaian fishermen were expelled from Etuéboué.
4. The Project tried to be more actively involved in fisheries management by requesting the assistance of the CRO to examine strategies for fishery regulation through a combination of using the closed-season approach, controlling both the type and number of gears, and stipulating a minimum mesh size to maximize catch and economic rents. However the situation gradually worsened until 1990 when the administration finally attempted to organize fisheries through the fishing effort regulation in collaboration with traditional authorities.

In July 1990, a group of young natives of the lagoon villages led many attacks against the foreign fishermen (Ghanaians, Beninese and Togolese), destroying any sort of property. On July 25, the Fisheries Office was destroyed at night; with the equipment and a car burned and staff physically threatened.

The reasons may still be attributed to the endogenous and exogenous factors plaguing the fishermen. From preliminary assessments, it was apparent that those principally responsible for the attacks were the youth from the different villages.

The “exogenous factors” include disturbances in the 1990 school year, when employment was scarce forcing many young people to return to their respective villages despite having completed their formal training, as well as changes in the existing political environment, which was beset by the formation of many political parties. The younger natives were also involved in generational conflicts; they claimed to seek a better social future. On one hand, the elders favored the stay of foreigners who provided incomes to the villages but on the other hand, the youths wanted a significant part of the economic rent drawn from the lagoon exploitation for their well-being as part of the local populace.

“Endogenous factors” in turn refer to the presence of important foreigner communities monopolizing access to fisheries on the lagoon. The Project was accused of favoring them by not taxing them, but instead taxes were imposed on native fishermen. There was communication deficiencies between the Project and the local populace and inadequately-funded loans granted to local fishermen. Following these unfavorable events, the Project ceased its activities from July 1990 to September 1992. It was nevertheless resumed after that inspite of the prevailing environment of suspicion and distrust.

This diagnosis is evidence that there have been past attempts to encourage formal association of the lagoon communities for fisheries management. The results were relatively acceptable and in 1993, the government showed a more active will to organize the Aby Lagoon fisheries management not by mere consultation nor by association alone, but with the effective participation of the local populace as well.

Attempts at defining co-management. According to Black-Michaud and Johnson (1984), any person who collaborates with other people to reach a commonly-decided target “participates.” “Participation” therefore is a co-management tool defined by Pomeroy and Williams (1994) as “the sharing of responsibility and/or authority between the government and the local users of a resource in order to manage the resource.” Participation and co-management supposes that the local users are ready to

associate themselves to participate on the basis of conventional rules and that the Government is ready to share its responsibilities and authority with structured local users.

Framework for Co-management

Co-management is based on rules determined by all partners through consensus. These rules are essentially based on the recommendations of a seminar organized in the Grand-Bassam in 1995, which permitted the setting up of a framework organization for the Aby Lagoon fishery. The concern of the lagoon population was broadly taken into account in the search for a balance between modern and traditional rule systems. Among the recommendations formulated from the seminar are as follows:

Mesh Size

- For collective gears (beach seines and union seines), a 40 mm mesh size for the whole body net was adopted,
- For ethmalosa nets, a minimal mesh size of 40 mm was adopted;
- For tilapia nets, a 70 mm mesh size was adopted; and
- For cast nets, a 35 mm mesh size was adopted.

Seine Length

The beach seines length should not exceed 1 600 m on the Aby Lagoon and 1 000 m on Tendo-Ehy.

Bays (Reserves)

Due to the significant contribution of the renewal of lagoon resources through their functions of spawning, refuge and nurseries, the 10 bays: Etuessika, Mélékoukro, Assomlan, N'Guiémé, Akounoubé, Eboinda, Ebobo, Tiapoum, Mama and Adiaké were declared as reserves. In these reserves, commercial fishing was forbidden and villages beside these bays had the duty to look after them.

For the specific case of the Etuessika bay, the prefectural administration was entrusted to reconcile both communities to draw equal benefits from the bay exploitation. For this purpose, the constitution of an ad hoc committee was recommended to resolve the conflict.

Apart from these bays, fishing is authorized on the whole lagoon surface with regard to the respect of the text regulating the attribution of fishing licenses. However, it had been announced at this seminar that some villages unilaterally delimited some lagoon areas they considered their own reserves. To this purpose, the seminar asked the administrative authority and the technical services to order the concerned villages to free these areas in order to reintegrate them to the whole lagoon body and make them accessible to all. Exceptionally, the districts having no natural bays have been permitted to create some. Their technical characteristics would be defined by the technical services.

Deep Water Fishing

With regards to the prohibition of fishing in deep waters, which is in fact a tacit agreement between all the lagoon villages, the seminar took note of these measures and suggested that the application of this regulation be subjected to customary norms until the implementation of the new management dispositions.

The Fishing Season

Taking into account the reproduction cycles of lagoon species, the lack of selectivity of fishing gears (beach and collective beach seines) and the specific hydrology of each large fishing area, the seminar recommended a closed fishing period of four months minimum each year for collective nets, starting from May with the option of changing this period each year.

Fight Against Fishing with Poisons

Considering that fishing with the use of poisons represents a real danger not only for lagoon stocks but also to human health, the seminar recommended the following measures:

- To vigorously fight this practice,
- To take actions to sensitize and inform the fishermen on the impacts of such poisons on human health and the environment,
- To set up surveillance brigades equipped with appropriate means to monitor nonconformity,
- To take immediate dissuasive sanctions against offenders through rapid processes, and
- To mobilize the local populace to eradicate this practice.

Prioritize Fishermen from the Ivory Coast

This essentially involves the initiation of actions (formation, equipment, and organization, etc.) that favors the involvement of youths in the fishing sector.

Fishing Licenses

The administration would bear the cost of printing licenses to facilitate the fishing activity.

Environment

In terms of ensuring environmental wellbeing and ecological sustainability, the seminar agreed essentially to scientifically follow the evolution of the Assinie channel, to fight against floating aquatic plants and to follow the growth of the periodic algae.

One must note that the recommendations of the seminar in relation to the lagoon exploitation express the transitory period well in the mode of the lagoon management. In fact, the seminar explicitly recognized the competence of the traditional authorities in some areas, notably the management of the areas known as “deep water” areas. In this aspect, the co-management strategy seemed first to tacitly or explicitly recognize the areas of influence and/or competence of the different partners so that through concerned strategies, the integration and/or the renewal can be done to reach the stage of shared responsibility.

Organizational Structures

After approval of these rules, organizational structures had to be set up for the application and evaluation of these rules. The Project favored the creation of village and cantonal committees.

Village committees. Following the recommendations of the seminar, 26 village committees have been set up on the whole lagoon complex (Aby-Tendo-Ehy).

The committee has a staff whose head is elected at the level of each village by the villagers at a public meeting and under the authority of the village chief. The committee is headed by a president and supported by a vice-president, a secretary-general, a secretarial assistant, a treasurer-general, an assistant treasurer and four ordinary members. On the average, there are 10 members per committee. It rules that any fisherman in the village may be required to do duty on the lagoon. The duties of the committee are as follows:

- To assure the surveillance of the water surface,
- To control the mesh size and nets used by the fishermen,
- To retrieve from the water any net which does not respect the regulating dispositions and entrust it to the village chief instead,
- To participate with the Fisheries Office team in the checking of the mesh size of the collective gears and ensuring that the program for changing the mesh sizes is respected,

- To conduct surveillance of the bays declared as reserves, as favorite habitats of the fish (refuge, spawning and nurseries) where commercial fishing is forbidden,
- To ensure that the closed periods are respected,
- To monitor use of toxic products as means of catching fish,
- To propose relevant management measures,
- To represent the interests of the users, and finally
- To represent the users at any meeting related to fishing or lagoon management, and contribute towards conflict resolution.

Cantonal committee. The cantonal committee was set up in January 1998 with the expressed will of the lagoon population. It comprises all the chiefs of the villages centers of the two cantons (Adjouan and Ehotilé) along Aby Lagoon (Figure 3). The head is elected by his partners and is empowered to set up his staff. The head's mission is to assure surveillance and control that go beyond the limits of a village, to resolve conflicts between villages in fishery matters, to propose relevant management measures and to represent the interests of the users.

