

**PELAGIC FISHERIES OF SENEGAL : MANAGEMENT OPTIONS,
POLICY CONSTRAINTS AND THE ROLE OF SUBSIDIES ***

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ABSTRACT

After a global presentation of the Senegalese pelagic fishery, the identification as well as the location and the distribution of the fish stocks, this article analyses the effects of financial support programs in the industry. The suitability of some classical regulatory policies to manage small scale fishery of Senegal is discussed and constraints which fishery managers may be confronted when **implementing** such measures are identified. Special consideration is given to subsidies as a management tool for the fishery.

Key words : Fishcrics, Management, Senegal, Small pelagics, Subsidies.

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**LES PECHERIES PELAGIQUES DU SENEGAL :
OPTIONS DE GESTION,
CONTRAINTES POLITIQUES ET ROLE DES SUBVENTIONS**

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RESUME

Après une **présentation générale** de la **pêche** des petits pélagiques côtiers au **Sénégal**, ce document analyse les impacts macro-économiques de quelques politiques sectorielles **d'accompagnement** de l'industrie. L'application de **certaines** techniques classiques d'aménagement à **cette pêche** est **discutée** et les contraintes potentielles sont **identifiées**. L'assistance financière comme instrument de gestion des pêcheries est explorée.

Mots-clés : Pêcheries, Aménagement, **Sénégal**, Petits pélagiques côtiers, Subventions.

INTRODUCTION

Senegalese fishery benefits from some exceptional natural factors like a sea rich in fish, a climate characterized by sub-tropical upwelling conditions and a coastal zone extending over 700 kilometres.

Fishery is a vital sector in Senegal. It was the second most important activity after agriculture in the country's economy. Currently it is becoming predominant due to the persistent drought hurting the agricultural sector since the late 1970's. The value of fish and fish products, estimated at US \$ 100 million, exceeded the value of the agricultural products in both- 1980 and 1981 (11). Fishery is a source of currency which contributes significantly to the **improvement** of the balance of payments and to the financing of public investments. This activity is the primary source of animal protein, urban as well as rural. The average per capita consumption of fish exceeds 20 kilograms in some areas of the country. Fishery **contributes** greatly to employment in the country by providing jobs to 35 000 fishermen - not including the many people involved in processing, distribution and retailing, boat building and net making. This massive fisheries base helps to **stabilize** rural populations along the coast line. On **the** whole, fishery comprises about 10 percent of the Senegalese work force (10).

State authorities having **realised** the importance of fishery in the Senegalese economy, instituted several development projects. As pointed out by many fishery economists (24), this **development** program should be supported by studies of the effects of such investments on the fish stocks, long-term fish production, national employment, local income, and foreign exchange.

This **paper** focuses on the pelagic fishery due to its long term importance in **Senegalese** landings and some indications of over exploitation in some areas of the country due to increasing fishing effort.

After providing a description of the Senegalese pelagic fishery, the identification as well as the location and **the** distribution of the fish stocks, effects of financial support programs in the industry are **analysed**. The suitability of some classical regulatory policies to manage small scale fishery of Senegal is discussed and constraints which fishery managers may be confronted when implementing such measures are identified. Special consideration is given to subsidies as a management tool for fishery.

FISHERY RESOURCES

Major small pelagic fish landed are round sardinella (*Sardinella aurita*), flat sardinella (*Sardinella maderensis*), and bonga (*Ethmalosa jimbrata*). These three species account for more than 63 percent of the pelagic catches in 1988 and are characterized by their high abundance that makes their economic exploitation possible.

