The Economics of Fisheries Access Agreements: Perspectives on the EU-Senegal Case

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Abstract

Relations between coastal countries and fishing fleets from non-adjacent countries changed radically in the 1970s and early 1980s. This was primarily a consequence of the declaration of exclusive economic zones (EEZs) by many coastal states in the years leading up to the close of the negotiations of the *United Nations Convention on the Law of the Sea* (UNCLOS) in 1982. Most significantly, by recognizing the right of coastal states to determine how their waters were to be exploited, the UNCLOS provided a legal basis and economic motivation for the negotiation of access agreements between coastal states and distant water fishing fleets.

This paper examines some of the economic issues which arise out of such agreements, particularly as they relate to relations between relatively poor coastal states and fishing fleets from richer non-adjacent countries. Using Senegal-EU agreements as a case study it examines the economics of the agreements from the perspective of the coastal country. Factors related to the characteristics of the distant water fleet (*ie*, relative discard rates, fleet infractions, changes in fleet efficiency, and the mobility of the fleet) and the characteristics of the coastal country (*ie*, public debt and discount rates, capital constraints, access to overseas markets, and national political considerations) are examined in order to cast light on the incentives for signing the agreements.

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Introduction

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This paper examines some of the economic issues which arise out of such agreements, particularly as they relate to relations between relatively poor coastal states and fishing fleets from richer non-adjacent countries. Using Senegal-EU agreements as a case study it examines the economics of the agreements from the perspective of the coastal country. Factors related to the characteristics of the distant water fleet (*ie*, relative discard rates, fleet infractions, changes in fleet efficiency, and the mobility of the fleet) and the characteristics of the coastal country (*ie*, public debt and discount rates, capital constraints, access to overseas markets, and national political considerations) are examined in order to cast light on the incentives for signing the agreements.

Section I places the agreements in their institutional and economic context.

Section II reviews the nature of exploitation of Senegal's waters.

Section III examines the state of its marine resources.

Section IV highlights some of the factors which adversely affect the relative value of the agreements for Senegal; and

Section V discusses some of the Senegalese incentives for signing such agreements despite these factors.[1]

[1] The paper does not report on the results of a full economic cost-benefit analysis of the agreements, nor does it undertake a financial analysis of actual expenditures and receipts. (For an example of the latter see Dieng 1995 and for a preliminary attempt at the former see Michaud and Rioux 1989.)

I. The Origins and Economics of Access Agreements

This section will examine the institutional origins and the economics of access agreements, as well as discuss the relative importance of the EU distant water fleets in the exploitation of non-adjacent waters.

The Law of the Sea and Access Agreements

As noted above, the widespread declaration of EEZs by coastal states, in the years leading up to the close of the negotiations of the UNCLOS, was the main institutional impetus which led to access agreements.[2] In particular, *Article 56* of UNCLOS recognized the right of coastal states to determine how their marine (and other) resources were to be exploited. In effect, the resources in coastal waters (out to 200 miles) were converted from an open access regime to a state property regime. In addition to the increased rights the convention also prescribed responsibilities for coastal states. *Article 61* of the convention explicitly mentioned the "obligation of coastal states to ensure through proper conservation and management measures that the living resources are not to be endangered by over-exploitation." The legal implications of this stipulation remain unclear. (See Munro 1993.) *Article 62* of UNCLOS states that the difference between the coastal state's targeted management objective and domestic fishing capacity was to be "made available" to distant water fleets through access agreements. However, once again the implications of this stipulation are not clear and do not imply any legal right of access. Allowances were made for the protection of the special needs of fishing communities, particularly in developing countries.

In theory the UNCLOS allowed coastal states to exclude distant water fleets (DWFs) from many regions which the latter had traditionally exploited. In practise this has rarely been the case, as numerous access agreements have been signed. The immediate and precipitate decline in non-adjacent fisheries activity that many had predicted when UNCLOS was signed did not, in fact, occur. Instead, after remaining relatively stable for approximately 20 years from 1970 to 1991, marine catch by countries in non-adjacent fishing areas has only fallen in relatively recent years from a high of over 9 million tonnes in 1989 to less than 5 million tonnes in 1993 (FAO *SWFA* 1995). This recent decline is due in large part to the withdrawal of previously subsidized Former Soviet Union (FSU) and other Eastern European countries' fleets from many non-adjacent fisheries. The FSU saw a decline in DWF activity from 4,281 mt in 1990 to 1,133 mt in 1993 (FAO *SWFA* 1995).

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[2] See Kwiatkowska (1989) for an excellent discussion. For shorter discussions of the consequences of the UNCLOS see Munro (1993) and FAO *MFLS* (1994).

Given that there were no legal binding commitments in UNCLOS for coastal states to grant access to DWFs for "surplus" fish stocks, it is necessary to examine the economic motivation for such agreements.[3]

The Economics of Access Agreements

In effect, the declaration of EEZs gave all coastal states the option to either harvest the fish themselves or allow foreign vessels to harvest the fish.[4] The two strategies are not mutually exclusive and could, of course, be used in combination. For instance, in some cases the coastal state may choose to exploit certain species and grant access rights for other species to foreign fleets which may be better suited to their exploitation. In other cases the coastal state may harvest a proportion of the catch for a given species and grant access to foreign fleets for the rest of the catch. This might arise, for example, if the fish in question are found both in-shore and off-shore, and if the characteristics of the fleets are better suited to one or the other location.

In return for being granted access to the resource, the foreign nation usually pays some lump-sum compensation and the fleet pays a tax on catch (**ie,** tonnes caught) and/or effort (**ie,** gross registered tonnage). The former serves as a means for the coastal state to extract some of the resource rent, while the latter serves the dual purpose of both extracting the resource rent *and* regulating/managing the harvest. The latter function is partially achieved – albeit in a crude manner – through the establishment of the overall DWF quota. However, the simultaneous use of a tax is preferable, since fleets will respond to resource depletion more readily, due to the marginal effect of the tax.[5]

Given that the declaration of an EEZ gives the coastal state full rights to resources within 200 miles of its shore, and distant water fleets are only allowed to fish within those waters at the behest of the coastal state, economists have tended to analyse coastal nation/distant water nation relations in terms of principal-agent theory. (See Clark and Munro 1990.) In effect, in attempting to maximize rents from the resource, the coastal state may find it optimal to "import" foreign fleet capacity by contracting their services. The distant water fleet is thus merely an agent, contracted by the coastal state to undertake specific harvesting of resources. (See Annex A for a formal

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[3] Perhaps more significantly there is no objective means whereby the "surplus" can be determined. For instance, UNCLOS appeared to support the view that "maximum sustainable yields" should be used as the criteria through which to determine the resource surplus relative to domestic fleet capacity. However, given uncertainty about the state of most marine resources, determining the surplus reliably is often difficult, if not impossible. Moreover, if more appropriate economic criteria ("maximum economic yields") are applied, then there is likely to be considerably more ambiguity, even if the state of marine resources can be determined reliably. In particular the MEY will depend upon the discount rate applied by the management regime.

[4] Coastal states can also promote joint ventures, whereby foreign capital, rather than fleets *per se*, are used to help in the development of a domestic fleet. See Rettig (1995) and Johnston (1992) for discussions of coastal state development options.

[5] For instance, the tax will play a role in adjusting effort levels appropriately as stocks fluctuate.

discussion.) The principal factor which determines whether or not such a strategy is optimal is the relative costs of exploitation of the two fleets.

The EU and Access Agreements

Since the Hague Declaration (1976) the European Union has had sole responsibility for the negotiation of fishing rights with all non-member states (Wise 1984). Despite the apparent EU-level impetus for negotiated agreements, the motivation for the EU striking such agreements is usually derived from specific national interests based upon historical fishing patterns. These tend to be reflected in the nationality of the vessels which purchase licenses in order to fill the allocated quota. (See Holden 1994 and European Court of Auditors 1993.)

A number of EU agreements were struck with African, Caribbean and Pacific (ACP) countries during the 1980s and early 1990s. The main impetus for these agreements came from Spain and France, with Greece, Italy and Portugal also involved in many cases. By 1993 a total of 23 agreements were in operation. Compensation associated with the agreements is considerable. Between 1987 and 1993 the EU spent 1.1bn ECU on EU-ACP fishery right agreements (O'Riordan 1995 and Karagiannakos 1995). As a percentage of total Common Fisheries Policy (CFP) appropriations, financial compensation for all access agreements (including those with non-ACP countries) has ranged between 25% and 38% since the late 1980s. (See Table 1.)

Relative to other fishing nations the EU plays a significant role as a distant water fishing fleet. In 1993 the Spanish fleet was the second-largest non-adjacent fishery fleet, with a total catch of 596,000 tonnes. This represented 47% of the national fleet's total catch. In 1993 France had the 8th largest catch by country in non-adjacent fisheries, with a catch of 179,000 tonnes. This represented 23% of the national fleet's total catch (FAO *FS:C&L* 1995). These figures compare with the global average of 5% of total catch from non-adjacent fisheries (FAO *SWFA* 1995), indicating that the EU fleet is particularly significant in the exploitation of non-adjacent waters.

Much of the EU fleet's non-adjacent fishing takes place in the three African ocean regions (Eastern Central Africa, South-East Atlantic and the Western Indian Ocean[6]). For instance, in 1993 56.8% of the (legal) non-adjacent catch of the Spanish fleet was caught in the Eastern Central Atlantic (ECA), which borders the West African coast; 5.7% came from the South-East Atlantic bordering Angola, Namibia and South Africa, and 18.7% from the Western Indian Ocean which borders East Africa. In the case of France, 49.7% of the overseas catch came from the Eastern Central Atlantic and 50.2% from the Western Indian Ocean (FAO *FS:C&L* 1995).

[6] It should be noted that the Western Indian Ocean also has Asian coastline.

Table 1: Financial Compensation for Access Agreements & the CFP Budget

	FAAs (m Ecu)	CFP (m Ecu)	Percentage
1983	10.1	90.0	11.22%
1984	12.9	106.8	12.07%
1985	29.5	153.9	19.17%
1986	29.1	165.4	17.60%
1987	59.1	228.9	25.82%
1988	110.3	316.1	34.90%
1989	116.7	363.2	32.13%
1990	173.1	455.8	37.98%
1991	171.4	525.0	32.65%
1992	101.1	492.7	20.52%
1993	156.0	618.5	25.22%

II. The Exploitation of Senegal's EEZ and the Role of the EU

Before turning to a detailed discussion of the role of the EU DWF in Senegalese waters, it may be helpful to present a more general picture of the exploitation of Senegal's EEZ.