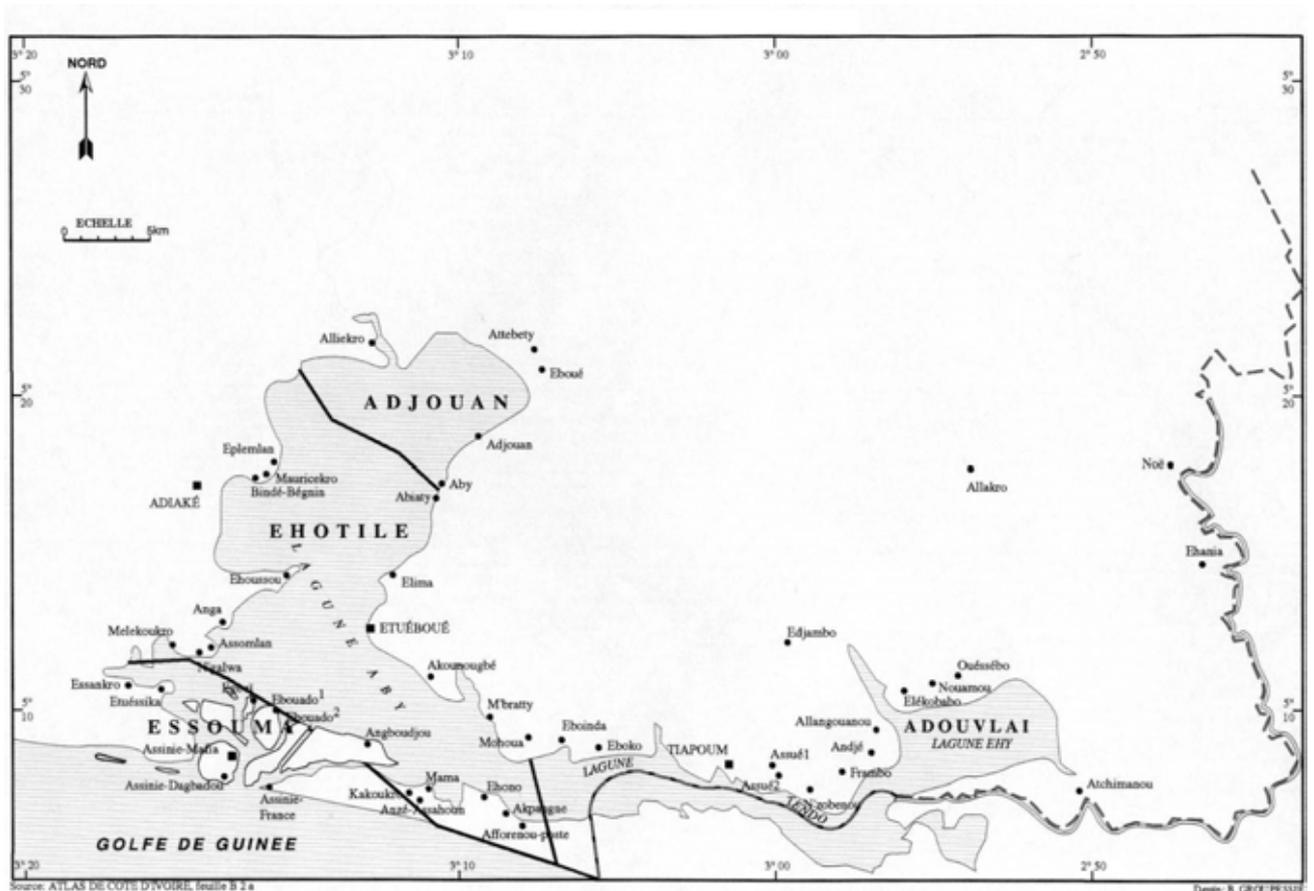


Fig. 3. Local authority in the lagoons

The leading staff of the cantonal committee on Aby Lagoon comprises the following:

Table 15. Leading staff of a cantonal committee

Role	Village	Canton
President	Etuéboué	Ehotilé
1st Vice-President	Adjouan	Adjouan
2nd Vice-President	Assomlan	Ehotilé
Secretary –General	Aby	Adjouan
Secretary –General Assistant	Abiaty	Ehotilé
Treasurer –General	Akounoubé	Ehotilé
Treasurer –General Assistant	Eboué	Adjouan
Auditor	Etuéssika and Mélékoukro	Ehotilé
Members	M'Bratty and Eplemlan	Ehotilé

To make the structures functional, a consultation framework was created.

Consultation Framework

The consultation framework is defined as a means whereby different partners in the management periodically meet to discuss and evaluate the programs in application. It consists of four meetings held each year, i.e.:

- Two evaluation meetings, i.e., one on the opening of fishing (in May of each year) and the other in September on the closing of fishing;
- One public meeting for the closing and opening of fishing presided over by the administration authority (Sous-Préfet or Préfet) and a public meeting for opening of fishing.

The two evaluation meetings are held at the Fisheries Office with the staff of the cantonal committee (all the village chiefs) and the head of the village committee with his secretary. These meetings precede either the closing of fishing or its opening. It is a forum during which the Fisheries Office makes an evaluation of the agreed actions relative to the application of the seminar recommendations and to the state of the production statistics. The decisions take into account the observed evolution.

For example, during the evaluation meeting of the opening of fishing in May 1997, the committee revealed that the ethmalosa resource was so abundant that fishermen were inclined to fish with an excessive number of gill nets that they were unfortunately unable to undo later. As a result, they left the nets in the water to let the fish decay. Then, they just had to shake the nets and take them out of the water. This practice however spoiled the resource and therefore, the fishermen recommended that the number of ethmalosa gill nets used per fisherman be fixed at 10. The meeting approved that decision. The decision was publicly communicated and applied.

The second example: at the evaluation meeting of the closing of 1998, during which the change of mesh size of collective beach seines was approved the meeting decided that:

- Transport costs incurred by Fisheries Office staff must be borne by the gear owner, who must provide the fuel, and that

- The owner must pay US\$4 to the village committee where the net must be measured and US\$8 to the committee coming from another village.

In fact, the beach seines with an average length of 1 200 m must from then onwards use a mesh size of 40 mm to replace the 28 mm bar mesh. The program will last for three years (1997-99) with a change of a third of the length per year. It has been noticed that the committees were mobilized and actively involved in checking the mesh sizes.

Institutional Structures of Co-management

To assure the participation of all in the setting up of the organizational framework, an informal institutional structure of co-management was set up, however with no administrative basis. It comprises the following:

- Village committees, i.e., a basic committee set up in each lagoon village whose role is to apply the rules and measures of co-management in the village, and
- The cantonal committee, which gathers all the lagoon village chiefs. It has a functional relationship with the village committees.

Both structures, inspite of their non-formal existence, are still acknowledged by the following parties:

- The Fisheries Office, which is the technical representative (official) of the Ministry of Agriculture and Animal Resources,
- The Department of Fisheries and Aquaculture, which is the central department which puts into practice government policy in matters pertaining to the management of hydrography,
- The Ministry of Agriculture and Animal Resources, which defines the national policy for the development of agriculture and animal production (fisheries and aquaculture included), and
- Local representatives of the Government (Sous-Préfectures, Préfecture). Their role is to implement local administrative actions or regulations decided by the Government.

The institutional structure (Figure 4) seems to be functional. It assures the participation of users in the decision-making process and in their application. However, it is very precarious because of its informal status. In fact, the actions on the ground have out-distanced the administrative practice and for the time being, no legal dispositions permit the formal recognition of the existence of representative structures of users. The passing of a bill is expected to contribute to the improvement of the situation on Aby Lagoon while reinforcing the ongoing process.