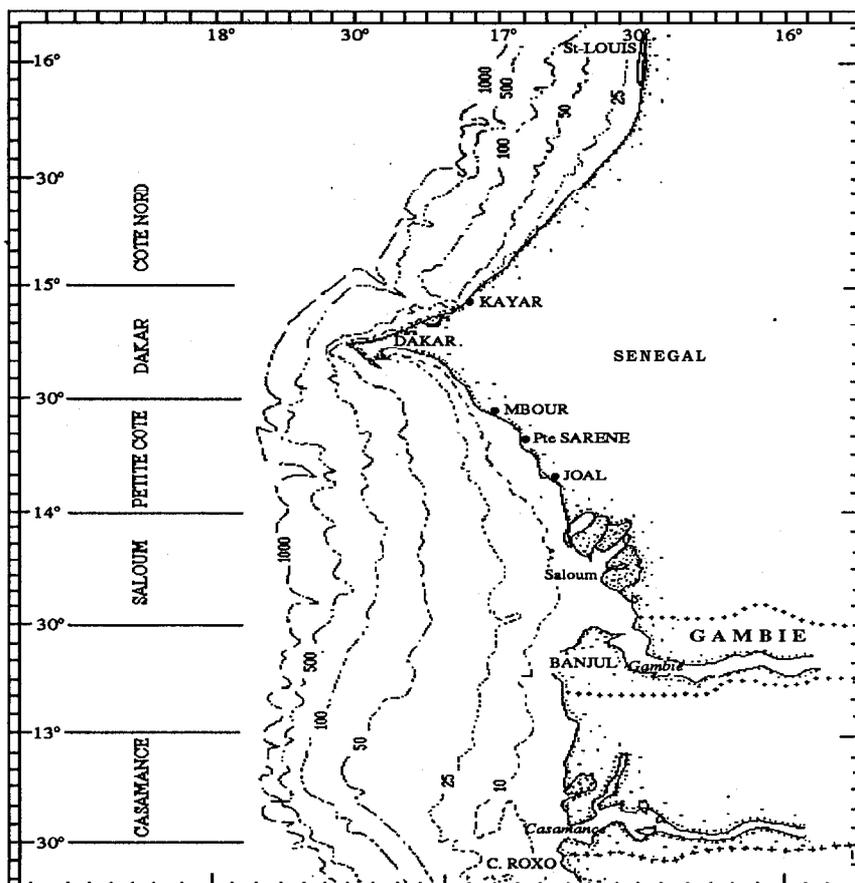
Sardinella aurita is found in **the** cooler water upwelling areas. The species has two spawning **peaks** occurring in May-June and September-November (16). The age of first maturity **of** *Sardinella aurita* is on average 18 centimeters (5). The individuals born in the Senegalese waters will stay there until they reach a size of 25 centimeters on average and start their migration cycle which would take them back only during the cold season (14). As a result, adults are **present** in the Senegalese waters for no more than 6 months during the -year.

Surdinellu muderensis is found in areas of upwellings and warm waters with low salinity such as estuaries and river mouths. Reproduction of this species takes place from April to November, with the period of spawning varying from year to year (20). The age of first maturity of *Surdinellu muderensis* is estimated at 16 centimeters (5). Two nursery areas occur in the Mauritania-Senegalese area coinciding with those of *Sardinella aurita*.

Ethmulosu fimbriata or *bonga* occurs in shallow waters, lagoons, estuaries, and near river mouths. This species is characterized by its coastal distribution. Migration of *Ethmcszlosu fimbriata* is very limited compared to *Surdinellu auritu*. In Senegal, spawning peaks occur from March to July, and from October to November (22).

Data collected from acoustic surveys show there to be a potential of 60 to 70 000 tons of small pelagic fish available in the Côte Nord of Senegal (2) while FREON (16) estimated 110 000 tons of *Surdinellu spp* in the Petite Côte region in the most favourable upwelling conditions. Polish seiners catches and results from acoustic surveys indicate a potential of 80 to 90 000 tons of small pelagic in the Casamance area (2) (Fig. 1).

Figure 1 : Fishing regions of Senegal



HARVESTING SECTOR

Small pelagic fish are subject to both small-scale and semi- industrial exploitation. Each of these sectors have had its own distinct evolution and impact on the fisheries of Senegal and on the small pelagic fisheries in particular. These sectors are compared in several respects below.

