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**West Africa Regional Fisheries Project**

**ESTIMATION OF THE COST OF ILLEGAL FISHING IN WEST AFRICA**

**FINAL REPORT**

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**MRAG**

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## EXECUTIVE SUMMARY

1. This study was conducted as part of the preparation for the World Bank's West Africa Regional Fisheries Project. It had as its primary aim a focused case study on the economic impacts of illegal fishing activities in CSRP<sup>1</sup> member states: Cape Verde, the Gambia and Guinea, plus the key study countries Mauritania, Senegal, Guinea Bissau, Sierra Leone.
2. Illegal fishing as defined by the terms of reference for this task was restricted to infringement of regulations by licensed or legal vessels, or fishing activities by unlicensed vessels in a managed location. The methodology followed was:
  - Development of a general model for investigating direct costs and benefits of illegal fishing problems;
  - Testing of this model following in-depth country visits to two of the key counties, Senegal and Guinea Bissau;
  - Circulation of a questionnaire to other countries in the region. Full responses were received from the other two key study countries, Sierra Leone and Mauritania, and additional information was obtained from The Gambia;
  - Construction of models for up to three case study fisheries within each country.
3. The analytical model used, for each case study, included data on the value of main commercial species, volume of catches and landings (national and foreign), characterisation of the fleets (the various nationalities, types of boats, tonnage, number of active vessels, crew size, *metiers*, etc.), size of the illegal fishing problem, value of fishing licenses, value added (direct value added for fishing and processing; no estimates could be obtained for indirect value added), direct employment and government receipts (licence fees, taxes and fines for infractions) to calculate:
  - the value of fish that are illegally removed from the country;
  - added-value and tax revenue lost from fish that are illegally removed from the country;
  - the value of licence revenue foregone, which is a loss to government revenue;
  - other losses such as the loss of employment of observers or national crew members on vessels that would be required if they were legally licensed.
4. The potential benefits from elimination of illegal fishing were investigated in two scenarios: (1) the illegal vessels are eliminated from the system, but with the illegal catch being taken by legal vessels using the same effort with an increased value added; and (2) the illegal vessels become legal, meaning that the country captures more in licence revenues, but the benefits are shared amongst a larger number of vessels.
5. The following case studies were investigated in detail:
  - Senegal industrial demersal fishery;
  - Guinea Bissau industrial shrimp fishery;
  - Sierra Leone industrial shrimp fishery;
  - Mauritania artisanal mixed fishery;
  - Senegal artisanal small pelagic fishery;

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<sup>1</sup> Commission Sous-Régionale des Pêches or Sub-Regional Fisheries Commission members are: Mauritania, Cape Verde, Senegal, the Gambia, Guinea Bissau, Guinea, Sierra Leone

- Senegal artisanal shrimp fishery;
  - Guinea Bissau artisanal fishery;
  - Sierra Leone artisanal fishery.
6. Intangible impacts of illegal fishing were investigated qualitatively through the questionnaire and quantitatively in respect of a) the depletion of current demersal stocks of fish in the region and b) the benefits of eliminating illegal mesh size use in industrial shrimp fisheries.
  7. Throughout the region there is concern about three fundamental types of illegal fishing: unlicensed foreign industrial vessels; illegal fishing in prohibited areas, particularly close to shore, and with illegal nets; and illegal fishing by artisanal vessels, many of which are unlicensed and fishing with illegal nets (Table 1).
  8. The estimated total value of illegal catch from the industrial case studies was US \$22 million. The estimated illegal catch value from the artisanal case studies was US\$ 85 million, although this was about the same proportion (35%) of the total catch value as in the industrial case studies, which were much more restricted in total catch volume than the artisanal case studies (20,000 t compared to 560,000 t).
  9. We augmented our artisanal case studies with tentative calculations for The Gambia and Guinea, based on understandings of catch and illegal fishing problems in those countries combined with economic data from Guinea Bissau.
  10. The combined value added lost to countries (removed through illegal fishing and not landed in-country) was US\$ 8 million for the industrial case studies and US\$ 74 million for the artisanal case studies. Estimated illegal losses from the artisanal fishery are very high for Guinea (US\$ 173 million), and very small for The Gambia. Our industrial case studies covered a relatively small, but highly valuable, set of fisheries. If other industrial fisheries are included, the total value added lost for industrial and artisanal fisheries combined could be close to US\$ 300 million.
  11. There was a big difference in the anticipated destination for industrial and artisanal catches. In the case studies, all the lost illegal catch from the industrial fisheries is probably lost to the region, although it may be landed relatively close by, for instance into the EU. For the artisanal catch, we estimate that only 14% of it is lost to the region (i.e. to countries from Liberia southwards), much of it being landed in other countries within the region. Senegal appears to be a net receiver of illegally-caught artisanal fish from the region, with other countries being net losers.
  12. The gains from eliminating illegal fishing and allowing currently licensed domestic vessels to take this catch instead (Scenario 1) are quite high, roughly US\$ 71 million over all case studies (except Guinea and The Gambia), and (because individual vessel profits are not as high) are about US\$ 42 million for Scenario 2, where the illegal vessels are licensed. Neither of these scenarios would be advisable if the potential intangible benefits are to be realised.
  13. For the intangible impacts we estimate that, given the state of demersal resources in the region, elimination of illegal fishing (industrial and artisanal) and the imposition of sustainable management could increase stock size, and potentially fishing and processing value added, by 10–20%. Our investigation of the use of illegal mesh sizes in the Guinea Bissau industrial rose shrimp suggested that elimination of illegal mesh sizes could result in an increase in profit (fishing value added) of between 50% and 100%. Other intangible benefits would accrue, particularly the elimination of conflict between artisanal and industrial vessels and protection of conservation areas.