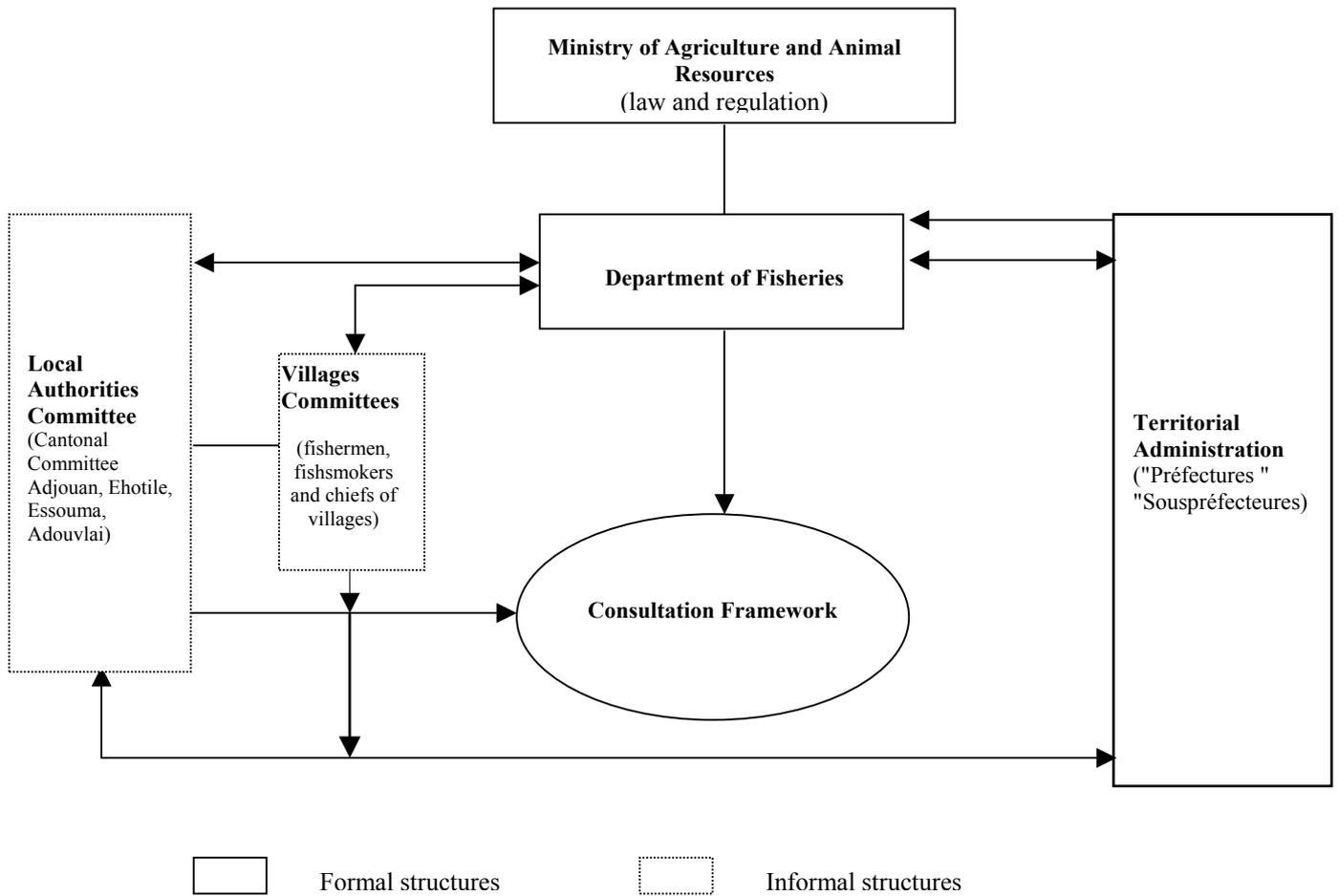


Fig. 4. Decision-making process on Aby Lagoon

Preliminary Results of the Bioeconomic Impacts

After three years of experiments of the participative approach, relevant results which have been recorded are presented below.

Mesh size. The application of a strict regulation related to the mesh size of all gears used over the Aby-Tendo-Ehy Lagoon Complex is absolutely necessary to restore the halieutic resource.

Collective Gears

With regards to the beach seines, the decision to widen the mesh size of beach seines from 28 mm to 60 mm was taken in 1982 after the first crisis of over-exploitation. However, it was not applied then. In 1995, the same decision was reaffirmed and implemented successively, giving the following results:

Table 16. Evaluation of the changes of beach seines mesh sizes

	Number of nets	1997		1998	Percentage of achievement
		Change of one-third	Change of two-thirds		
Assinie	4	0		2	50
Tendo-Ehy	15*	8		8	100
Lagune Aby	40	34		35	87.5

Note: There were 15 nets initially but as soon as the application commenced, 7 nets were withdrawn.

The program first started on Tendo-Ehy since 1996, then on Aby Lagoon in 1997 and in the delta area in 1998. The organization at that time permitted the Fisheries Office to master the process in each sector and to draw lessons to better improve the operation in the other sectors.

The owner whose net is ready is visited by an official from the Fisheries Office accompanied by two or three members of the fishery committee in the village and from the nearest neighboring committee. The net is measured along all its length but sometimes the owner reduces the proportion of his net mesh size to make his gear conform to the regulation. At the end of the visit, the fishing team receives a document authorizing the team to fish. This document which is not paid for is necessary before inserting the net into the water.

In the Tendo-Ehy Lagoon, most of the nets belong to Ghanaians. Since the beginning of the application of the measure, the number of nets in activity fell from 15 to 8, a reduction of 7 nets. That is, a reduction of the nominal fishing effort of 46.6%. All the nets changed their total length in mesh size of 40 mm.

On Aby Lagoon 40 beach seines have since been selected. The rate of the program achievement is 87.5%, representing 35 nets in 1998. The five other nets which did not change their mesh sizes received no authorization to fish for the season 1998-1999. In the delta area however, two out of four nets were permitted to fish.

The population through the village committees largely contributed and enabled the attainment of this target with a satisfying level of the program achievement.

Purse seines present a particular case although as a matter of fact, their case had not explicitly been mentioned during the seminar. Furthermore, their fishing season lasts nearly only four months (from October to January), which causes them to be confronted with a problem of profitability. Apart from that, they defend a kind of specificity. They exclusively fish for ethmalosa. Despite their mesh size (28 mm), the teams pretend to be capable of avoiding the "smaller" fish and therefore not catch them. They believe it is not necessary to alter their mesh size as they practise selective fishing. That argument won the sympathy of the committee members and even that of the cantonal committee which organized a meeting with the Fisheries Office to address the issue. Finally, in order to convince all, it was decided to test for selectivity with the 40 mm mesh size to ascertain the validity of the argument. These tests are

to be achieved with the owners of this kind of gear and the Fisheries Office. The conclusions will determine the decision to be taken.

Individual Gears

The individual gears concern the gill nets and cast nets. The village committees confiscated and destroyed many non-prescribed nets. Lack of statistics however does not permit the quantification of the extent of the phenomenon. It is worth noting that the committees efficiently contributed to the application of the said measures.

Seine lengths. The seine length has been imposed through financial requirements necessary to facilitate the change of the mesh size. The initial average length of the nets was 1 200 m. In 1997, it fell to 908 m, or a 24.3% reduction; in 1998, the average length was 842 m, a further reduction of 66 m or 7%. As a result of the high cost of the net, the change of the mesh size contributes significantly to reduce the average length of the nets and consequently reduce the nominal fishing effort. One must note that the owners made less effort in 1998 than in 1997. In 1997, on the average, 338 m of net length had been changed per team. In 1998, the change was 230 m, i.e., a difference of 108 m.

Bays. Since 1990, the will of the population to change certain bays on Aby Lagoon into reserves where fishing would strictly be regulated to their benefit had increased. The use of these reserves is so important for the local populace that each village wants to possess one each. Studies had shown that the bays constitute appropriate habitats for the fish refuge, spawning and nurseries. There were 11 such bays after the seminar of 1995, following the creation of the Etueboué bay.

In 1998, a workshop organized on bay management with the committees and the village chiefs enabled the determination of rules for bay exploitation through the following measures:

- They are closed throughout the year,
- Commercial fishing is forbidden in the bays,
- Village committees have the responsibility for surveillance of the bays,
- Fishing in bays is subject to a prior authorization by the Fisheries Office, and
- After fishing, part of their income is given to the village committees to support their work.

These measures are aimed at protecting the bays and controlling their rate of exploitation. The applications for permission to fish formulated by the villages display the respect accorded to these rules.

Fishing in deep waters. The area of the Aby Lagoon called “deep waters” where the fishing activities of beach seines are forbidden, is a relatively limited area whose particular hydrology (channel of Bia river and the lagoon) makes the lagoon nutrient-rich and consequently increases its productivity. This area plays a role in establishing spawning and nursery areas and must imperatively be preserved.

Exclusive power has been given to committees to resolve problems related to the management of the area known as “deep water.” However, the technical service must commensurate with the necessary assistance for better comprehension of the stakes. The workshop organized in August 1998 allowed the fishermen to specify the form of management. Fishing is not totally forbidden there but is regulated. Thus, fishing is authorized for beach seines but with the condition for the team to stay on the bank to pull the nets after fishing. Fishing in full waters is forbidden. The present practice, introduced by Ghanaians, consists of fishing in full water where the net is pulled from the canoe.