Catch and Fleet Characteristics in Senegalese Waters

The FAO has estimated that total activity (direct off-shore and indirect on-shore) accounted for by the sector represents 10% of the labour force and 2.5% of GDP (Westlund 1994). The sector is the single greatest source of foreign exchange earnings, derived from all three (industrial, semi-industrial and artisanal) fleets (Westlund 1995). 90% of the artisanal small pelagic catch is consumed locally, with the remainder exported to Mali, Guinea, Congo, Zaire, Côte d'Ivoire, Togo, Cameroon and Nigeria (Westlund 1994). Total export earnings in 1991 represented 167m ECU (Barry-Gerard *et al.* 1994a).[7]

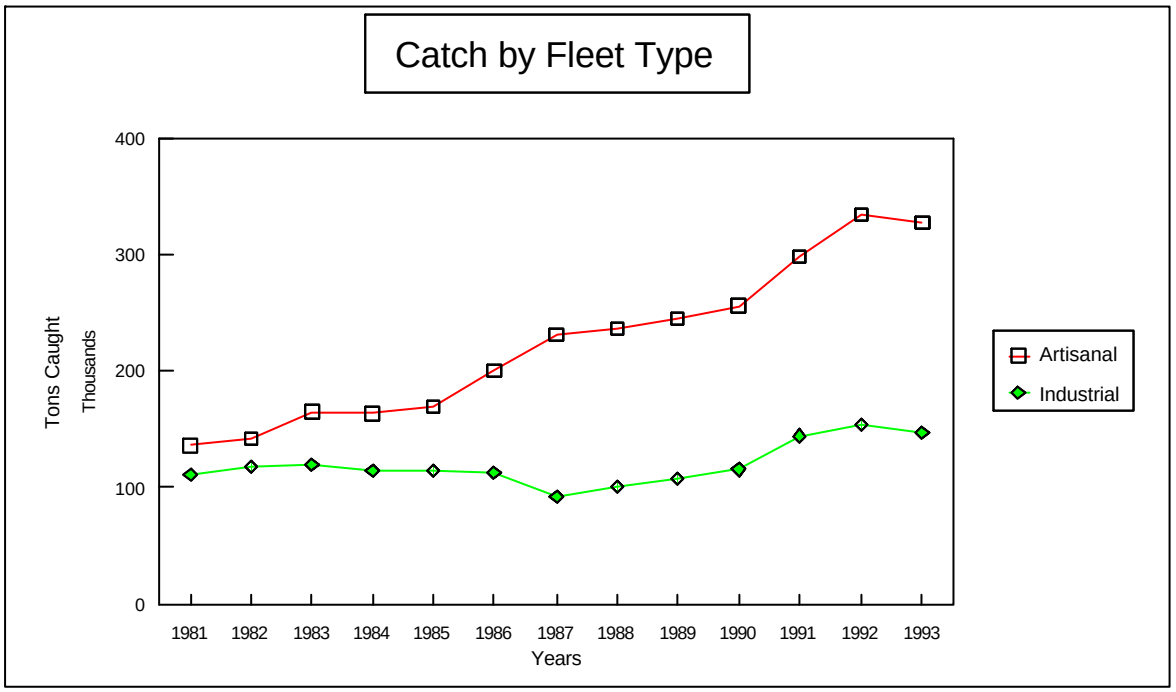
The Senegalese fishing fleet can be broken down into the artisanal fleet (essentially canoes, known as "pirogues") and the industrial fleet (trawlers, seiners and tuna vessels). Significantly, the proportion caught by the artisanal fleet rose from 58.4% in 1982 to 68.2% in 1992. (See Figure 1 for a comparison of artisanal and industrial catches.) Moreover, figures for the artisanal fleet may actually be an underestimate since monitoring is much more difficult due to the decentralized nature of the fleet.

In 1993 the artisanal fleet caught a total of 327,153 tonnes (CRODT *SPMS* 1995). The most common gears are encircling nets (270 units in 1992) and ring nets (140 units in 1992), but there is also some beach seining. Flat sardinellas and round sardinellas together accounted for 63.6% of the total artisanal catch in 1993, but demersal species are rising in importance (DOPM *RGPMS* 1993). It has been estimated that total employment in the artisanal fleet at the end of the 1980s was 35,000, with another 150,000 involved in shore-based activities (Westlund 1994). Another source estimated artisanal employment in 1994 as 50,000 directly and 200,000 in shore-based activities (ERO 1995).

[7] Detailed catch and fleet data for Senegal is available from the *Centre de Recherches Oceanographiques de Dakar-Thiaroye* (CRODT) and the *Direction de l'Oceanographie et des Pêches Maritimes* (DOPM).

The industrial fleet, based in Dakar, caught a total of 98,830 tonnes in 1993. This figure can be further broken down by species/vessel type, with 39,288 tonnes attributable to the demersal[8] trawler fleet, 50,564 tonnes attributable to pelagic[9] fishing, and 8,978 tonnes attributable to the tuna fleet (CRODT *SPMS* 1995). The most variable catch on a year-to-year basis has been the tuna fishery, with the demersal trawlers having a relatively stable catch, and the pelagic fleet declining and then increasing in importance. (See Figure 2.) The number of industrial trawlers has stayed more or less constant in recent years, falling from 135 in 1981 to 125 in 1993, while the number of pelagic seiners has risen from 15 to 26 vessels over the same period. Conversely, the tuna fleet has declined by more than half, falling from 30 to 14 ships (CRODT *SPMS*, various years). Direct employment in the late 1980s was estimated at approximately 10,000, with 15,000 in shore-based activities (Westlund 1994).

Figure 1



In the period 1981-1993 DWFs caught an average of 10.4% of the total catch in Senegalese waters, with the trend being slightly upward. DWFs which have exploited Senegalese waters include those from the FSU and Eastern European countries as well as East Asian countries and the European Union.

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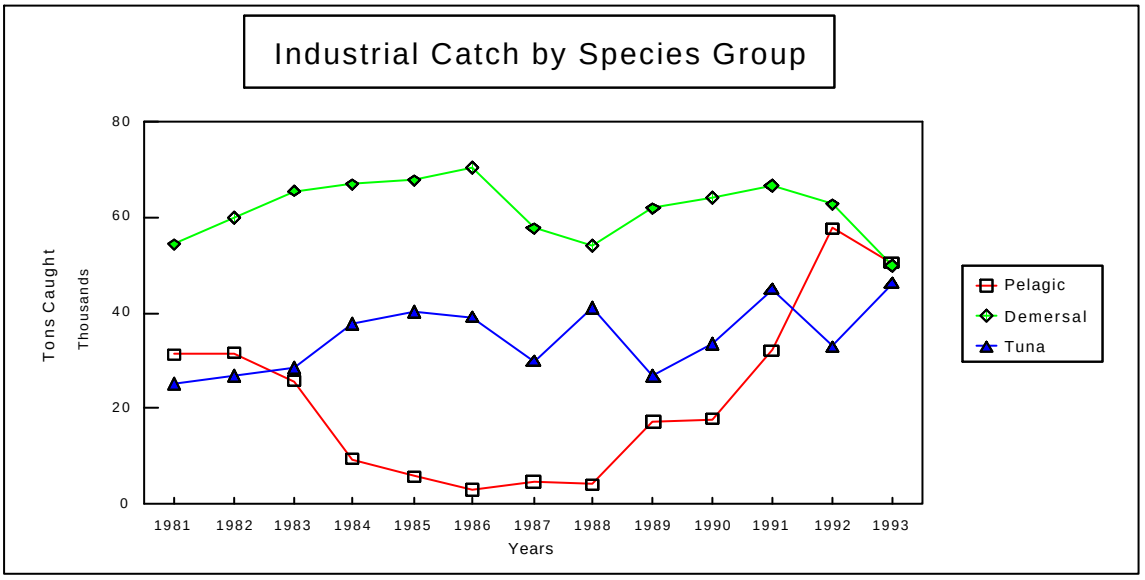
8 Bottom-dwelling fish such as cod and haddock.

9 Surface-dwelling fish such as anchovies and sardines.

Unfortunately, the DWF catch is no longer dis-aggregated by country of origin, although it is dis-aggregated by species type. Of the 48,123 tonnes caught by the DWF in Senegalese waters in 1993, 78% was tuna and the rest attributable to demersal trawlers (CRODT *SPMS* 1995). Pelagic species which had previously been targetted by FSU and Eastern European fleets were no longer being caught.

In the Eastern Central Atlantic region (including Senegal) the East Asian, FSU and Eastern European fleets have been primarily composed of large industrial freezer vessels. The most important species targeted were grunts (FSU, Romania, Korea), croakers and drums (FSU and Korea), jack and horse mackerel (FSU and Romania), European pilchard (FSU and Romania), chub mackerel (FSU and Romania) and cephlapods (Korea) (FAO *FBFCECA* 1994). In the early 1980s it was reported that 10,000 Soviet crew passed through Dakar each year and 150 Soviet vessels were "turned around." The level of activity has fallen considerably in recent years, but this may be due in part to the fact that many former FSU vessels have been sub-contracted (Westlund 1995). Similarly, many Korean vessels have been "re-flagged" in recent years, although the precise figure is difficult to determine (Everett 1994).