**Table 1: Summary of illegal fishing problems in the sub-Region, and the benefits of their solution. Green = low level or no problem; yellow = intermediate level problem; red = high level of problem.**

	Unlicensed fishing		Illegal transshipments	Illegal gear (undersized mesh)		Fishing in closed area	
	Industrial	Artisanal	Industrial	Industrial	Artisanal	Industrial	Artisanal
<b>Mauritania</b>		Part of the Senegalese fleet is unlicensed		Illegal mesh used in the shrimp fishery	Illegal mesh used in the shrimp, demersal and small pelagic fisheries		Fishing in Banc D'Argun national park
<b>Senegal</b>		Some incursion by other country fleets, most landed in Senegal			Illegal mesh used in the shrimp, demersal and small pelagic fisheries	Fishing in artisanal areas	
<b>Gambia</b>				no information	no information	no information	no information
<b>Guinea Bissau</b>	Unlicensed foreign vessels, or foreign vessels licensed by other regional countries	Artisanal vessels from Senegal and elsewhere in the region	Foreign vessels transshipping at sea	Illegal mesh used in the shrimp fishery	Illegal mesh used in the demersal and small pelagic fisheries	Fishing in areas preserved for artisanal fishers and in the national park	Fishing in national park by foreign artisanal vessels
<b>Guinea Conakry</b>	Unlicensed foreign vessels, or foreign vessels licensed by other regional countries	Artisanal vessels from Senegal and elsewhere in the region	Foreign vessels transshipping at sea	no information	no information	no information	no information
<b>Sierra Leone</b>	Unlicensed foreign vessels, or foreign vessels licensed by other regional countries	Artisanal vessels from Senegal and elsewhere in the region	Foreign vessels transshipping at sea	Illegal mesh used in the shrimp fishery	Illegal mesh used in the inshore demersal fishery	Fishing in areas preserved for artisanal fishers	
<b>Legal problems</b>	Legislation is adequate	Legislation is not adequate to cover licensing and registration across the region	Legislation is clear	Legislation is clear	Legislation is clear but not communicated to artisanal fishers well	Legislation is clear	Legislation is clear