ARTISANAL FISHERY

The purse seine is by far the most widely used gear in the small-scale fishery. The artisanal purse seine unit consists of two outboard powered pirogues, about 14 to 20 meters in length with a load capacity ranging from 16 to 25 metric tons and a crew size of 20 people on average. The net has a length ranging from 300 to 400 meters.

The surrounding gillnet, which is used less intensively in small-scale fishery, is on average operated by a 7-man crew using a 14 meter motorized canoe. The bigger meshed nets capture *Ethmalosa fimbriata*, while the smaller meshed nets are directed mainly toward the capture of *Sardinella maderensis*.

Since being introduced by FAO in 1972, the number of artisanal purse seines has increased sharply over the years. The April 1988 CRODT census counted 324 operational nets along the Senegalese coasts. At the same time 140 surrounding gillnets were counted. The economic importance of this gear has decreased with the introduction of the purse seine, which is more productive and more efficient in the fishery.

The total artisanal fishing catch estimated at 231 272 metric tons in 1987 increased to 236 966 tons in 1988. Pelagic fish accounted for the major part of the catch in both years totalling about 186 046 and 194 430 metric tons respectively in 1987 and 1988 (tabl. 1).

Fishing trips in artisanal fishery last a day, and usually less than ten hours due to the small carrying capacity and the mode of fish preservation. Small-scale fishery has experienced an unprecedented increase of its fishing effort in Mbour and Joal, the two major fishing grounds of the country (tabl. 2).

The catch per unit of effort (CPUE) of artisanal fishing units showed a decrease since 1978 and had remarkably improved in 1988 by reaching its highest level for the last ten years. In fact, the artisanal purse seine CPUE was 4.06 tons/fishing trip in Joal while the surrounding gillnet registered 1.80 tons/ fishing trip (tabl. 3).

SEMI-INDUSTRIAL FISHERY

The semi-industrial purse seine fishery operates with vessels up 32 meters in length with carrying capacities ranging from 13 to 120 tjb and equipped with engines varying between 110 and 600 horsepower, a power-block and various electronic equipment. Unlike the artisanal sector, the catches of the semi- industrial fleet are preserved with ice chilled sea water before being landed ashore for processing.

The number of semi-industrial seiners was limited to one vessel until 1966. A record of 19 units was reached in both 1974 and 1982. In 1988 only 5 vessels are operating following the crisis resulting from poor management, difficulties of access to formal credit and the sharp decreases in both landings and prices that the fishery is experiencing.

Table n° 1 : Total landings of the artisanal fishery (tons)

Year	1982	1983	1984	1985	1986	1987	1988
Species							
Pelagic fish	107 940	125 565	120 365	122 065	150984	186046	194 430
Demersal fish	22 835	30 042	36 736	37 880	40 777	34 149	32 576
Shrimps	1279	1 184	598	946	1741	2 131*	1 984
Gasteropod	7901	6 372	3 886	5 818	5600	6 846	4 619
Miscellaneous	1951	2 052	1 806	1 559	2 033	2 100	3 357
Total	141 906	165 215	163 391	168 268	201135	231272	236 966

Table n° 2 : Fishing trips for artisanal units in Mbour and Joal

Year	MBOUR		JOAL	
	Purse. Seine	Surrounding Gillnet	Purse Seine	Surrounding Gillnet
1978	5 141	837	2 940	3 371
1979	8 455	260	3 798	7 136
1980	6 283	383	4 316	5 448
1981	8 377	911	5 665	6 650
1982	7 838	817	7 683	9048
1983	10 796	2 933	8 253	11 552
1984	9 702	3 766	9 087	16 215
1985	8 376	4 884	9 505	19 929
1986	11 960	1 595	10 208	17 702
1987	9 375	2 026	10 684	19 569
1988	13 529	1 844	11 816	18 117

Table n° 3 : CPUE for artisanal fishing units in Mbour and Joal (tons)