Figure 2



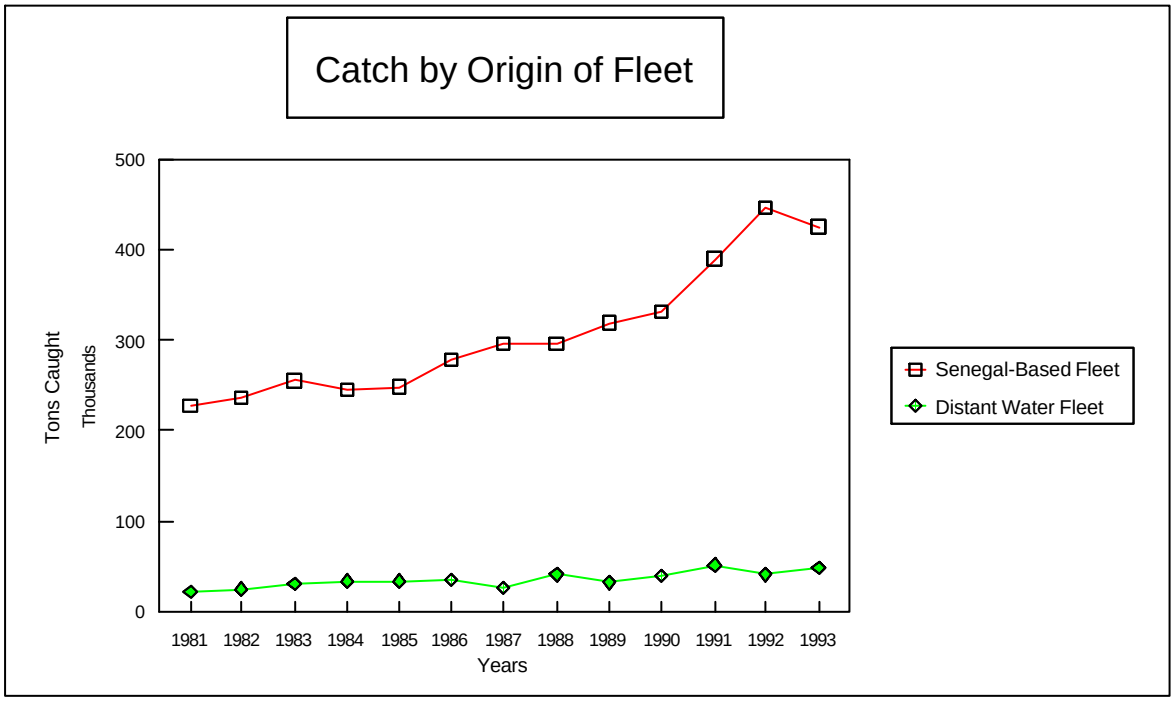
The principal EU countries involved in the exploitation of the Senegalese EEZ are Spain, Italy, Portugal, France, Greece and Germany. The character of the fleet is rather more heterogeneous than that of the other distant water fleets, involving in-shore demersal trawlers (freezer and non-freezer), off-shore demersal fish trawlers and shrimp trawlers, and a variety of tuna vessels (bottom longliners, canner/pole & line vessel, freezer seiners, and surface longliners). Primary targets have been flatfishes, shrimp, prawns, squids, octopi, hakes, herrings, sardines, groupers, seabass and others (FAO *FCECA* 1994). The nature and extent of EU fleet activity in Senegalese waters is further discussed in the section on fisheries access agreements below.

EU-Senegal Access Agreements

The first fisheries access agreement between Senegal and the European Union was signed in 1979. Indeed, this was the first such agreement signed directly by the EU rather than a member country. The agreement has since been renewed in 1982, 1985, 1987, 1990, 1992 and 1994. There are three broad categories of species targeted by the EU fleet and which have been included in such agreements: coastal demersal, deep demersal, and tuna. As with all agreements, the EU pays financial compensation in return for specified quotas (expressed in terms of gross registered tonnage of the DWF).

The total compensation package tends to be divided between: direct payments paid to the Senegalese Treasury; support for the Ministry of Fisheries; support for the monitoring agency; bursaries for students; support for research institutes and programmes; and support for the artisanal sector. However, the Treasury takes the majority, having never received less than 77% of total compensation, and in most years well over 90%. In addition to the aggregate compensation, license fees are paid by the fleet. The value of compensation and license fees – expressed in terms of tonnes actually caught rather than quotas allocated – is depicted in Figure 4.

Figure 3

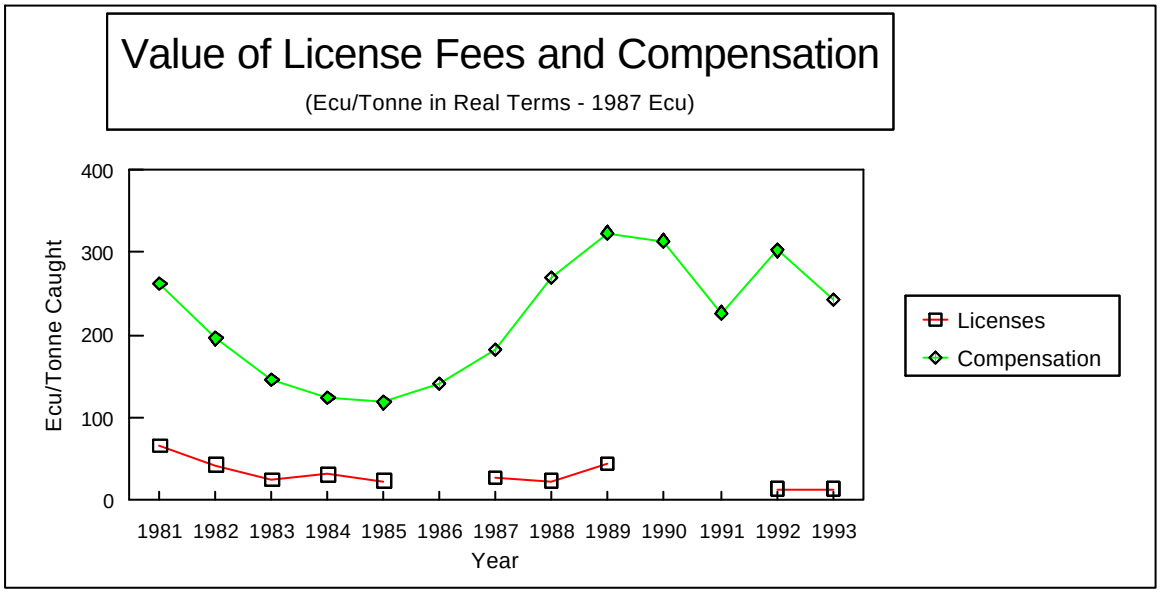


The agreements set out specific requirements for the fleets. For instance, specified proportions of catches must be landed within Senegal in order to encourage the domestic processing sector. The proportion of DWF coastal demersal catches to be landed in Senegal reached a high of 29% in the 1992-94 agreement. The highest figure for freezer trawlers was 72% in 1988-1990. Tuna vessels and

shrimp trawlers have no such requirements (Dieng 1995).

The agreements also have a number of technical provisions, and the 1992-1994 agreement can be used to illustrate some of these. Coastal demersal trawling in vessels smaller than 300 GRT is allowed beyond 6 miles (or 7 miles in some regions) of the coast, while larger in-shore demersal trawlers must be beyond 12 miles. Tuna canners and seiners can fish anywhere, while permitted zones for other types of vessels depend on vessel type, region, and target species. The minimum distances from shore range between 6 miles and 35 miles, whilst mesh size varies from 16 mm (purse seiners with live bait) to 65 mm (fish and cephlapod trawls). The minimum mesh size for shrimp trawls is 40 mm. Employment of Senegalese crew must be at least 33% of total crew on trawlers and longliners, with the percentage for other vessels more flexible. Foreign vessels are encouraged to employ Senegalese facilities and inputs to the greatest extent feasible. (See European Parliament 1993. A useful comparison with other agreements can be found in FAO *CSRFF* 1993.)

Figure 4



Actual catches arising from the agreements will not be in strict (or even loose) proportion to stated quotas, for three reasons: the state of fisheries stocks may have changed over time; improvements in the technological efficiency of the fleet means that a given GRT will result in higher catches over time if the characteristics of the stock remain unchanged; and, take-up is not usually complete.

All of these issues are discussed in more detail below.

III. Marine Resources in Senegal's EEZ and Potential Resource Competition

In order to determine whether or not the agreements make economic sense, it is first necessary to determine the relationship between fishing effort and available resources.

The State of Senegal's Fish Stocks

On the basis of a number of reports, CRODT has estimated the maximum sustainable yield (MSY) by species. These can be compared with actual catches in order to determine the relative intensity of exploitation of Senegal's marine resources. (See Table 3.) The figures presented indicate that any over-exploitation which does exist is not reflected at an aggregate level. However, the degree of aggregation may mask significant over-exploitation at the level of particular regions and/or species. Moreover, if the intensity of exploitation is estimated relative to economic criteria (**ie,** MEY) rather than to biological criteria (**ie,** MSY), some of the aggregate figures may themselves reflect a degree of over-exploitation. Therefore it is necessary to examine the evidence at a more detailed level.

Table 3: The Intensity of Exploitation of Senegal's EEZ

	MSY	1990-1993 Avg	Highest
Coastal Demersal	125 – 130	91	113
Deep Demersal	20	8	10
Large Pelagic*	25 – 30	16	23
Small Pelagic**	173 – 248	167	NA

Source: Dieng (1995) and CRODT (various reports).
* 1989-1992 and ** 1984-1991.

A recent FAO report put the percentage of "fully fished, overfished, depleted and recovering stocks"[10] for the ECA region (of which Senegal is a part) at 82% – the second highest of the 16 FAO regions (FAO *SWFA* 1995). According to the report, demersals, pelagics, crustaceans and molluscs were all well over 90% overfished. Another report (FAO *RSWMFR* 1994) states that most demersal stocks in the region are either fully exploited or over-exploited, and "the future of the resources is a matter of concern", citing lobsters and shrimp in particular. On the basis of catch-per-unit-of-effort data, Niamadio (1994) reached the conclusion that all demersal species except cuttlefish, "brotule" and

[10] "Recovering" stocks are included as an indicator of past over-exploitation.

octopus have exhibited decreasing abundance trends since the early 1980s. Another report (Westlund 1994) claims that the small pelagics in the Senegalese EEZ are fully exploited, but that there is regional variation with Casamance having some potential for a slight increase in activity of sardinellas and bigeye grunts, while the Petite Côte near Dakar is over-exploited. Reporting the results of a FAO synthesis of results on pelagic species gathered from 1966 to 1992, Niamadio (1994) states that coastal pelagics are only over-exploited in the region of the Petite Côte, although there may be localized problems in regions where large pelagic trawlers operate.

Given that there is considerable evidence of over-exploitation at the level of the species and/or the region, it is necessary to examine the degree of competition and complementarity which exists between EU and Senegalese exploitation of specific resources in order to determine whether or not the agreements are, in fact, consistent with the "surplus principle" and/or economic efficiency.

Resource Competition

This section is strictly concerned with direct target resource competition and complementarity. Issues related to discards and by-catch, as well as more indirect forms of competition such as through the market, are discussed below.

In its simplest form, direct competition between the EU fleet and domestic fleets can be documented by examining the degree of congruence between species captured. Given that the EU has always played an exceedingly limited role in the capture of small pelagic species and that Senegalese fleets have played a relatively limited role in the capture of tuna in recent years, it is demersal species which seem to be of primary interest. CRODT data suggest that some demersal species have significant (and increasing) congruence across fleet catches. The case of one particularly valuable coastal demersal cephlapod – octopus – is illustrated below in Figures 5, while the degree of correlation between catches is presented in Table 4.