<b>Enforcement problems</b>	Inadequate MCS resources in the south	Inadequate control of artisanal vessels throughout the region	Inadequate ability to enforce transshipment requirements				
<b>Damage/cost</b>	Estimated illegal catch value \$22 million and estimated \$8 million value added lost to the region just from case study fisheries	Estimated illegal catch value \$170 million and estimated value added exported from countries of \$251 million of which 11% is lost from the region	Transshipment/ port fees lost (no direct estimate in this report)	Overexploited stocks and Sub-optimal economic benefit from fisheries, particularly in the south and particularly for demersal fisheries	Catching juvenile and small species. Growth overfishing. Overexploited stocks and Sub-optimal economic benefit from fisheries, particularly in the south and particularly for demersal fisheries	Catching protected species. Overexploited stocks, particularly of shallow demersals. Habitat and other environmental damage. Conflict with artisanal fishers and depression of artisanal catch rates	Catching protected species. Overexploited stocks, particularly of shallow demersals. Habitat and other environmental damage
<b>Solutions</b>	Enhance MCS cooperation particularly across the south	Require better reporting and more inspections in port for artisanal vessels; cooperation between Senegal and other countries	Require observers and VMS reports from all foreign vessels	Increase inspections at sea	Increase inspections in port to enforce mesh provisions	Require observers and VMS reports from all foreign vessels	Education and increase at-sea patrols
<b>Benefits</b>	Potential gain government revenue \$2 million and in total value added \$7 million from Scenario 1	Potential gain government revenue \$3 million and in total value added \$159 million from Scenario 1	Increased control and revenue	Increased yield and estimated 100 - 200% increase fishing value added (bioeconomic model)	Increased yield and biomass, recovery of stocks: in the south, potential 10-20% increase in stock status could translate to similar increase in VA	Protection of marine ecosystems, recovery of inshore demersals	Protection of marine ecosystems

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## ACRONYMS

ADB	African Development Bank
BEAM	Bio-Economic Analytical Model
CECAF	Fishery Committee for the Eastern Central Atlantic
CEP	<i>Cellule d'études et de planification</i> (Studies and Planning Unit) (Senegal)
CPUE	Catch per unit effort
CRODT	<i>Centre de Recherches Océanographiques Dakar-Thiaroye</i> (Dakar-Thiaroye Centre for Oceanographic Research) (Senegal)
CSRP	<i>Commission Sous-Régionale des Pêches</i> (Sub-Regional Fisheries Commission)
CVCs	Coastal Surveillance Centres ( <i>Centros de Vigilância Costeira</i> ) (Guinea Bissau)
DPM	<i>Département des Pêcheries Maritimes</i> (Marine Fisheries Department) (Senegal)
DPSP	Fisheries Protection and Surveillance Directorate ( <i>Direction de la Protection et de la Surveillance des Pêches</i> ) (Senegal)
DRC	Democratic Republic of Congo
DSCPM	( <i>Délégation à la Surveillance des Pêches et au Contrôle en Mer</i> (Fisheries Surveillance and Sea Control Delegation) (Mauritania)
EEZ	Exclusive Economic Zone
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FCFA	CFA Franc (Senegalese currency)
FISCAP	Fisheries control and surveillance unit ( <i>Fiscalização e Controlo de Actividades de Pesca</i> ) (Guinea Bissau)
GDP	Gross Domestic Product
GRT	Gross Registered Tonnage
IEZ	Inshore Exclusion Zone (Guinea Bissau)
IMROP	<i>Institut Mauritanien de Recherches Océanographiques et des Pêches</i> (Mauritanian Institute for Oceanographic Research and Fisheries) (Mauritania)
IUU	Illegal, unregulated and unreported
IUU	Illegal, unreported and unregulated
JMA	Joint Maritime Authority (Sierra Leone)
MCS	Monitoring, Control and Surveillance
MFMR	Ministry of Fisheries and Marine Resource (Sierra Leone)
MPEM	<i>Ministère des Pêches et de l'Economie Maritime</i> (Ministry of Fisheries and Maritime Economy) (Mauritania)
MSY	Maximum Sustainable Yield

PNBA	Parque Nacional de Banc d'Arguin (Mauritania)
SFLP	Sustainable Fisheries Livelihood Programme
UM	<i>Mauritania</i> Ouguiya (Mauritanian currency)
US	United States
VA	Value-added
VMS	Vessel Monitoring System

# **1. INTRODUCTION**

## **1.1. Scope of the study**

This Study on 'Estimation of the Cost of Illegal Fishing in West Africa' was conducted as part of the preparation for the World Bank's West Africa Regional Fisheries Project. Its primary aim was to conduct a focused case study on the economic impacts of illegal fishing activities in the member states of the Sub-Regional Fisheries Commission (CSRP<sup>2</sup>): Mauritania, Cape Verde, Senegal, the Gambia, Guinea Bissau, Guinea and Sierra Leone. Illegal fishing as defined by the terms of reference for this task was restricted to the infringement of regulations by licensed or legal vessels, and fishing activities by unlicensed vessels in a managed location.