Year	MBOUR		JOAL	
	Purse Seine	Surrounding Gillnet	Purse Seine	Surrounding Gillnet
1978	2.85	1.03	2.72	1.09
1979	2.36	0.78	2.41	1.17
1980	2.33	0.72	2.63	0.74
1981	2.35	0.70	2.85	0.74
1982	2.44	0.78	2.70	0.98
1983	3.18	0.99	2.64	0.99
1984	2.34	0.84	2.14	1.09
1985	3.14	0.83	2.44	1.03
1986	3.70	1.10	2.57	1.21
1987	3.66	1.05	3.82	1.60
1988	3.40	1.11	4.06	1.80

The annual landings of semi-industrial seiners increased from 2 000 tons at the beginning of the activity (4) to a record of 33 908 tons of fish in 1974. Landings have decreased since, and in 1988 only 4199 tons were landed.

Fishing effort of the semi-industrial fishery increased up to 1982 when it reached 32 720 sea hours and then decreased to only 7520 hours in 1988.

Semi-industrial fleet catch per unit of effort, very high at the beginning of the fishery (15 tons/10 hours), has decreased remarkably and is oscillating around only 6 tons in 1988. This seems to be the result of the concentrated effort of semi-industrial and artisanal seiners confined on the fishing grounds near Dakar, which are heavily exploited. Also the semi-industrial vessels which are very old and poorly managed are suffering from competition of artisanal units which have lower operating costs and special financial assistance from the state authorities. These two factors enable artisanal vessels to sell their catch at a lower price.

Table 4 summarises the historical data of -semi-industrial fishery.

There must added 4 Gambian seiners which have caught 5 539 tons of fish in the Senegambian waters between November 1987 and the end of 1988, accounting for 85 fishing trips (21).

Ships operated by AFRICAN SEA FOOD are not considered in this paper, since they started their activities in 1989 only.

Table n° 4 : Evolution of the semi-industrial fishery

<u>Year</u>	<u>Number</u>	<u>Landings (Tons)</u>	<u>Fishing Effort (10 Hours)</u>	<u>CPUE (Tons/10 Hours)</u>
1978	10	20 507	1 777	12
1979	15	25 025	2 215	11
1980	18	27 508	2 634	10
1981	15	31 362	2 900	11
1982	19	24 884	3 272	8
1983	17	17 981	3 065	6
1984	13	6 990	1478	5
1985	9	5 982	1 086	6
1986	5	3 145	684	5
1987	5	4 805	662	7
1988	5	4 199	752	6

FINANCIAL SUPPORT PROGRAMS AND FISHERY SUBSIDIES

The Senegalese government, realizing the importance of fishery as a major source of animal protein, income, and employment, instituted several development projects. The most important are the motorization of pirogues and the introduction of the purse seine gear in the small-scale fishery. These two major projects benefit from financial support programs. Outboard motors, fishing gear, and spare parts are sold to fishermen duty and tax free, and gasoline includes a subsidy element which is about 51 percent of the total price. These financial support programs have without doubt contributed to the development of small-scale pelagic fishery just as they have also generated adverse effects in the industry.

POSITIVE IMPACTS OF CURRENT POLICY

Financial support programs have contributed to the profitability of the Senegalese pelagic fishery by providing a less costly fishing method to the small-scale fishermen exploiting the pelagic fish stocks. As a result, production has increased remarkably following the extensive expansion of fishery. The unprecedented increase in landings led to the rapid development of both local and export fresh fish markets and the artisanal fish smoking industry. The creation of new jobs, the stabilization of rural populations along the coastline and the improvement of the quality of the fish landed are other successes linked to the assistance programs for the small-scale fishery. With the wide adoption of outboard motors,

motorization is "likely remaining a permanent feature of the artisanal fishery of Senegal" (19). However, the decrease in the profitability of the artisanal purse seine which is apparently related to overfishing resulting from excess fishing effort, especially in the *Petite Côte* region, seems to indicate that assistance programs have passed their limits.