Figure 5

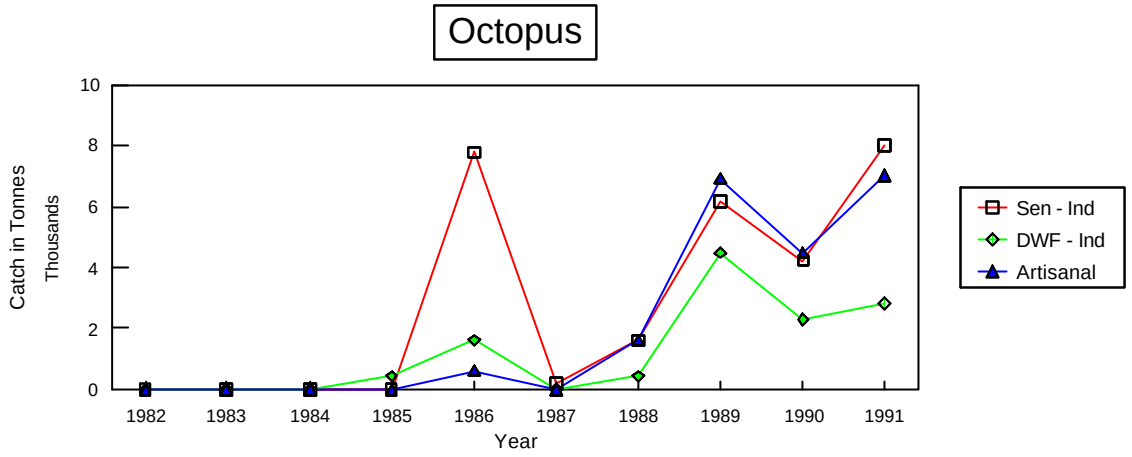


Table 4: Congruence of Octopus Catch by Fleet (Correlation Coefficient)		
	DWF-Artisanal	DWF-Industrial
Octopus	0.82	0.92
Source: CRODT (June 1994)		

Some of this congruence arises from the fact that all fleets are affected by changes in resource abundance. In particular, this may explain much of the congruence between the target species of the Dakar-based demersal trawler fleet and the foreign trawler fleet. On the other hand, the significant and increasing congruence between target species of the artisanal fleet and the EU fleet, is due in large part to recent technological developments within the sector. Indeed, with some pirogues greater than 20 metres in length and with crews of more than 20 the distinction between artisanal and industrial fleets is increasingly blurred.

Most significantly, the degree of motorization of pirogues is exceptionally high. According to Breuil *et al*. (1996), the rate of motorization of pirogues in Senegal in 1993 was third highest in the West African region, at 67% relative to 60% for the region as a whole. Another source (DANIDA 1994) gives a much higher figure of 90%, which is the highest in West Africa as a whole and compares to an average of 28%. Although regional coverage and the year of estimation for individual countries is somewhat different, this is not sufficient to explain the discrepancy. In any case, it is clear that the Senegalese rate is higher than average.

The high level of motorization means that pirogues are able to fish in waters which were not within their reach previously and which are targeted by industrial fleets (domestic and foreign). According to a

variety of sources, pirogues are increasingly being found as far as 50 miles from the coast, somewhat undermining the logic of 6-mile limits to protect artisanal resources. (See ERO 1995, Diallo 1995, Martinez i Prat and Tudela i Casanovas 1995 and Niamadio 1994.) Moreover, the adoption of refrigeration and polystyrene storage boxes has reinforced this trend, allowing pirogues to stay at sea longer (often more than ten days) and to catch higher value, but perishable species which are already targeted by foreign industrial fleets. (See Barry-Gerard *et al*. 1994a and Niamadio 1994.)

Resource competition may also be sequential, whereby different fleets may target the same species at different stages of development. (For a good general discussion see Panayotou 1992.) Such a case might arise if the gears used are different or if the location of exploitation is different. It appears that such cases are prevalent in the Senegalese EEZ. For instance, CRODT analyses have found that the average size of specimens in the cuttlefish fishery is much larger for the artisanal fleet than for the industrial fleet, implying that the latter are catching younger specimens. (Reported in Diallo 1995 and Niamadio 1994.) In the case of white shrimps the situation is reversed, with the artisanal fleet catching specimens in estuaries which are not accessible to larger vessels (Barry-Gerard *et al*. 1994b).

IV. The Case for the Agreements from the Senegalese Perspective

It is clear from the regional and species-level studies that at least some marine resources in the Senegalese EEZ are over-exploited and that some of these same species (principally demersal species) are targeted by both domestic and foreign fleets. Although this brings into question the relevance of the "surplus principle," this is not sufficient reason to conclude that access agreements are not an optimal economic policy from the perspective of the Senegalese state, if not necessarily for all members of the Senegalese industrial and artisanal fleet. However, there are reasons to expect that the value of the agreements are rather less than would initially appear to be the case.

Four issues will be discussed:

- *uncertainty of EU DWF effort;*
- *technology choice for the EU fleet;*
- *the means of quota allocation and fleet efficiency; and*
- *the economic cost of fleet infractions.*

Uncertainty of DWF Effort and Senegal's Bargaining Position

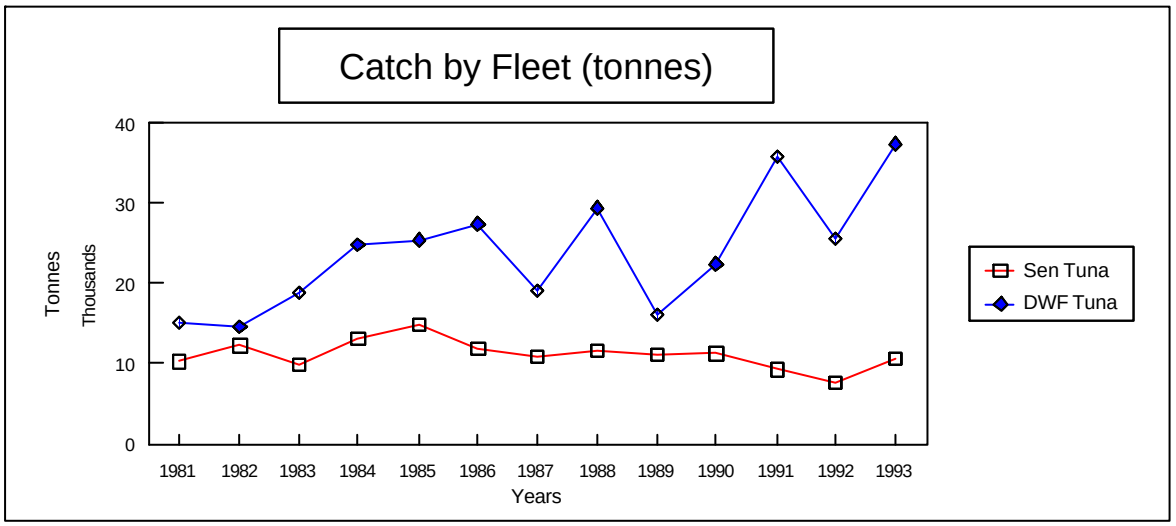
The bargaining position of Senegal relative to the EU is undermined by the combined effects of species migration across EEZs in West Africa and the lack of regional cooperation. According to Everett (1994) sardinellas, shrimp and tuna straddle EEZs with neighbouring countries, with the latter two species representing a significant proportion of EU fleet catches. This means that the EU is able to negotiate from a position of strength, since it can gain access

to the resource through negotiations with any one of a number of countries.

This problem would be obviated if the governments in the region cooperated in their negotiations. Unfortunately, unlike the Pacific Island states, this is not the case. (See Breuil *et al*. 1996 for a discussion.) Significantly the EU itself advocates such a policy for ACP countries. Perhaps even more significantly, since the Hague Declaration (1976) the EU itself does cooperate, explicitly prohibiting bilateral agreements by member countries in order to avoid member states undermining each other's bargaining position.

Even if the marine resources are not shared, the lack of regional cooperation may weaken the bargaining position of Senegal in negotiating access agreements, due to the discrepancy in the number of potential DWFs which might choose to fish in Senegalese waters relative to the number of potential non-adjacent fishing areas available to the EU DWF. Whereas there are numerous other regions in which the EU DWF could (and does) fish, there are relatively few DWFs which might choose to fish in Senegalese waters, particularly since the collapse of the Eastern European pelagic fleet. As such, Senegal's bargaining position is constrained by the prospect of European negotiators choosing to target other fishing areas. This arose in the late 1980s and early 1990s, when the EU concluded a number of agreements with coastal states in the Indian Ocean.

Figure 6



The potential importance of this effect is reflected in the degree of variability in DWF catches in the Senegalese EE, relative to the catch of the Dakar-based industrial fleet. In the case of the trawler catch, variability (measured in terms of variance deflated by the mean of catch) is 40% greater for the DWF fleet (calculated on the basis of CRODT data). With respect to the tuna fleet the variability of the DWF fleet is almost 800% greater than that of the Dakar-based fleet. (See Figure 6.) This makes management much more difficult since either compensation payments or DWF effort will tend to vary widely. Historically it is the latter which has adjusted.

Technology Choice and Secondary Losses

The value of access agreements is also affected by the choice of technology adopted by the EU fleet. Mesh size is most significant, since it determines both bycatch/discard rates and the prevalence of immature species in catches, and thus the long-run viability of the fishery. A comparison of mesh size regulations for EU waters relative to regulations in Senegalese waters for comparable species/gear types, reveals that allowable mesh in Senegalese waters tend to be smaller, at least for those gears and species for which comparison is feasible. (See Table 5.)

How is this reflected in discard/bycatch rates? The overall discard/catch ratio in the Eastern Central Atlantic regions was estimated to be 15.7%, which is lower than all but three other FAO regions (FAO *SWFA* 1995). The figure for the North-East Atlantic is considerably higher (26.7%), indicating that incidental losses are greater in European waters than in Senegalese waters. However, differences across regions may be more a reflection of the fish species pursued and resource characteristics than gear choice. Thus, within particular fisheries in the region the problem might be acute, especially since data is sparse for the area relative to other regions. Data for the EU fleet will be examined first, followed by the Senegalese fleet.