Although several general studies on illegal fishing in West Africa exist, these have not in general been conducted to a level of detail that allows an understanding of the losses at the country level beyond the overall value of fish lost to illegal fishing. This study therefore concentrated on up to three case studies for each of four countries – Mauritania, Senegal, Guinea Bissau and Sierra Leone. Other impacts of illegal fishing, including in Gambia and Guinea are described with reference to the results from these detailed case studies.

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<sup>2</sup> Commission Sous-Régionale des Pêches.

## **2. METHODS**

### **2.1. Process**

The overall methodology followed was:

- Development of a general model for investigating direct and indirect costs and benefits of illegal fishing problems;
- Development of a preliminary set of data requirements for the study;
- Implementation of two pilot studies (Senegal and Guinea Bissau) involving site visits to acquire detailed country data and explore the viability of obtaining the data necessary for the general model and identify additional data requirements for the model;
- Development of a questionnaire to acquire data on illegal fishing, and circulation to in-country contacts, in two parts: the first part was used to identify the case study fisheries and illegal fishing problems for each country, and the second part was used to gather detailed catch and economic information required for the specific case study fisheries; and
- Analysis of the data from the questionnaire and compilation of final model results.

Responses to the questionnaire were received only from Mauritania, Senegal, Guinea Bissau and Sierra Leone. Information on Gambia and Guinea was therefore inferred from the results for the former four countries and other information and reports. As a result, these countries are only considered in general terms, and as extrapolations from data from the other countries.

### **2.2. Definitions**

The following definitions were used in the development of the model:

- Illegal fishing: infringement of regulations by licensed or legal vessels, or fishing activities by unlicensed vessels in a managed (EEZ) location.
- Value added: the value of the goods produced less the cost of materials or supplies used in producing them (intermediate costs).
- Direct fishing value added: value added from the fishing activity.
- Indirect fishing value added: value added from activities linked to fishing activity e.g. boat building, repair etc.
- Direct processing value added: value added from processing activity.
- Indirect processing value added: value added from activities linked to the processing sector e.g. production of packaging, transport.

## 2.3. The model

### 2.3.1. Background on the fishery

Background data on the fishery were collected, such as the number of vessels of different nationalities, their average size (tonnage), number of months fishing per year, the cost of a licence for each category ( $l$ ) (which often differs between national ( $l_{NAT}$ ) and foreign ( $l_{FOR}$ ) vessels and may be based on tonnage and may differ according to the number of months' fishing), and the number of national and foreign crew employed per legal vessel. Total reported catches by species or species groups were obtained, together with average first-sale prices per tonne ( $p$ ) for each species or species group.

These data were used to calculate the following background statistics on each case study fishery:

- Number of (legal) national vessels:  $n_{NAT}$
- Number of (legal) foreign vessels:  $n_{FOR}$
- Number of legal vessels:  $n_{LEG} = n_{NAT} + n_{FOR}$
- Total reported legal target catch:  $C_{LEG}$
- Total value of legal catch (first sale value of production):  $V_{LEG} = C_{LEG} \cdot p$
- Total catch value per legal vessel  $v_{LEG} = V_{LEG} / n_{LEG}$
- Government revenue from licences:  $r_{LIC} = n_{NAT} \cdot l_{NAT} + n_{FOR} \cdot l_{FOR}$
- Government revenue in addition to licence fees<sup>3</sup>:  $r_{OTH} = r_{LIC} \cdot s_{LIC} + V_{LEG} \cdot s_{CAT}$  (where  $s_{LIC}$  is the proportion applied to licence fee revenue that is captured as extra revenue by the government through fees levied as a proportion of licence value and  $s_{CAT}$  is the proportion of catch value captured by the government through fees).
- Total government revenue:  $r_{TOT} = r_{LIC} + r_{OTH}$
- Number of nationals employed on legal vessels:  $E_{NAT,LEG} = e_{NAT,LEG} \cdot n_{LEG}$  (where  $e_{NAT,LEG}$  = number of nationals employed per legal vessel)

### 2.3.2. Estimate of illegal activity

An estimate of the proportion of illegal (unlicensed) fishing ( $a$ ) was obtained from reports and from our in-country studies. This was defined as illegal activity as a proportion of total activity. So for example, if there were 40 licensed vessels and an estimated 20 unlicensed/illegal vessels, the proportion of illegal activity would be 0.33. Such estimates were usually based on an estimate of the total fleet size (from experts, fisheries administration staff, research staff, inspection agencies) compared with the number of licensed vessels. They were thus derived independently from surveillance data, inspection coverage and detection rates. However, where available, such data were used to inform the estimate, where the data were robust enough and reliable to provide an indication of the total active fleet size

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<sup>3</sup> For example, inspection fees, employment and company taxes and fines for not landing catches in-country.