The nonconformity of these rules by the beach seine owners leads to heavy taxes. The cantonal committee organizes patrols and receives taxes.

Fishing seasons. Pertaining to the fishing seasons, the closing lasts four months on Aby Lagoon and in the delta area, and six months on Tendo-Ehy. The opening in turn lasts eight months on Aby Lagoon and in the delta area, and six months on Tendo-Ehy.

Closing of Fishing

The closing of fishing concerns only the beach seines. It is not a total closing. The individual gears are utilized for more selective fishing throughout the year. The closing periods are determined according to the dominant species in each area.

In Aby Lagoon and the delta area, the dominant species, i.e., *Ethmalosa fimbriata* breeds in March-April. The recruiting is done in August, with the closing aimed at protecting the smaller ones. Fishing is closed from the 1 June to 30 September. The public meeting presided by either the “Sous-Préfet” or “Préfet” is held in the month of May every year but with the participation of the fishermen, committees and the Fisheries Office.

During the closing, it has been decided together with village chiefs and the committees a process of allowing an exceptional authorization for fishing in case of ascertained needs. For that, the village concerned (i.e., the village chief and committee) informs the president of the cantonal committee. The latter formulates a request to the Fisheries Office which then delivers the authorization and chooses the committees responsible for its application. This process has been respected by all villages which were in need. Thus, 8 authorizations were delivered during the closing season of 1998, with 6 on Aby Lagoon [Aby (2), Aboisso (1), Etuéboué (1), Assomlan (1), Etuessika (1)], and 2 for Assinie.

In Tendo-Ehy, the dominant species have a continental affinity and so they breed during the rainy seasons. The spawning and breeding must be protected. Furthermore, this rainy period is chosen by the fishermen to temporarily stop their activities. The combination of the fishing habits and the species biology permitted the “settling” of the closing period from 1st June to 30 November each year. The public meeting for the closing is held in May of every year, presided by the “Sous-Préfet.” To avoid possible fraud, it has been decided that the Ghanaian fishermen working in Côte d'Ivoire must keep their gears in their home village. The villages resolutely decided not to host any team that uses its own equipment.

Since the implementation of the measures in 1996 and with the vigilance of the village chiefs and committees who patrol on their own initiative, the closing is actively respected.

Opening of Fishing

In the Aby Lagoon and delta area, the public opening is held in September and presided over by the “Préfet.” In Tendo-Ehy the public opening is held in November of each year and presided over by the “Sous-Préfet” of Tiapoum.

Fight against fishing with toxic products. The use of poisonous products as a means to catch fish on Aby Lagoon is a plague that must actively be fought. Though it is difficult to establish statistics to follow its evolution, there seems to be a reduction. Thanks to the committees’ actions, four offenders have since been caught and imprisoned for two months. During the patrols, if the equipment of the offenders is abandoned at the fishing place and traces of toxic products are found in the canoe by the committee members, the canoe is destroyed together with the nets.

Resolutions of the 1995 seminar, which constitute the framework of fisheries organizations on Aby Lagoon, have been applied. It is worth pointing out that the resolution whose application requires the involvement of the population, seem to give the most convincing results. This is opposed to the points related to the promotion of national fishermen, the environment and fishing licenses which depend on the government. The state hastily enters into engagements but does not always fulfill them. That often discredits them before the population.

The actions undertaken in terms of shared responsibilities (public authorities and users) can durably motivate only if the social and bioeconomic effects are perceived by the different partners.

Production

Over-exploitation occurred in 1981, 1982, 1987. The crisis experienced in 1990 was more of a social nature than a crisis of production. Since 1991, a period of stability and even improvement of the level of landings have been witnessed. The production has even doubled since 1995 (Figure 4) whereas the methods and basis of data treatment have not changed.

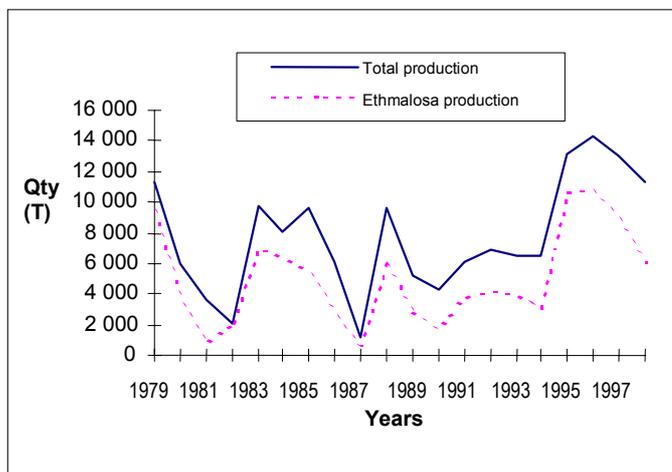


Fig. 5. Production statistics from 1979 to 1998

The *Ethmalosa fimbriata* remains the dominant species. Five other species also contribute to the production with levels of contribution that vary from one year to another.

Table 17. Commercial species of the Aby Lagoon

	<i>Ethmalosa</i>	<i>Elops lacerta</i>	<i>Tilapia spp</i>	<i>Chrysichthys spp</i>	Crabs	Shrimps
1994	46%	14%	14%	8%	7%	-
1995	82%	4%	5%	3%	1%	-
1996	76%	1.6%	5.1%	5.7%	3.5%	-
1997	68%	4%	2%	5%	5%	2%
1998	53%	4%	2%	5%	5%	2%

The levels of production recorded since 1995 seem to be close to production expectations which is 10 000 tons, according to Doucet and AI (1985). These authors who rely on a linear predictive model of *ethmalosa* production are able to show that:

- The variation of the Bia flow accounts for 46.4% of the production, noted with a positive r,
- The activities of beach seines account for 38.44% of variation of the production, noted with a negative r, and
- The activities of the purse seines, which account for 6.25% of the variation of the production, noted with a negative r.

The modeling factors in the climate effect on the resource lead to a conclusion that if the correlation is a cause-and-effect relationship, one can think that the continental supply would contribute to the success of the pre-recruiting by improving the primary level of production. The fluctuation caused by the flow variation would be superior to the ones generated by variations in the fishing effort.

This observation seems very pertinent to us. In fact, two hydroelectric dams are built along the Aby Lagoon and on the Bia river. The Bia river flow, which influences the lagoon, is no longer linked to the climate but to the functioning rhythm of turbines. So there is a regulating effect of flow which is added to the climate effect. It is generally admitted that when the recruiting decreases as a result of climatic conditions, the resistance of the fishery stock is reduced. Many pelagic stocks, and the most important among them, disappeared due to the combined actions of unfavorable climatic conditions and excessive fishing. In 1998, the decrease in *ethmalosa* landings reached 30%. The drought of 1997 and 1998 probably had an influence on the production.

Fishing Effort

Fishing effort is defined as the total number of gears taken out. For beach seines, it is represented by a daily use of the fishing unit. For gill nets, it is the number of nets taken out every day per fishing unit.

If 1996 is considered a year of reference for the closing of fishing, it may be noted that the fishing effort of beach seines decreased by 27% (Figure 5). The use of purse seines was somewhat stagnant whereas that of gill nets increased by 57.6% (Figure 6). The closing of fishing favors individual gears but does not with collective gears.