PROBLEMS WITH IMPLEMENTATION

Export-Orientation

One of the major objectives of the state authorities, by providing assistance to small-scale fishermen, is to improve the nutritional standard of the Senegalese population through a sufficient supply of fish in the home market at a fair price. However, the small-scale fishery is presently an industry well integrated into the economic activity of the country and contributes more than 40 percent of the supply of the processing plants for exports in 1981 (8). The orientation of the artisanal fishery towards the foreign markets coupled with the available export subsidies (15 percent of the FOB value of exports) make one wonder who benefits most from the financial assistance to the fishery, outside of local processors and the foreign consumers. As an illustration, in 1981 the subsidy per kilogram of fish landed at Djifere, estimated at 22 FCFA trebled the price paid to fishermen by the processing company Sopcsinc.

Trough 1982, this company converted, on a yearly basis, nearly 20 000 tons of sardinellas and bongas to fish meal for the international market (15, 6), while at the same time there is a severe shortage of animal protein in most rural areas of the Senegal.

Poor Distribution and Marketing

Financial assistance to fishery is mainly concentrated on production leading to an increased harvesting capacity of fishermen, but the existing market distortions and their costs are often neglected. The inefficient distribution system of fish in Senegal is partially caused by the precarious transportation facilities of fish traders and the insufficiency of fish marketing infrastructure facilities in the main markets and landing sites. The inadequate transportation system coupled with the long distances involved lead to high marketing costs, due principally to fuel and refrigeration costs. Part of these costs are then passed on by middlemen as increases in consumer prices. As an illustration, in 1985 fishermen received on average 29 F CFA per kilogram of sardinella in the *Petite C&e*. This fish was then sold for 300 FCFA at Tambacounda, some few hundred kilometers away from the coast.

This is not to argue that subsidies and direct fiscal incentives for fishermen should cease but rather that some subsidies could be redirected in order to improve the marketing and distribution network, and thereby increase the welfare of fishermen and domestic consumers. As the fishery has undergone a rapid growth since the introduction of the purse seine and the motorization of canoes, an improvement in the efficiency of marketing should be given priority in any development plan. Refrigerated trucks and cold storage facilities could be sold to fish traders through a governmental tax exemption program.

Excess Fishing Effort

Subsidies and tax exemption contribute to decrease the cost of fishing. In turn, lower costs bring more effort into fishery. The excess effort could push the fish population

down to such an extent that sustainable yield would fall, as would the revenues of fishermen due to the decrease in sustainable yield (assuming a constant price). Any profit produced by lower costs encourages further entry in the open-access fishery until that profit is dissipated'. Depending upon the ratio of price to cost, a decrease in cost offered by financial support programs will **not** help fishermen under open-access conditions in the long run. In fact, it may lead to a decrease in catch due to excessive effort from existing boats expanding their fishing capacity and from new fishing units entering the industry attracted by the short-run profits provided by the financial assistance programs. For example, in the Ivory Coast, as reported by LAWSON and ROBINSON (18), fishery underwent an unprecedented expansion following the introduction of a soft loan scheme in 1980, leading to the proliferation of the purse seine gears. The high resulting pressure put on the fishery **resulted** quickly in a decrease of both catch rates and fishermen's incomes. Defaults on loans and the potential extinction of the fish stock pushed fishermen, fishing department authorities and the lending banks to agree to **close** the fishery temporarily. As a further example, the policy of industrialisation in Norway through state subsidies as pointed out by JENTOFF and MIKALSEN (17) *"did more to produce overcapacity and resource depletion than to generate profitability and efficiency"*.

CLASSICAL MANAGEMENT POLICIES AND SMALL PELAGIC FISHERIES

The level of catches in the *Petite côte* in 1986 was higher than the potential **which** is estimated at 110 000 tons.. And in 1987 and 1988 landings have increased again. Given the structure of Senegal's small **pelagic** fishery, as discussed above, and indications that the existing and **generally increasing** fishing effort has caused biological as well as **economical** overfishing in some areas of the country, what **relevance** do classical management approaches have for this fishery. Should management policies accompany the development program in the open-access fishery, in order to realise the added profit ? Are classical regulatory policies **applicable** to the small-scale fishery ?