Table 5: Industrial Fleet Minimum Mesh Sizes

	EU Waters	Senegalese Waters
Purse Seine	16 - 40 mm[11]	16 mm
Fish/Cephlapod Trawls	100 mm	65 mm
Black Hake Trawls	27-30 mm	60 mm
Shrimp Trawls	16 -45 mm	40 mm

Source: European Parliament (1993), EC OJ Reg. 3094/86 (1986) L288/1 and EC OJ Reg 345/92 (1992) L42/15.

According to the FAO (Alverson *et al.* 1994) an EU DWF shrimp trawl had an estimated discard rate of 2.72 kg per kg of primary catch, while an EU DWF finfish trawl had an estimated discard rate of 1.48 kg per kg of primary catch. A *Protection et Surveillance des Pêches Maritimes* (PSPS) programme in the late 1980s found shrimp fleet discard rates in Senegalese waters ranging between 1.5 kg and 9.0 kg. (Michaud and Rioux 1989.) More recent government studies have generally revealed lower rates (PSPS, Personal Communication). Other reports claim that the cephlapod fishery in the

[11] Anchovies, Sprats, Mackerel and Herrings.

region has a high incidental fishing mortality for juvenile seabream, and that the bycatch mortality of shrimp, hakes and seabreams also arises from the horse mackerel fishery (FAO *FCECA* 1995 and FAO *RSWMFR* 1993). Finally, a summary of the available evidence on discard rates by EU fleets in Eastern Central Atlantic waters was obtained by extracting the relevant data from the discard database gathered by Alverson *et al.* (1994). (See Table 6.)

These figures may be compared with a study of a Dakar-based shrimp trawler which found that discard rates varied from 1.6 to 2.5 kg, depending upon the season (Dieng 1995). Another study of Senegalese shrimp freezer-trawlers based in Casamance found a ratio of 3.0 (Barry-Gerard *et al.* 1994a). A third study for the Senegalese shrimp fleet in 1985 found ratios of 2.1 in the cold season and 2.4 for the warm season. And finally, a study of the "pageot" fishery found a rate of 1.0 (Barry-Gerard *et al.* 1994a). Although studies of the artisanal fleet have not been conducted, it is quite likely that discount rates will tend to be lower since the gear is more selective (Martinez i Prat and Casanovas 1995).

Table 6: EU Discard Rates (Discarded/Landed) in ECA Water

Period of Study	Gear	Target Species	Discard Species	Discard Rate (kg per kg of target catch)	Fleet Origins
1983	Trawl	Shrimp	Various	2.2500	Italian, Greek
1983	Trawl	Finfish	Various	0.8898	Italian, Greek
1982	Trawl	Finfish	Various	1.4758	Italian, Greek
1982	Trawl	Shrimp	Various	2.7252	Italian, Greek
1977	Trawl	Shrimp	Various	16.8000	French, American, Japanese

Source: Alverson *et al.* (1994).

Given the range of results, it is difficult to draw any firm conclusions about discard rates for the Senegalese and European fleets, but it does appear that rates across the two fleets are not dissimilar. Moreover, in general they compare favourably with a global average of 5.2 for shrimp (Alverson *et al.* 1994). Conversely, the global figures for finfish range from 0.05 (salmon and smelt) to 0.75 (flounders, halibut and sole), indicating that discard rates in Senegalese waters are rather high for both fleets, although the evidence is very limited (Alverson *et al.* 1994).

Perhaps a more significant issue than the volume and weight of fish discarded by the foreign fleet is the type of species discarded. Data collected by PSPS casts light on the types of species caught by fleet type. (See Table 7.) The value figures are a lower-bound estimate, since the opportunity cost of discards is assessed at the value of fish meal, whereas some of the species discarded are in fact high-value species. Nonetheless, on this basis, the figures would indicate that over the period 1992-1994 the value of discards incurred by the EU fleet in Senegalese waters was equal to approximately 18% of the financial compensation received, even if it is assumed that their alternative use was for fish meal.

Table 7: Estimated Tonnage and Value of DWF Discards in Senegalese Waters (1992-1994)

	Shrimp Trawl	Hake Trawl	Other Trawl
Species	Brotule, Crab, Whitebait, Cod, Ojo Verde, Scorpionfish	Brotule, Chinchard, Scorpionfish	Triggerfish, Chinchard, Black Seabream, Whitebait, Pageot, Flying Fish, Sole, Yet
Est'd Weight (tonnes)	6,450	1,680	2,687
Est' Value (m ECU)	3.4	1.2	1.2

Source: Data supplied by PSPS.

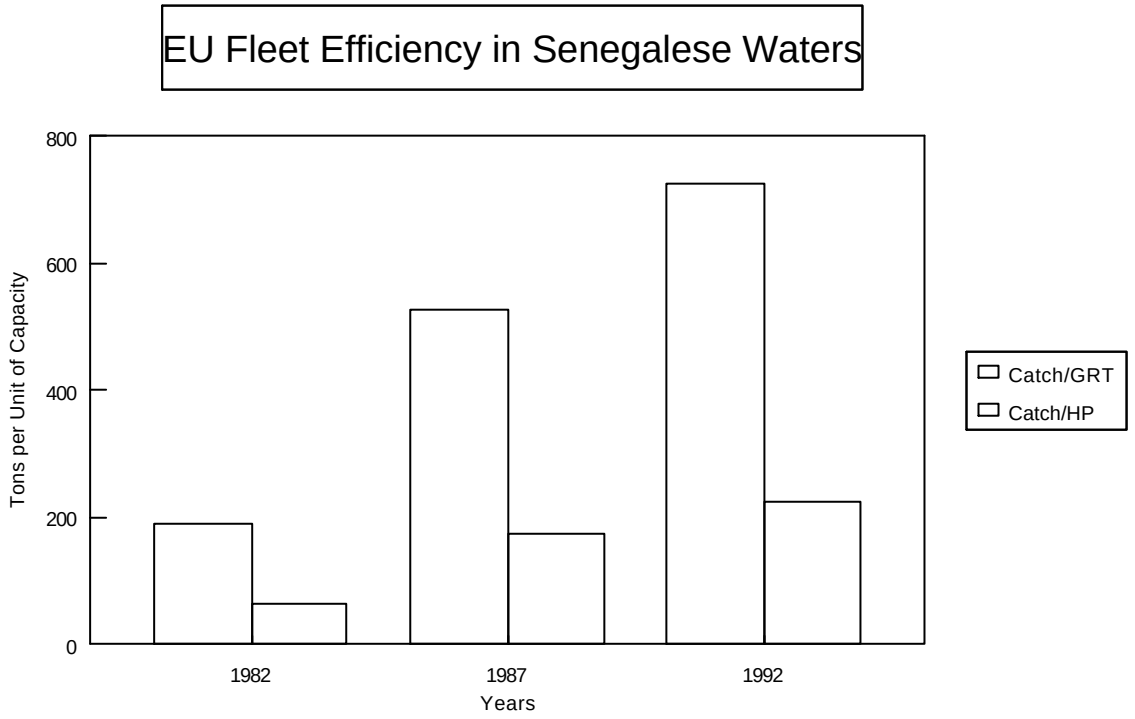
Nominal Quota Allocation and Actual Catches

The means by which quotas are determined in the access agreements may also have an effect on their relative value to Senegal. More specifically, in its own waters the EU does not apply effort measures such as those which are applied in the access agreements with coastal countries. Although determination of GRT is one of the primary policies of the CFP's structural policy it is not used as the determinant of the technical conservation policy, which instead relies upon catch licensing on the basis of total allowable catches (TACs).

If GRT is not a good indicator of actual effort then the whole basis for the agreement's quota allocation might be flawed. Actual efficiency when expressed in terms of catches per horsepower (HP) or GRT are shown in Figure 7. The figures for GRT represent an annual increase in efficiency of approximately 14%. More significantly, the rate of increase seems to be rather higher than for the EU fleet in general. For instance, it has been estimated that in recent years EU fleet efficiency has increased by an average of 2%-3% *per annum*. (See Holden 1994 and Karagiannakos 1995.)

Unlike the EU estimate, the Senegalese figure derived above does not account for the effects of changes in stock abundance and/or fishing intensity. However, in general it does appear that EU fleet efficiency in Senegalese waters is on the rise, particularly since abundance is unlikely to have risen significantly, and is perhaps more likely to have fallen. As such, Senegalese negotiators may be systematically underestimating the potential catch of the EU fleet when agreements are signed in terms of GRT.

Figure 7



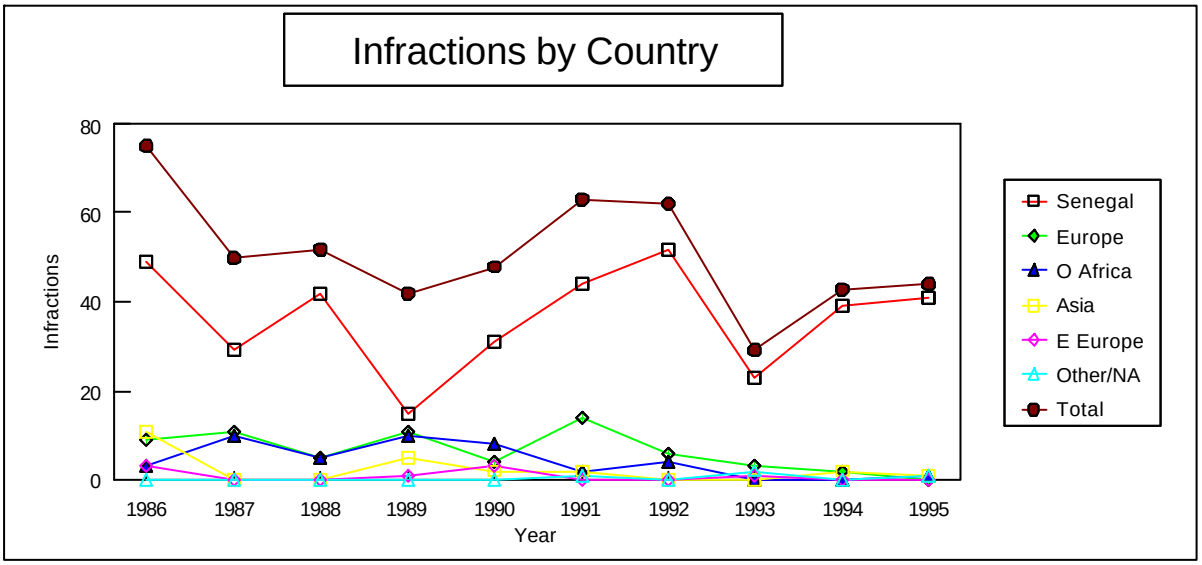
Moreover, it is significant that efficiency levels for the EU fleet are functions of the CFP itself. Through the structural policy the EU funds the withdrawal of older (presumably less efficient) vessels and the modernization of the remaining fleet. Thus, to a certain extent EU policy is itself undermining the effectiveness of the quota system used in the access agreements.