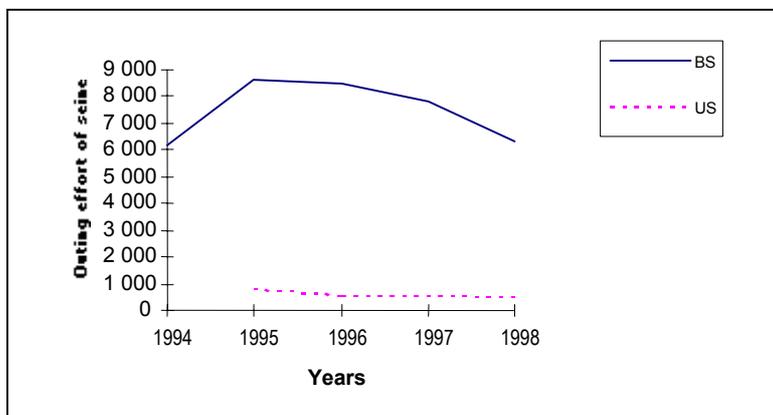


Fig. 6. Fishing effort of beach seines

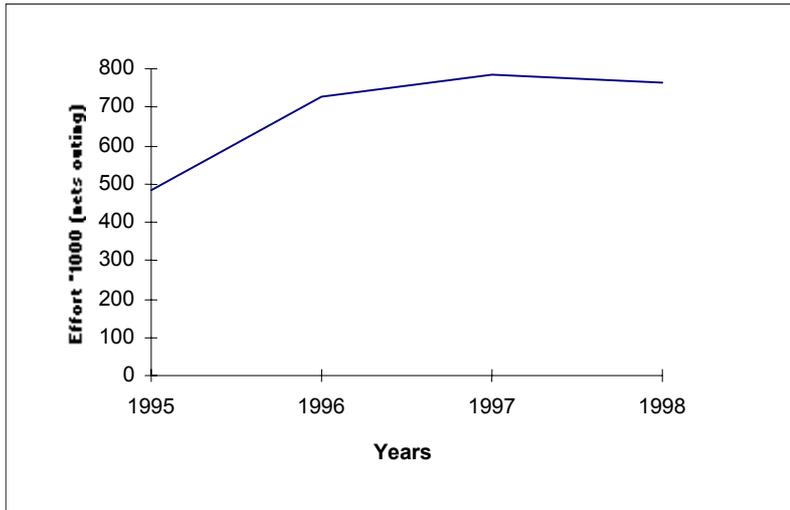


Fig.7. Fishing effort of ethmalosa gill nets

This new distribution of the fishing effort has repercussions on the contribution of each type of landing gear. Beach seines which were the main gears of production until 1996 lost their leadership in favor of the ethmalosa gill nets (Figure 7). Charles-Dominique (1989) noted a sharp increase in the number of nets taken out per gill nets team in 1986, when in 1985 the landings reached a level of 9 630 t. This explains a more important capacity of adaptation of individual fishermen to the environment. Later on, a kind of balance between both types of gears may occur, for as it is mentioned, both types of gear tend to catch fish of the same size. The beach seines may improve their productivity.

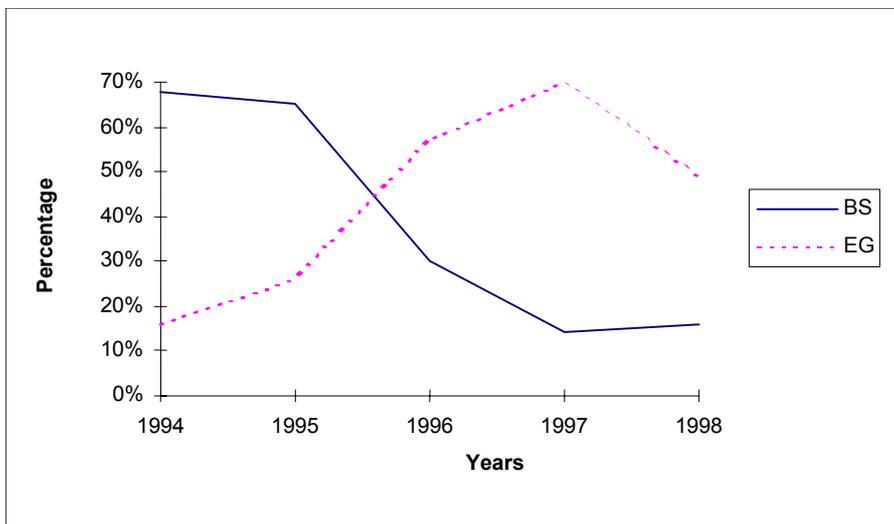


Fig. 8. Contribution of the main fishing gears

Productivity

The measures of closing and changing the beach seine mesh sizes have had immediate effects on gear productivity. Productivity is defined as the quantity of fish caught per outgoing for beach seines. For gill nets, it is the quantity of fish landed per nets taken out.

In relation to beach seines, the productivity which was relatively high in 1994 and 1995 (with 936 t and 1 370 t respectively) gradually decreased to reach 624 t in 1996, 538 t in 1997 and 314 t in 1998. The

seines lost 77% of their productivity (Figure 8) compared to their earlier level in 1995. In fact, the change of the mesh size led to the reduction of the net size.

With regards to purse seines in turn, their productivity was regular and even improved to reach 2 081 t (Figure 8). It is an active fishing that is practised openly. These gears are functional only during the period of important concentration of ethmalosa (October to January).

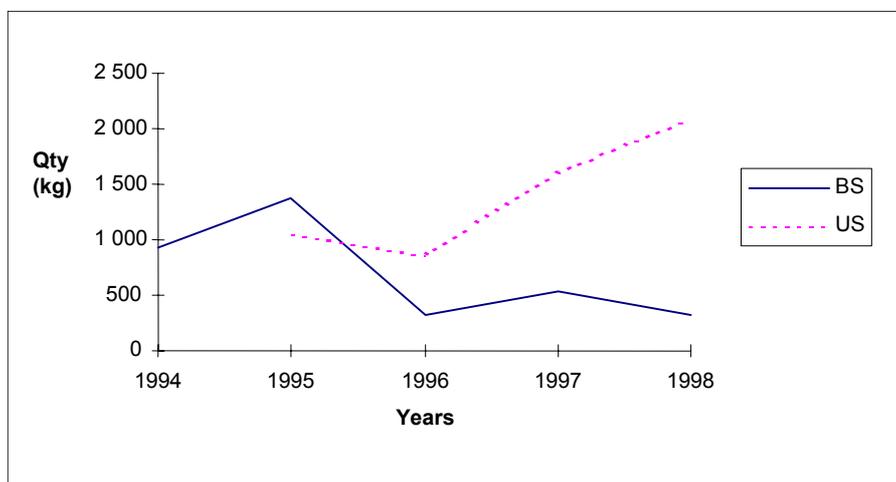


Fig. 9. Productivity (kg/outing) of collective gears

For ethmalosa gill nets, their productivity improved much in 1996 and 1997 with 83% of earnings compared to 1995 (Figure 9). In 1998, the productivity considerably decreased, probably because of the decrease in the relative abundance of ethmalosa.

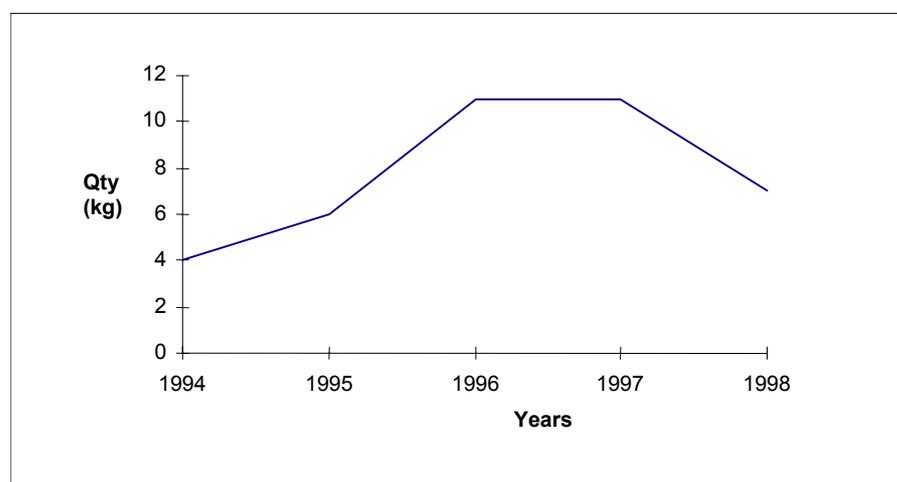


Fig. 10. Productivity (kg/outing) of ethmalosa gill nets

Size of the Fish Caught

The combined effect of the closing and adoption of new mesh sizes for all the gears had an impact on the size of the fish caught. The size of the ethmalosa at its first stage of sexual maturity is 10.7 cm for the female and 10 cm for the male (N'Goran 1995). However it must also be noted that 50% of the catch during the period of reproduction are mature at this size. As a rule-of-thumb, the fish whose size is below 11 cm are immature and the others are mature.