As pointed out by many fishery economists(7, 23) the choice among 'alternative management policies should be based on a set of criteria which includes: acceptance and support of the majority of **fishermen** concerned, **flexibility**, full accounting of the involved costs, wealth distribution, and **employment** implications. This chapter discusses the suitability of some of the classical measures to manage the small pelagic fishery of Senegal.

QUOTAS

With a global quota the **regulatory** agency decides on the total amount of fish to be caught during a given period and closes down the fishery when that amount is reached.

A quota system has a **positive** effect on the conservation of the fish stock through direct control of the fishing mortality. No equity considerations are present because of

¹ It is not the purpose of this **paper** to argue the important efficiency implications of rent dissipation. We are merely pointing out that if it is the **objective** of the public to retain resource rents in the public domain or in the hands of a limited number of fishermen, then this policy will not achieve that objective.

the absence of direct allocation. Enforcement costs are relatively low and it is easy to monitor the fishery once it is closed. There is no incentive for fishermen to fill the global quota with the most valuable species, reducing the risk to extinction as may be the case in a multispecies fishery because small pelagics are close substitutes and low value fish, and each gear directs its effort mainly to a specific species. However, due to the nature of the Senegalese small-scale fishery a quota system would be impractical. Fishing units numbering in the hundreds are highly mobile and widely distributed over 700 kilometers of coastlines and often in remote and highly inaccessible areas.

Monitoring catches would be too costly and technically impossible if individual quotas were implemented. In addition to the allocation problem that may emerge, the regulatory agency may face two mutually exclusive objectives consisting of encouraging efficiency in the fishery and keeping in the industry the poor fishermen who have no means to compete for quotas in the market (12, 13).

GEAR RESTRICTIONS

The best known and most widely used gear restriction is the adjustment of the mesh size of the different active gears in the fishery. This type of regulation prevents the destruction of the fishery by maintaining a productive age structure of the stock. Young fish allowed to grow larger can reproduce and hence contribute to the biomass of the fish stock before being caught.

This management policy is already implemented in the Senegalese pelagic fishery. Its non-distributional form of regulation makes it politically and socially acceptable. Enforcement costs can be very low when meshes are standardized. The economic performance of this type of regulation is however suboptimal because resulting increases in stocks generate better short-term catches and more profit to fishermen, thus attracting new fishing units in the industry until dissipation of the generated rent results. As observed in Senegal, fishermen in the long run easily by-pass such restrictions by replacing the nets with larger ones during the repair and maintenance process. Gear restrictions, as demonstrated by many fishery economists, raise the average cost of fishing and leave the open-access problem unsolved.

TAXATION

This regulatory policy aims to control fishing effort by taking away the rent which motivates fishermen to over-invest in fishing equipment or attracts new fishing units in the industry. The capability of taxes to conserve the fish stock is high since the management authority can influence effort or the amount of fish landed.

Furthermore, taxes can be used to channel fishing effort towards the less heavily fished stocks. However, as already mentioned, the nature of the Senegalese fishery (mobile fishing units, multi-species, heterogeneity of gears, over 125 landing sites) makes monitoring and enforcing taxing regulation very expensive. In most developing countries like Senegal, taxing artisanal fishermen, who are among the least favoured in the community, and who barely earn subsistence incomes is politically and socially infeasible. As mentioned by BEDDINGTON and RETTIG(3) taxes would have to rise if they are to reduce effort as stocks decline. However, for political and social reasons, it would be quite difficult to increase artisanal fishermen's taxes at exactly the same time that their expected catch

has been reduced. Unlike the artisanal fishery, the semi-industrial fishermen are subject to payment of port taxes and landing charges. However, this taxation scheme does not attempt to control fishing effort but is only a way to increase state revenues,