The Economic Cost of Infractions

Another factor which affects the net benefits derived from access agreements is the cost of infractions arising from the (necessarily) imperfect nature of surveillance. This is particularly important since in agreements between countries at different levels of economic development there is a danger that there will be an asymmetry between the sophistication of the foreign fleet and the institutional and technological capacity of the monitoring and enforcement regime. (See Martinez i Prat and Tudela i Casanovas 1995.) To some extent this is recognized in the agreements themselves, since funds are provided as side payments to the DOPM. Moreover, the Senegalese monitoring and enforcement regime is recognized for being exceptionally capable within West Africa. (See Michaud and Rioux 1989 and Breuil *et al*. 1996.)

Despite common assertions to the contrary, the available evidence does not indicate that the EU fleet is particularly given to violating regulations. PSPS data (Personal Communication) reveals that the number of infractions by the EU fleet has been consistently falling, while that of the Senegalese fleet has been more variable. (See Figure 8.) It should be emphasized that reported infractions offer only be a rough guide to the actual rates of illegal fishing practices. For example, even in EU waters it has been estimated that reported catch of some species is only 60% of the actual catch levels (Karagiannakos 1995). In Senegalese waters the figure is likely to be much lower. On the other hand, the authorities may discriminate between fleets, targeting some more than others. This would affect relative catch rates by fleet, although the likely bias is not self-evident.

Figure 8



For a more useful guide to relative infraction rates, the figures for the Senegalese industrial fleet and the European fleet can be weighted by the size of their respective catches. Assuming that the surveillance

authorities are indifferent between arrests of the domestic and European fleet this indicates that the European fleet is certainly no more likely to commit infractions than the domestic fleet, and may be somewhat less likely. (See Figure 9.)

However, the repercussions for a given infraction – whether caught or not – are different depending on the origin of the fleet. Since European fleets which are fishing unauthorized in Senegalese waters are unlikely to land their catch at a Senegalese port, the total value of the catch is in effect lost to Senegal. A vessel which is fishing illegally is unlikely to purchase inputs from Senegalese ports, contract Senegalese crews, nor sell its output to Senegalese "mareyeurs" and processors. However, Senegalese vessels fishing illegally probably provision themselves in Senegal and almost certainly will land their output in Senegal. They will, therefore, generate all of the upstream and downstream value-added, with multiplier effects throughout the economy that are not dissimilar to legal catches. All that is lost is the value of the license fees and associated costs arising from the specific nature of the infraction.

Figure 9

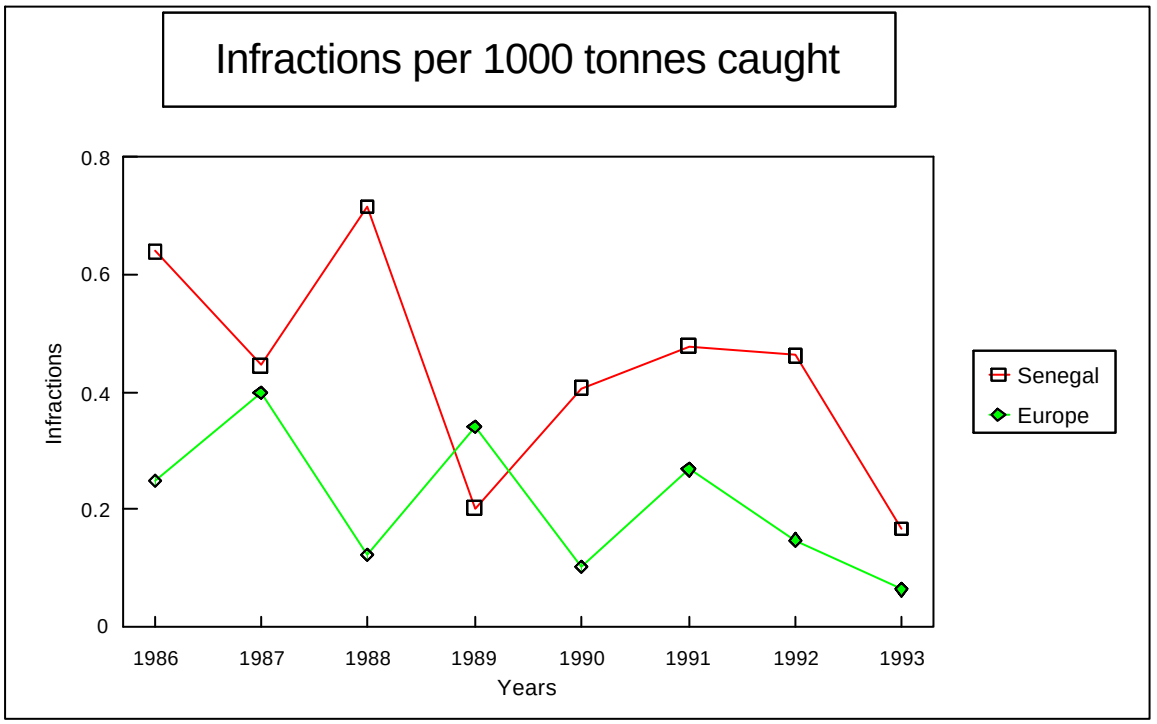
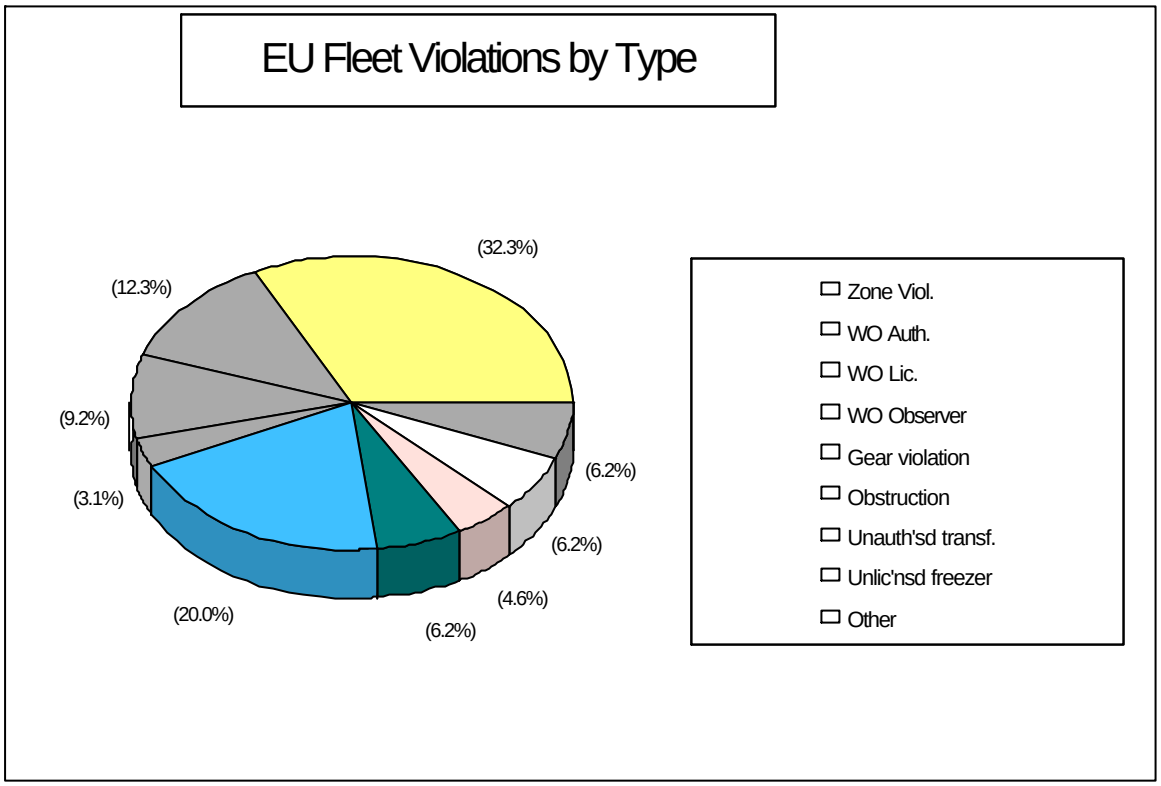


Figure 10



To cast more light on this issue, European infractions by type for the period 1986-1995 are presented graphically in Figure 10 (data provided by PSPS). Zone violations (32.3%) represent the largest proportion, followed by gear violations (20.0%) and fishing without authorization (12.3%), and fishing without a license (9.2%). The environmental consequences of the first two have been discussed above, while the latter two are of direct relevance here, since these captures may be lost to the Senegalese economy entirely.

In other words, even with equal costs of surveillance and equal propensities for the two fleets to engage in illegal fishing practices, the regulatory and associated costs of granting access to a DWF may be greater than would be the case if the increase in capacity was realised through the domestic fleet.

V. Economic Motivation for Signing the Access Agreements from the Senegalese Perspective

Given that there are good reasons to question the apparent value of access agreements to Senegal, it is worth examining the motivations for the agreements in more detail, concentrating on some issues which have not been extensively discussed in the literature.