On beach seines the proportion of ethmalosa with a size less than 11 cm strongly dominated the landing from 1994 to 1996, with a maximum of 78% in 1996. This proportion fell to 31% in 1997 and became zero in 1998 when the seines started catching the ethmalosa sized from 11 cm (Figure 10).

On ethmalosa gill nets, the proportion of immature fish is relatively low. Its highest level was 19% in 1996. In 1998, it was reduced to 4% (Figure 10). These results apparently show the acute vigilance of the village committees to reduce the mesh size of the irregular nets and consciousness of users to respect the said regulation.

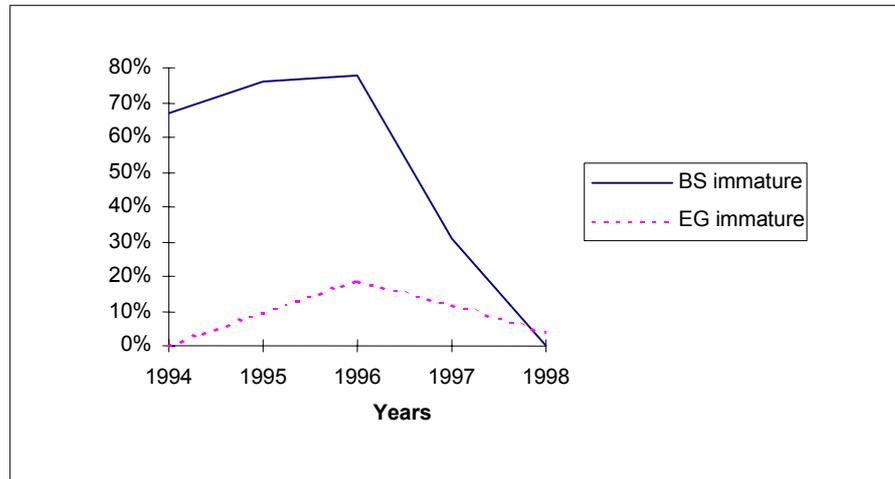


Fig. 11. Percentage of immature ethmalosa in the catches

The recruiting is the process whereby the youngest part of the fish population integrates for the first time the group of “accessible” fish (Laurec and Le Guen 1981). Charles-Dominique (1993) and N'Goran (1995) report that the recruiting of ethmalosa on beach seines with 28 mm mesh size starts between 6 cm and 7 cm. Remarks made since 1996 on the distribution of the size frequencies of the *Ethmalosa fimbriata* on beach seines (mixed mesh size 28 and 40 mm) show an evolution of the recruiting size (Figure 11) which moves from 6 cm in 1996 to 11 cm in 1998. On ethmalosa gill nets, the recruiting size is relatively stable and is fixed at 10 cm (Figure 12).

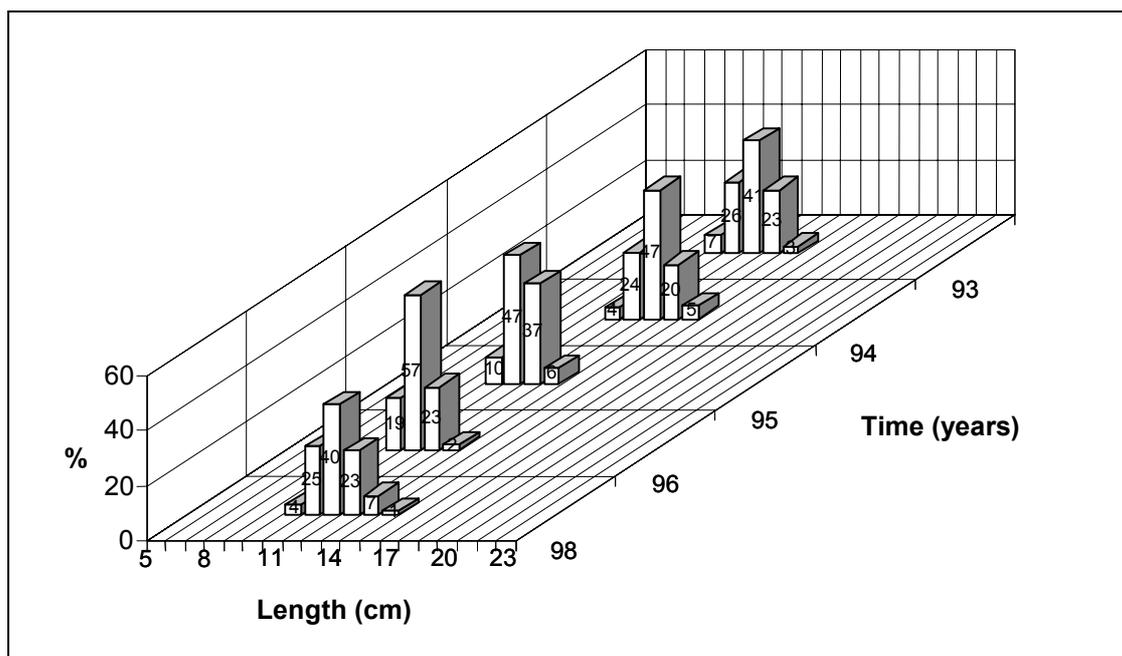


Fig. 12 Distribution size frequency of *Ethmalosa fimbriata* on ethmalosa gill nets (40 mm), Aby area

The evolution of the sizes of the fish caught has a corresponding effect upon the prices and value of production.

Value of Production

The collection of information related to the production, fishing effort and size of the fish caught has intensified with the rise of prices, thus permitting the estimate on the economic value of the production.

Fish prices. Observations on fish prices is based on kilogram prices of the ethmalosa on beach seines and on ethmalosa gill nets. The prices on gill nets have always been superior to those of beach seines because of the mesh size. The beach seines which catch small-sized fish have prices known to be relatively low. Since 1996, their prices have tended to reach that of the gill net (Figure 13). In the long run, both types of gear catching the same size would fetch equivalent prices, thus valuing the resource more.

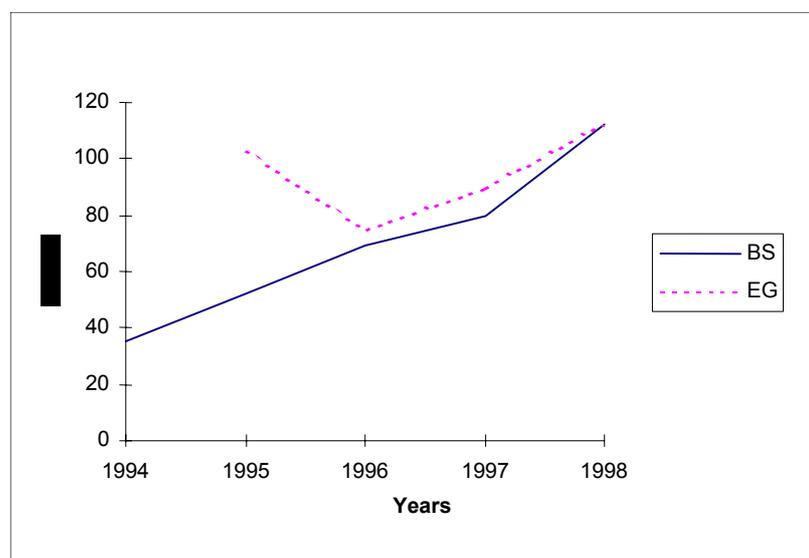


Fig. 13. Prices of ethmalosa on two gears

Global value of the resource. It is noticeable from 1994 to 1998 that the production is more valued. The devaluation of the French Franc cfa (Fcf, the currency used in Côte d'Ivoire) in 1994 enabled the national halieutic resource to become competitive due to the increase in the price of imported fish. This has had further repercussions on the prices of fish observed in the Aby Lagoon. The value of the production also appreciated from US\$2 148 000 in 1995 to US\$2 815 000 in 1996, that is, a rise of 31%. Between 1997 and 1998, the growth reached 25% (Figure 14).