LICENSING

This regulation restricts directly the number of units operating in the fishery, resulting in a probable improvement of both the yield and economic performance of the fishery. But how is one to distribute the licences? If auctioned or sold in the market, most artisanal fishermen, who barely earn a **subsistence** income and who have no access to formal credit, would be driven out of the fishery. The lack of **alternative employment** outside the fishery makes exiting from the fishery very difficult. Some political and social constraints are then present when **implementing** any licensing scheme involving the withdrawal of **some** fishermen from the industry **when other** sectors of the economy are suffering from chronic unemployment. In **the worst case** licences can be granted to fishermen who are already in the fishery for some equity considerations. This would remove the open-access nature of the fishery but would not reduce the amount of effort deployed on the fish stocks. ANDERSON (1) proposes to make **each** license non-transferable and to retract it as the holder retires or dies until **the proper number remains** outstanding. But do small-scale fishermen actually retire? Is it socially **feasible** to retract a license from a fishing- dependant household after the head **member holder** of the fishing license dies (9)?

At present, industrial fishermen are licensed. This policy in addition to controlling the fleet operating in the waters **under the** Senegalese jurisdiction, seeks mainly to bring in foreign exchange currency.

THE ROLE OF SUBSIDIES

The importance of the fishery in Senegal as a source of food supply for the growing population, employment, and hard currency are all good reasons for carefully considering the merits of different management strategies.

However, subsidies, which are arguably the most powerful of all management incentives, **merit special** and careful **consideration**, due to their political popularity and stability, as well as their likely **negative effects** at the biological level.

The heavy concentration of subsidies on production has **given** fishermen **access** to a more efficient technology. **The overcapacity** in **some areas** of the country and the decrease in the profitability of **the** artisanal purse seine combined with the inefficient distribution system of fish in the country **suggest** that **subsidies** might be **better** used if they were now directed toward improving the marketing network. The **adverse** effects of permanent assistance programs generated in both **the Ivory Coast** and **Norwegian cases** suggest a progressive reduction of subsidies as effort in the fishery builds up. Kept on a permanent basis, financial **support** programs cause overcapacity and resource depletion, and consequently rising costs of harvesting. It is likely that subsidy structures which are not carefully planned with an objective **of overall sectorial development** will have results which are exactly the opposite of **those intended**.

As stated earlier, subsidies coupled with the free access to the fishery may cause serious external effects ranging from the dissipation of the rent to the depletion of the fish stock when exploitation is occurring **beyond** maximum sustainable yield. Subsidies

can however play an important role in management in the particular case of Senegal if they are used to expand inshore fisheries by directing effort from the *Cup-Vert* and *Petite Côte* heavily exploited stocks to the lightly exploited fish stocks of the southern *Casamance* region. This tool of managing the fishery was implemented with success in Ghana as reported by LAWSON and ROBINSON (18) where a governmental project proposed to provide 2 500 outboard motors to fishermen willing to operate only in areas where over-fishing was not detected. The same strategy was also adopted in Norway as part of a policy aimed at intensifying the merging of fishery communities in the north of the country. The apparent low cost of enforcement and the lack of serious equity problems make this approach of managing a small-scale fishery more feasible than any classical regulatory policy:

CONCLUSION

Fishermen in Senegal are already in a position to promote their own group action. The existing fishermen's cooperative could be expanded to handle basic needs of the industry ranging from gear and motors to gasoline and even credit services provided to artisanal fishermen.

The few semi-industrial vessels operating in Dakar are dilapidated due to poor management and access to capital. A policy of replacement and modernisation of these vessels could take considerable pressure off the heavily exploited Dakar fishing grounds. The new semi-industrial vessels in complement with a dynamic and modern small-scale fleet could then direct their activities on the lightly exploited stocks of Casamance. Improvement or construction of adequate infrastructure such as landing piers, ice plants, cold storage as well as better road, are needed before any exploitation of these fish resources can begin.

However, all these recommendations involve a substantial amount of directed subsidies for specific structural changes. As we have seen, blanket subsidy programs with little attention to fishermen behavior or political realities can have severe impacts in the fishery sector.

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