Public Debt and Discount Rates

For a given access agreement the outcome of negotiations (the value of the compensation and the size of the quota) is dependent upon discount rates prevailing in the coastal country and the country representing the DWF. In those studies which apply principal-agent theory to the case of access agreements it is usually assumed that the discount rate applied by the principal (the coastal country) exceeds that applied by the agent (the country representing the DWF). Tucker and McKellar (1993) discuss this point with reference to sedentary and transient negotiators. In the case of coastal state-distant water state relations this would arise from the assumption that the principal's probability of gaining future streams of income from the resource are greater than that of the agent (Clarke and Munro 1990).[12]

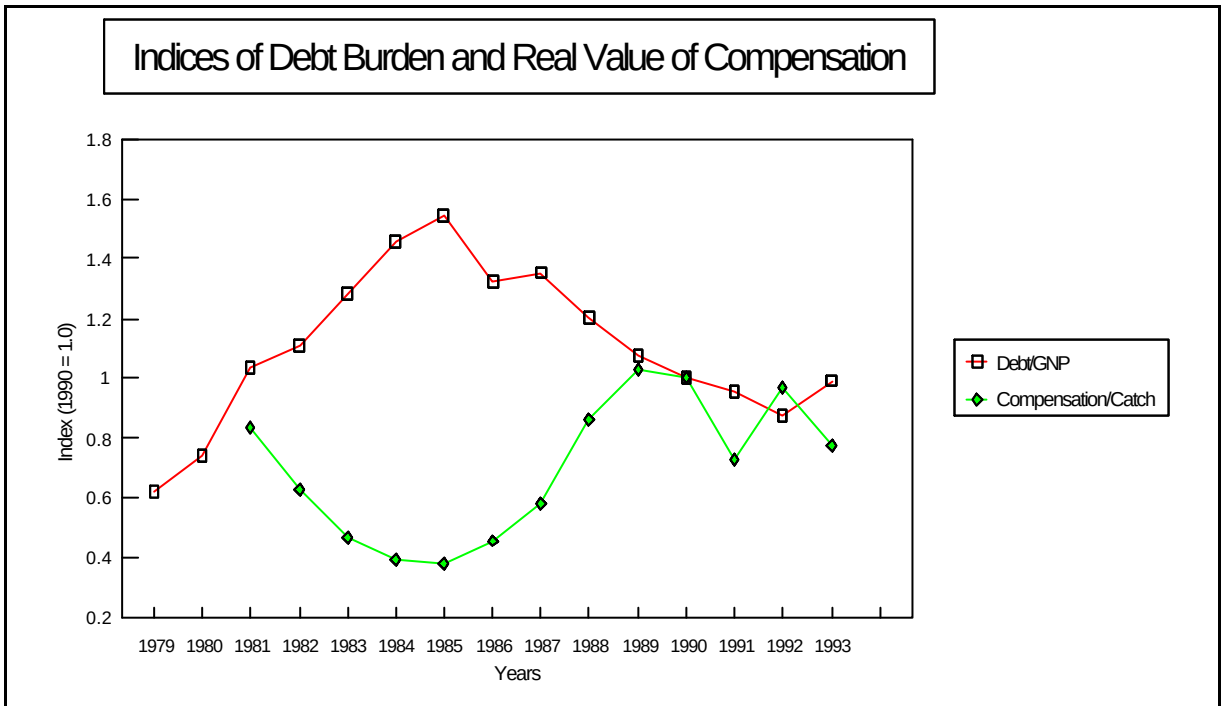
However, there are also reasons to believe that the principal's discount rate may be higher. More specifically, this may be the case if the displaced economic agents in the host nation are poor relative to members of the distant water fleet (Michaud and Rioux 1989 and Tucker and McKellar 1993). Given that the agreements are signed government-to-government, the relative importance of this latter point depends upon the extent to which the respective governments represent the interests of the communities affected. Although of considerable interest and certainly one of the most important factors determining the outcome of negotiations, this question, which is essentially political, will not be pursued here.

Instead, it is interesting to examine the manner in which government incentives are affected directly. The most telling manner in which this arises is with respect to government debt.

[12] This might be more accurately reflected in differences in planning horizons rather than actual discount rates. In this case the difference would be reflected in the range of the integral and not the discount rate. Moreover, since agreements are always of limited duration and there are no guaranteed extensions this latter interpretation more closely reflects actual practice. In practice the difference is not significant, but it may introduce the duration of the agreement into negotiations.

Indeed a number of commentators have attributed Senegalese motivation for the access agreements to the existence of Senegalese budgetary deficits and aggregate public debt. (See Michaud and Rioux 1989.) To some extent the link between public debt and discount rates is direct, with the interest paid by the Treasury on outstanding debt a primary determinant of discount rates applied by the fisheries and planning authorities. Since the Treasury usually plays the principal role in access agreement negotiations, and since it is the recipient of the bulk of financial compensation, such a relationship is likely to be quite strong.

In the event that public debt has been an important determinant of Senegalese motivation for access agreements, one would expect to find that compensation received per unit of catch would



fall as the government's bargaining position relative to the distant water nation deteriorated, and *vice versa*. The expected negative relationship between debt/GNP and compensation/catch holds well and is presented in Figure 11. The correlation coefficient is -0.83. (See Annex B for results of the estimated determinants of compensation per unit of catch.)

Figure 11

Capital Constraints for the Sector

Closely related to the issue of discount rates and public debt is that of capital constraints. To the extent that exploitation of many species is unsustainable – **ie,** the MSYs for certain species are exceeded – the management decision for many host nations is not so much between domestic exploitation and DWF exploitation within a single period, but rather between DWF exploitation of resources today and domestic exploitation tomorrow. If the country is not in a position to finance the development of a fleet, it will tend to favour the former strategy. Although the Senegalese government did play an important role in encouraging the development

of a fishing fleet in the early years following Independence, this is no longer the case (EC DG-VIII 1992 and Chauveau and Samba 1989). In addition, the domestic private financial sector has been notoriously wary of investing in fishing fleets. Hence financing is often cited as a constraint on development of the fisheries sector (Wijkström 1992).

The relative importance of financing depends upon the capital-intensity of the fleet. In the early 1980s, it was estimated that small-scale artisanal fisheries were as much as 100 times more labour-intensive (less capital-intensive) than large-scale industrial fisheries (Lawson 1984). Since the Senegalese fleet is largely and increasingly artisanal this would indicate that capital constraints may not, at least in abstract aggregate terms, be as binding as would appear to be the case.

However, if the capital market is highly differentiated, constraints may be nonetheless significant. FAO research has found that access to credit for artisanal fishermen is limited in Senegal, with the formal sector playing a minor role. The primary sources of credit are within the extended family, between fishermen and from related sectors, such as "mareyeurs" and transformers (Westlund 1994). More formal "tontines", which are important in the agricultural sector in Senegal, have played a limited role in fisheries (EC DG-VIII 1992). The relatively limited sources of credit are reflected in high interest charges. Rates from mareyeurs as high as 1/10 of the catch have been recorded for loans for fuel for individual fishing trips (Westlund 1994 and EC DG-VIII 1992).

Moreover, the degree of capital-intensity *within* the artisanal sector is clearly on the rise. (See Tvetdend and Hersoug 1992.) Increased motorization, more prevalent use of ice-boxes, and the adoption of sophisticated (and imported) gear such as encircling nets, has increased capital requirements for the artisanal fleet and, indeed, blurred the distinction between it and industrial fleets. If domestic capital markets do not respond to such requirements sufficiently quickly, then sale of access rights may be perceived as a more viable option for the government than the alternative - **ie,** more government support for artisanal fleet development.

Access Agreements and the Politics of Cooperation

A third incentive for the Senegalese government to sell access rights is related to the broader set of relationships which exist between the EU and Senegal. Thus it is important to recognize the link between access right negotiations and other areas of cooperation and trade between the EU and Senegal (Michaud and Rioux 1989). More specifically, negotiations for access rights can only be understood in the broader context of the Lomé Accords. The various Lomé Accords have always explicitly stated that the EU should encourage the development of domestic fleets in ACP countries – an objective which may itself be at odds with the existence of access agreements in some cases.

However, other aspects of the EU-ACP dialogue in the Lomé framework may actually encourage the signing of access agreements, since ACP countries must balance their interests in other discussions with their likely repercussions on the Lomé dialogue. In the case of fisheries access agreements this relationship is explicit, since Lomé IV listed access of EU fleets to ACP waters as one of its sectoral objectives, even though the negotiations themselves are

completely outside the Lomé Framework (Martinez i Prat and Tudela i Casa 1995).

To some extent, therefore, access agreements may be used as an incentive by Senegal to encourage the continued flow of development assistance for the sector from the EU (Martinez i Prat and Tudela i Casa 1995). Indeed, an examination of development assistance flows for the sector and access compensation flows between the EU and ACP countries indicates that large recipients of development assistance tend to sign access agreements with the EU. In absolute terms this is hardly surprising, since one would expect both to be a reflection of actual marine resources.

However, if both sectoral development aid and access agreement compensation payments are weighted by the relative size of the sector (expressed in terms of tons caught by the national fleet) a strong positive correlation (0.64) is also evident. (See Table 8.) This indicates that irrespective of the relative importance of the sector, those countries which sign more significant access agreements tend to receive more significant development aid for the fisheries sector. Although this relationship may be a reflection of complementarity (**ie,** support for port infrastructure and processing industries designed to add domestic value to DWF catches), it is more likely to be a reflection of an implicit *quid pro quo*, since access agreements are usually seen as a substitute for domestic sector fleet development.

Access to EU Markets

A fourth incentive for Senegal to sign access agreements with the EU is market access. This factor is likely to be of considerable importance since a large proportion of the Senegalese fleet's catch is exported. This has always been true of the industrial fleet, but is increasingly true of the artisanal fleet. In 1991, 41% of the artisanal catch was bound for export, while the figures for trawlers were 73% for refrigeration-trawlers and 100% for freezer-trawlers. (See Table 9.) Interestingly, the value of exports per ton of fish are highest for the artisanal fleet. Pelagic species exports are mainly destined for other West African countries, while demersal species are mainly bound for Europe, Japan and the United States. (See Desage *et al.* 1994.)

It is significant that the "law of one price" does not tend to hold for fisheries products. For instance, in the case of seabream, the price may be 20 times higher in the EU than it is in Senegal (FAO *DEEP* 1995). As such, it is of considerable value to Senegalese fleets and processors to gain access to EU markets. In theory, the Lomé Accords provide for this, since ACP countries are granted preferential access to the EU market. This should allow ACP fleets to exploit the EU market freely. In fact, however, the relative importance of ACP preferential access for Senegalese fisheries products may be limited by important non-tariff barriers arising from the CFP.

Table 8: Fisheries Development Aid and Access Compensation Weighted by Catch		
	Development Aid[13]/ Nat'l Fleet Catch	Financial Comp[14]/ Nat'l Fleet Catch
Angola	405.83	222.61
Cap Verde	0.00	366.06
Comoros	454.29	200.00
Cote d'Ivoire	80.66	101.18
Equatorial-Guinea	436.84	1886.84
Gambia	332.54	201.18
Guinea-Bissau	1555.14	2229.91
Guinea-Conakry	392.00	187.50
Madagascar	74.16	33.04
Mauritius	12.77	92.24
Mauritania	111.53	312.61
Mozambique	649.11	193.74
Sao Tome & Principe	281.82	990.91
Senegal	8.13	79.43
Seychelles	100.00	1414.29
Sierra Leone	128.94	91.06
Tanzania	0.00	4.87
Correlation Coefficient	0.64	
Source: Aid and Compensation from EP (1993) and Catch from FAO (1995)		

[13] Total fisheries sector development assistance over course of four Lome Accords.