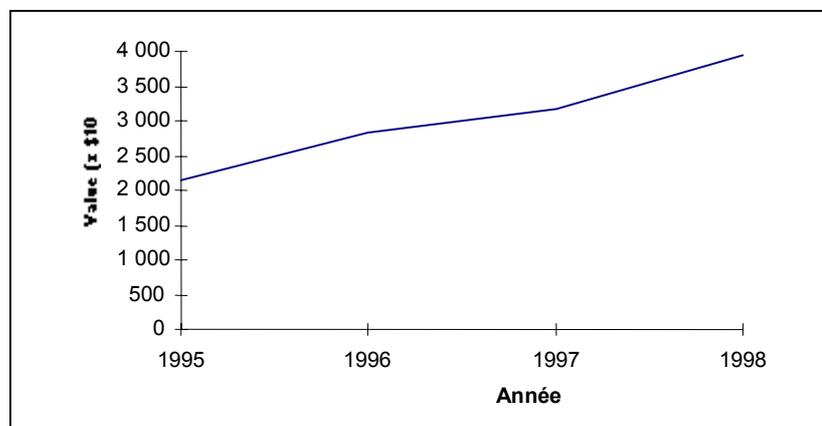


Fig. 14. Evolution of the production (US\$1 000)

Although *ethmalosa* remains the dominant species, other species like crabs, with a relatively high commercial value of US\$0.30/kg in 1998, and which is fished by young people, and shrimps (US\$1.02/kg in 1998) are increasingly significant taking into account income estimates generated by fishing. Despite the interannual variations in the production, the improvement of landed-fish size notably contributes to the value of the resource. In 1998, the value per species was dominated by *ethmalosa* (30%), shrimps (21%), crabs (12%), tilapia (12%) and the *Chrysichthys* spp (10%).

The co-management arrangements enabled the recording of some results at the organizational level and brought several benefits to all. However, it must be noted that the process is still at its infant stage. The underlying question however, is if it can be integrated in time.

Viability of the System

To ensure the viability of the system, an attitude change by the users of the system being set up is necessary. All the elements which constitute user-reference must therefore be analyzed to appreciate it. This is centered around the fundamental question of to whom does the lagoon belong, and if organizational structures are sufficiently strengthened in the area. Furthermore, it is necessary to determine the views of users on the impacts and their corresponding actions.

Lagoon Status

According to the prevailing regulations, the lagoon is part of public property, and in all respects, the property of the State of Côte d'Ivoire. This disposition has always been hardly accepted by the lagoon population who have always claimed property of the lagoon, thus conferring on themselves the right to implement management measures which excludes the State. This view partly explains the misunderstandings that have always characterized the relationship between the local populace and the administration. Since the start of the participation process however, this feeling seems to have been improved. In fact, 69% of people interviewed say that the lagoon is co-owned by both the State and the local populace. However, a significant minority (31%) insists that the lagoon belongs only to the local populace. This improvement explains the participation of users in the program, noting the difficulty in assuming responsibility for an entity which is not owned. It is noted that 75% of the lagoon's population remains convinced that management of the lagoon is the common duty of both the State (Fishery Office, Sous-Préfet and Préfet) and users. However, it can also be noted that 13% of people interviewed hold the view that only the population must impose the management rules against 8% who are for an exclusive and authoritative intervention of the State.

Local projects undertaken for development purposes are highly mobilized. The local populace (100%) is able to come together and self-determine their village's destiny whereas 98% feel able to convene to resolve problems specific to fisheries. As a matter of fact, each of the 12 villages interviewed around the Aby Lagoon has a primary school, 8 among them have electricity, 1 village has a generator and 8 have medical centers. These basic facilities have been acquired by the village communities themselves, and displays the solidarity shared among them. This solidarity is extended to the committees as well.

Survey of the Organizational Structures

The cantonal and village committees seem to be adequately represented on Aby Lagoon. However, the village committees which carry their missions out in the immediate neighborhood are more familiar with the local populace. Some 94% of the interviewees are aware of their existence and are very well-informed of their duties (88%), whereas the cantonal committee (with a more centralized power) is known to 63% of the users, with only 57% of the population informed about their functions. Nevertheless, the determination of the fishermen to work in these committees is strong, for 87% of those interviewed are ready to join village committees and take on responsibility.

The committees are set up by deferring to the traditional structures of the village. Those responsible are chosen at a general meeting summoned by the village chief and the Project for Fishing Service. The village inhabitants gather around the traditional authorities to choose the head of the committee. This way of choosing seems to meet the agreement of the users, since 88% of them are satisfied.

Survey of the Rules and Measures

At this stage of the co-management process, it is apparent that the users have a perfect knowledge of the rules and measures. It is noticed that 73% of the people interviewed know the period of the closing of fishing, 54% know the period of opening and 70% know the mesh size applied to tilapia gill nets. This satisfying level may be explained by their active involvement in the decision-making process. In fact, 88% of those interviewed are convinced that the rules are determined by the Fisheries Office and the local populace, and 73% maintain that they apply the agreed decisions.

The information means used by the committees seem to be functioning. They regularly hold meetings with the population to inform them about meetings (Fisheries Office, Sous-préfet and Préfet) in which they participate, and 60% of the interviewed confirmed they were informed through this way. However, it must be noted that the committees organize more meetings (48%) than the village chief does (12%). There are town criers in those villages but unfortunately, this communication tool is not very much used, and only 13% of the people interviewed remembered having been informed through this way.

Though the general level of information of the population is satisfying, the effort at information dissemination must imperatively be pursued, for information is the backbone of success. A user who does not know the rules cannot apply them and contribute to the general effort.

Appreciation of the Technical Results

The combined actions of the administration and the committees enabled the gathering of measured bioeconomic results, using instruments unknown to the users.

The seminar held in 1995 open the door to the co-management process, and 94% of those interviewed believe that this meeting contributed much to it. It set up by consensus the framework of the Aby Lagoon management. The users (81%) argue that since then, clear management rules are determined and the lagoon is better looked after. They (87%) say that the number of small mesh size nets has considerably decreased. The population (73%) recognize that the application of the measures notably contributed to the growth of the ethmalosa size with 91% among them affirming that the prices in the fish basin has increased. The interviewed (90%) think that these are the results of the good management of the lagoon. Nevertheless, some (56%) remark that productivity has decreased while others (25%) believe that the level of productivity is stable. The rest (15%) are satisfied by the increase in the level of productivity. It must be noted that 95% of the users strongly believe that if the present management mode is retained with the same determination, the lagoon's halieutic resources will be restored. Furthermore, it will equally be distributed between the different fishery jobholders.

The opinion that the users have about the results of the co-management arrangements is in harmony with the data mentioned above. At the level of the ethmalosa size, the fish price and productivity, the comments of the users and the results of the Fisheries Office are in agreement, expressing thus the relevance of observations made by the users. It must be noted that the population have no means of appreciation but their knowledge of the day-to-day realities and experiences permit them to shape a far more accurate opinion, which must be taken into account in the analysis and decision-making processes.

Relationship between Users-Committees-Administration

It is important to recall that the present process has been set up in an atmosphere characterized by a total lack of confidence between the different partners (Kponhassia 1994). As a result, the process used must be measured.

The interviewed users (90%) believe that what has been done has been possible, thanks to the combined actions of committees and the Fisheries Office, with 91% among them satisfied with the cooperation which now exists between the Fisheries Office and the local populace. As a matter of fact, 83% of those interviewed think that committees cannot work without the Fisheries Office. Yet, to reinforce the efficiency of committees, a number of conditions must imperatively be noted as follows:

- The formal recognition of the committees with an administrative order (prefectoral decision) delivered by the administrative authorities. In this regard, 95% of users say that the informal existence of committees is a serious handicap and could in the long run compromise the process;
- The committees wish they could have greater access and means for interventions, such as the provision of boats and outboard engines, etc., for facilitating greater control over the lagoon; and
- The formation (training) and the information disseminated to the committees is another obstacle. It is true that the meetings regularly contribute to the formation and communication purposes, but the committees must be empowered with adequate means.