[14] Compensation in most recent agreement.

Table 9: Exports of the Senegalese Fleet in 1991			
	Artisanal Pirogues	Refrigerated Trawlers	Freezer Trawlers
% of Catch	41.0%	73.0%	100.0%
Tons (th's)	33.5	18.7	40.6
Ecus (m's)	77.0	23.8	66.0
Source: Barry-Gerard *et al.* l 1994a			

Three factors associated with the operation of the CFP will be mentioned briefly:

- *market organization;*
- *hygiene standards;* and
- *producer organizations*.

The price system of the CFP is principally designed to ensure "a fair standard of living for fishermen" by stabilizing fish prices (Karagiannakos 1995). It does so through a system of guide and withdrawal prices which support fish prices and, in theory, smooth out fluctuations. In order to protect the price the EU can temporarily restrict imports from non-member countries. Through such a system, EU fleets and processors are granted effective priority relative to EU consumers. Moreover, foreign fleets may be subject to sudden trade restrictions. Although in the past such measures have been used only infrequently, the threat may be sufficient enough to discourage some trade. Moreover, since the restrictions can be of indefinite duration, the repercussions for perishable products – such as fresh fish – may be rather more severe than the relative infrequency of their application would indicate.

In addition, hygiene standards in the processing sectors are sometimes used as a pretext to stop imports. Through the CFP's "Common Marketing Standards" the EU set out "to improve the quality of fish marketed and to facilitate their sale" (Karagiannakos 1995). However, the end result may be to protect European fleets and processors by restricting imports on the basis of product quality. Senegal was affected by a French ban in 1995 (Martinez i Prat and Tudela i Casa 1995) and this year Mauritania has faced a similar ban (Woitellier, Personal Communication 1996). A recent Senegalese study has found that product quality and hygiene standards are often obstacles for exports, particularly to France (Desage *et al*. 1994). Although the study felt that European concerns were often justified, it is significant that European processors and fleets are given considerable financial support to comply with such EU regulations. The combination of strict regulations and generous subsidies may, in effect, serve as barriers to trade for ACP countries, despite their tariff-free access.

Finally, there appears to be a significant degree of market power exercised by those EU intermediaries responsible for the importation of fish and processed fish products (Desage *et al*. 1994). Part of this is certainly attributable to the establishment of producer organizations under the CFP's market organization policy. This encouraged the EU fleets to play a more active role

in the marketing of their output and to become involved in downstream stages of production. (See Karagiannakos 1995 and Hatcher 1993.) Conversely, within Senegal there is a multiplicity of export firms, particularly for fresh fish, most of which are quite small and likely to exercise little influence in European markets (Desage *et al*. 1994). This asymmetry in relative market power may allow importers to discriminate between sellers. Given the established links between EU fleets and downstream stages this may affect the ability of Senegalese fleets and processors to penetrate EU markets.

Thus, it may well be in the interests of the Senegalese government to sell access rights to its marine resources, since it is only in this way that it can gain access, albeit indirectly, to higher-price European markets. In effect, barriers to trade make it more profitable to sell the fish in the water rather than from the fishing port or the processing plant, after value has been added to the resource.

VI. Conclusion

In most discussions concerning the economics of access agreements, relatively lower costs of exploitation for the DWF are cited as the primary motivation for the coastal country. In effect, the coastal state is able to realize greater benefits from the exploitation of the resource by "contracting" the DWF. However, in the case study examined many qualifications were discussed which have the potential to adversely affect their apparent value to Senegal. These were:

- *a lack of cooperation over shared marine resources in West Africa and uncertainty about DWF effort may weaken Senegal's bargaining position*;

- *DWF technology choice may result in discards and by catch of immature or other species*;

- *improvements in DWF efficiency may undermine the basis for quota allocation*; and

- *DWF infractions may result in greater economic costs than equivalent national fleet infractions*.

Although no attempt was made to determine the total economic value of the agreements relative to greater national fleet exploitation, some reasons were given to explain Senegal's willingness to sign the agreements despite such qualifications. Significantly, those issues discussed were not related to relative costs of exploitation – although these are clearly important – but rather to market barriers in the development of a national fleet (capital constraints), differences in intertemporal choices between the coastal state and the DWF's country (discount rates), restricted access to higher value markets (non-tariff barriers) and other, seemingly unrelated, incentives (political cooperation).

However, perhaps more interesting than Senegalese incentives is the question as to why, for its part, the EU signs the agreements. In particular, there are good reasons to believe that the agreements are no more in their interest than they are in the interest of Senegal. Three general points can be made to substantiate this point.

Firstly, take-up of allocated quotas by the distant water fleet is low, being as little as 40% in some years according to the EU Court of Auditors (1993). This indicates that the DWF does not see the agreements as being economic, even after the EU taxpayer has covered the cost of compensation. In addition, compensation payments have been rising relative to import fish prices in recent years. Between 1983 and 1993 EU fish import prices fell by 17% in real terms, while compensation payments rose by 66% (calculated from Eurostat (various years), Michaud and Rioux (1989) and Dieng (1995)). Thus, unless abundance is increasing or fleet costs are falling (both of which are unlikely) the agreements are becoming increasingly uneconomic. And thirdly, the non-exclusivity of the agreements make their actual value to the EU

exceedingly uncertain, since the EU has no control over Senegalese fleet effort – nor other DWF effort in Senegalese waters – once the agreement has been signed.

Thus, although EU incentives have yet to be examined in greater detail, it seems clear that policy failures related to the Common Fisheries Policy lie at the root of EU motivation for the agreements. In effect, the agreements are perhaps best understood as the final outcome of a series of policy failures which have generated excess fleet capacity and artificially low fishing costs. Paradoxically, the existence of these very failures can be exploited by coastal nations in order to secure the best agreement possible from EU negotiators.

Annex A: Access Agreements and Principal-Agent Theory

In order to simplify the example, it will be assumed that there is only one potential distant water nation exploiting the coastal state's EEZ. It will also be assumed that there are no joint exploitation possibilities, whereby both the coastal state and the distant water fleet exploit the same stock. One or the other fleet will always be dominant. The fishery is modelled in the usual way, with fish biomass at time t equal to:

$$x = F(x)h(t), x(0) = x_0$$

and the harvest rate at time t equal to:

$$h(t) = q\,E^{a}(t)\,x^{b}(t)$$

where,

x (t) = biomass
F (x) = natural growth rate of stock
h (t) = harvest rate
E (t) = fishing effort

It will also be assumed that the parameters q, á and â are equal to 1.

Following Clark and Munro (1975), it is assumed that F(x) > 0, for 0 < x < x_{cc}, F '(0) = F'(x_{cc}) = 0, and F''(x) < 0, for all x > 0, where x_{cc} is the carrying capacity of the ecosystem. Both the price of the fish (p) and the cost of harvesting for the distant water fleet are constant (c). If the coastal state imposes a tax (m) per unit of effort (**ie,** GRT/year, horsepower, fishing days, etc….), then total costs (tc) for the distant water fleet are c + m. Assuming that the discount rate (ä) is the same in both countries the returns for the principal (R_p) and the agent (R_a) are as follows:

$$R_p(m,E) = \int_0^{infinity} e^{dt}\,[c\,c_0]E(t)dt$$

$$R_a(m,E) = \int_0^{infinity} e^{dt}\,[px(t)_{c0}]E(t)dt$$

Since relations between the principal and the agent are at the state-to-state level, they are better characterized as one of political negotiation rather than a simple market transaction. In international fisheries relations such negotiations are usually conducted with reference to financial compensation (FC) in addition to the tax on effort, or alternatively on catch. Therefore, an agreement will be struck if the returns to both parties are sufficient. In principal-agent analysis it is usually assumed that the necessary return is an exogenous constant - L_a for the

agent and L_p for the principal. (See Michaud and Rioux 1989 for a discussion.) Specifically, an agreement will be struck if there exists a level of financial compensation for which:

$$R_a \geq L_a + FC_0$$

$$R_p \geq L_p FC_0$$

What determines L_a and L_p? Assuming that there are no other non-adjacent EEZs which the fleet can exploit, L_a will primarily be a function of the costs of fishing in its own waters. Similarly, assuming that there are no other potential distant water fleets to "contract", L_p will be primarily a function of the domestic fleet's cost of fishing in its own waters.

Most of the points made in the text can be discussed in terms of this framework: The discussion of debt would be reflected in the discount rates applied by the principal and the agent; the discussion of market access would be reflected in terms of the inclusion of a price difference function for the principal; the effect of enforcement would be reflected in terms of an additional cost for the principal; and the effect of increased efficiency would be reflected in terms of the inclusion of a more sophisticated effort-harvest relationship for the agent.

Annex B: Determinants of Financial Compensation from Access Agreements

An attempt was made to determine the relative importance of different factors in the negotiated price for access to Senegal's marine resources. In all cases the dependent variable was the compensation received per ton of fish caught (CT) by the EU fleet. Data was obtained for 13 years.

The explanatory variables included were deflated EU fish import prices (MP) to reflect the opportunity cost of not signing the agreements for the EU; the magnitude of the combined artisanal/industrial Senegalese catch (SC), in order to proxy the available surplus; and the Senegalese debt/GNP (DG) ratio, to reflect the opportunity cost of not signing the agreements for Senegal. The results were as follows:

$$CT = 1018.01307 - 348.37224 * DG - 0.18159 * MP - 0.00028 * SC$$

$$(44.72243) \quad (97.57007) \quad (0.17704) \quad (0.00034)$$

$$n = 13 \quad df = 9 \quad R^2 = 0.71941$$

The sign for the debt burden is of the expected sign and is statistically significant at the 0.99 level. The sign for the import price is not of the expected sign, since a high import price would encourage the EU to pay more for access per ton of fish. However, it is not statistically significant. Nor is the sign for the Senegalese effort variable of the expected sign or statistically significant.

A number of other regressions were estimated, none of which improved upon the fit. However, in all cases the variable for debt burden was of the expected sign and significant. Thus, although the unsatisfactory nature of the results may bias the magnitude of the estimate, it seems clear that the debt burden plays a significant role in determining the outcome of EU-Senegal negotiations.

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