Durability and eventual viability of the system should therefore rely on the following:

- The adhesion of the population on Aby Lagoon. The population must imperatively signify their adhesion to warrant the expected success. The results show the inclination of the people to carry on the process and to own it.
- The communication aspect, where generally there are differences between the urban and the rural opinion. While one is characterized by rationality and vitality, the other bears the sign of religiosity and an acute sense of tradition. This perception of the supervisors (administrators and technicians) in the rural area sets a gap between them and the villagers they consider incapable of understanding and assimilating the values held dear to the educated. As a result, there is a social gap between the intellectuals living in cities and the villagers. This situation as described by M.J. Hilhorst, is frequently experienced in rural areas where the supervisors have a perceived intellect, very often minimizing the empirical knowledge of the rural people while not always taking them into consideration. In the co-management framework however, an effort must be made by the supervisors to set up a constructive dialogue between the different partners. Thus, the partners will have a better view of the goals to attain and will involve themselves.
- The mutual recognition, i.e., the sense of participation that partners must have in the decision-making process and their setting up. The current process (Figure 4) which presents the institutional structure of co-management on Aby Lagoon relies on the committees. The other components are formal administrative structures with a highly centralized vision of managing the public "property." In order to have a reliable institutional structure, each component must have a status that puts him in a position of a full partner. Yet, in the present situation, the administration is still hesitating to introduce an administrative decree (act, local ordinance) to change the committees into formal structures. The present internal dynamism will be maintained only when a durable system is based on mutual recognition of the partners.
- Conflict resolution, which is a very important goal of the State of Cote d'Ivoire through the co-management initiative. It must be recalled that the many conflicts on Aby Lagoon had succeeded in aggravating both fishery and territorial administration on the part of the Ivory Coast authorities. Conflicts are irrational and dangerous and must therefore be resolved. Unfortunately, since 1996, conflicts between users have multiplied in relation to violations of rules forbidding fishing in deep waters, in bays, fishing with toxic products, and nonconformity of designated mesh sizes. This situation shows that conflicts in both communities and organizations are inevitable and as a result, the administration must devise a new method for conflict resolution. Conflicts must neither be suppressed nor avoided but resolved, for efficiency, creativity and the very innovation required for resolution depend on them. It is admitted that conflicts lead to disorder but they prod the organization to reach for a better balance, as well as ensure its growth. It must be known that if the measures related to the change of the mesh size of beach seines (a very expensive measure) has been applied, this is due to the existence of potential conflicts. The owners were excluded from the lagoon, not due to the action of the administration, but by the will of the population. To avoid frustrations generated by conflict resolution, which endangers the mechanism, all partners must have an acute idea of their mission, and rules must be determined with impartiality, equality and

justice. The structures to deal with the respective levels of conflicts must be delegated responsibly in order to resolve them.

- The participation of women, which is still relatively weak in the co-management initiatives formulated in Aby Lagoon at the time of writing. They are dominant at the fish processing level but less represented and even absent from the decision-making process. They are those who bear the social cost of the organization of lagoon fisheries. During the four-month period of closing, their activities decrease by more than 75%. They have no alternative activities as well. At the present stage of the process, which favors the “policing” aspects, i.e., monitoring, surveillance and imposing controls within the lagoon fisheries organization, it is rather difficult to perceive their role. The present committees do not offer many opportunities to women. This situation is however regretted by the local populace and to institute changes, suggestions have been made to include women in the committees through the promotion of alternative income-generating activities and access to loans.

Unity on Aby Lagoon is based on the consensus of the population, but the danger exists that dominant groups may capture the committees for their own interests. The disintegration of the consensus could discredit the “informal actors” and compromise the general dynamism. To limit such possibilities, there must be a law to affirm support for institutional mechanisms. The second possibility is to have a decentralized structure which can work at the local level to determine regulations specific to the local situation as far as the natural resources management is concerned.

Conclusions and Recommendations

The co-management experience is a very recent development. It was initiated in 1995, and geographically restricted to an area of only 424 km², i.e., the Aby Lagoon. The partners, i.e., the administration, committees and fishermen, seem to have a clear vision of the goals.

At the level of the methodology, the performance measure (scale of performance) presented major difficulties which led to its nonuse. This is due to the fact that the scale may be interpreted with difficulty for both interviewers and incomprehensible to many respondents, inability to comment on the opinions given in a qualified manner and length of time in responding adequately as a result of resource limitations.

Furthermore, it may be noted that the co-management initiatives are not inherently formulated. It is very often externally imposed by circumstances caused by conflicts, ethnic diversity and restricted space. The administration is induced to take initiatives to set up structures, make them reliable and work together to make them functional. These are also no longer implemented to respond to the goals of the administration itself, but to achieve the well-known expectations of users. There is a sharing of responsibilities between users and mainly the administration. The policies of regionalization (decentralization and devolution of the administration) constitute an opportunity to assure the participation of local communities in the development, notably in natural resources management. Nevertheless, it must be admitted that the process is slow.

On Aby Lagoon, the present stage of the process can be qualified as a consultation-cooperation (Figure 15) comparatively to both poles, which are the management exclusively controlled by the Government and a second, more autonomous system of management. All attempts at effective management of the lagoon resources have experienced both poles. It seems that even at the present stage, real decision-making power has been given to committees. However, it should not be forgotten that the situation is highly ambivalent due to the duality of the local decision-making structures. In fact, the traditional authority is superseded by both the current administration and a “modern” organization. It must be remembered above all that co-management is a process. It is gradually set up in an environment in which tradition and modernism co-exist. It must take into account this “cultural” ambivalence to produce a synthesis in which all partners feel sufficiently considered in the economic, social, cultural, environmental and political aspects.

Ideally, co-management is attained when there is the free participation of all in the common goal of managing the common patrimony by taking into account the collective interests for the long term. The combined effort of all should bring about the sharing of the generated profits. However, the diversity of

groups and their interests tend to divert the common will from this ideal. Consequently, committees must have means to uphold the law to deal with fraud and have enough authority to resolve a certain number of problems at their level. Co-management therefore requires important efforts at formation (training) and information, and managing the system, which is the duty of the administration. However, it can be noticed that the administrations that are supposed to bring about changes over a long term do not always indicate the expected interests. They are exacerbated by the absence of a clear policy, insufficient funds and lesser-qualified staff, etc. Experience seems to show that when administrative authorities recognize the committees' own authority, they are able to mobilize with greater honesty and goodwill, enabling them to put their duties to practice.

In all respects, it must be acknowledged that co-management must be supported with adequate scientific credibility. At the beginning of the process, some management decisions and some regulations are based on a mixture of empirical knowledge and user-experiences. As the process becomes more complex and some users see their interests threatened, conflicts appear. To reinforce the consensus, the rules must be determined on a strictly objective basis, which is why reliable biological and socioeconomic data is necessary to provide greater clarity in the decision-making process.

Ultimately, the search for equity to warrant to all the same rights and duties such as access to the resource and sharing of benefits, must adequately guide both the users and partners.

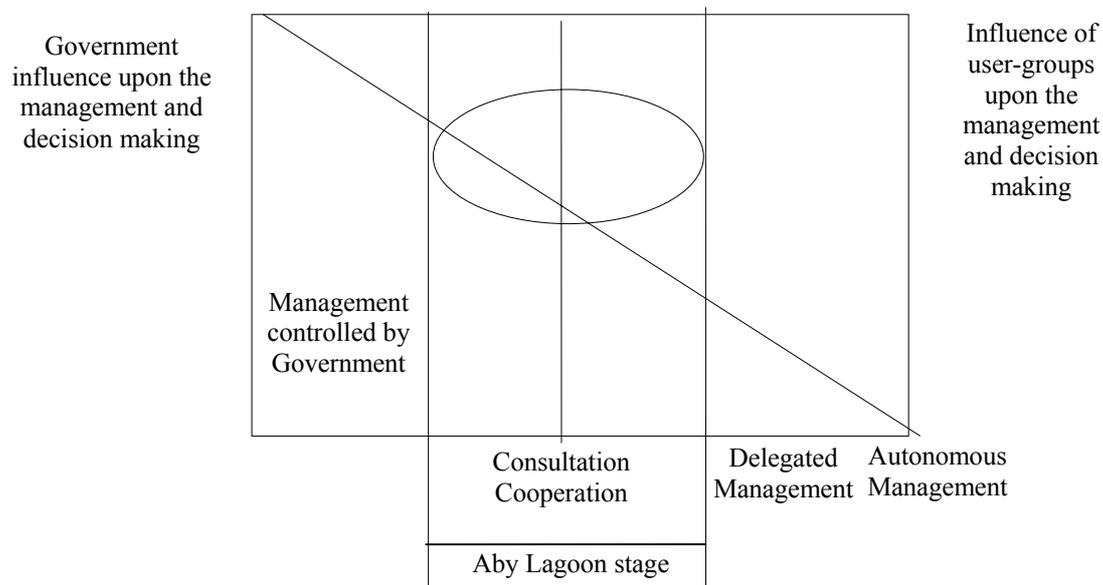


Fig. 15. Stage of co-management in Aby Lagoon

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