(e.g. Kelleher 2002). The value of a fine for an illegal vessel ( $f$ ) was obtained from the questionnaire, and was based on the level of fines for the various types of offences according to fleet sector.

The estimates of illegal activity were used to estimate the illegal catch and its value, which is a financial loss to the legal fishing system but may not necessarily be a financial loss to the country as it may still be landed.

The number of offences detected ( $n_{DET}$ ) was obtained from fisheries administrations' surveillance data.

The following statistics were calculated:

- The number of offences committed:  $n_{ILLEG} = n_{LEG} \cdot a / (1 - a)$
- Estimated illegal catch of target species:  $C_{ILLEG} = C_{LEG} \cdot (a / (1 - a))$
- Total value of fish lost to illegal fishing:  $V_{ILLEG} = C_{ILLEG} \cdot p$
- Licence fee value for an illegal vessel (i.e. what it would have to pay if it were to buy a licence)<sup>4</sup>:  $l_{ILLEG}$ .
- The number of nationals employed on the illegal fleet:  $E_{NAT,ILLEG} = e_{NAT,ILLEG} \cdot n_{ILLEG}$  (where  $e_{NAT,ILLEG}$  = number of nationals employed per illegal vessel. Estimates of employment of nationals and foreigners per illegal vessel were based on knowledge of fleet characteristics obtained from the questionnaires and other in-country data).

### 2.3.3. Tangible losses

Tangible ('direct') losses are those losses arising from unlicensed fishing. They can be catches taken over-quota, where a licence fee is levied for quota, or catches taken by vessels that are not licensed. The direct losses therefore include:

- Government revenue losses from licence revenue foregone and revenue foregone from other sources (landing fees etc);
- The value of fish that are illegally removed from the country (see above);
- Added value lost, both direct and indirect for fishing and processing, from fish that are illegally removed from the country;
- Other losses such as the loss of employment of observers or national crew members on vessels that would be required if they were legally licensed.

A tangible losses model, developed in an Excel spreadsheet, was constructed around specific case studies. It is only practical to calculate tangible losses due to unlicensed fishing or fishing over-quota. These two issues are effectively the same in our treatment. Information on government income from fishing – licence revenue and other revenue – was used to calculate total government revenue from legal vessels, and consequently lost government revenue from unlicensed fishing activity. The latter

<sup>4</sup> This was based on the cost of licence fees for the different categories of legal vessel (by nationality, size etc), based on the predominant characteristics of the illegal vessels (i.e. if they were national vessels, foreign vessels, their size etc.).

was offset by expected fines from detected illegal activity ( $n_{DET}$ ). Note that only a fraction of the illegal activity is actually detected.

For each study the following were calculated for the losses to government revenue:

- Government revenue lost through foregone licence fees:  $q_{LIC} = n_{ILLEG} \cdot l_{ILLEG}$
- Government revenue lost from other sources:  $q_{OTH} = q_{LIC} \cdot s_{LIC} + V_{ILLEG} \cdot s_{CAT}$
- Government revenue from fines from detected illegal activity:  $r_{FIN} = n_{DET} \cdot f$
- Net government revenue loss:  $q_{TOT} = q_{LIC} + q_{OTH} - r_{FIN}$
- Present government revenue:  $r_{TOT} + r_{FIN}$
- Lost employment of nationals due to illegal fishing:  $e_{NAT,LEG} \cdot n_{DET} - e_{NAT,ILLEG}$

### Value-added

The next step was to estimate value added from fishing and processing. The following definitions of value-added were used:

FISHING VALUE ADDED			DOMESTIC	EXPORTED
<b>Legal fleet</b>				
Direct value-added			<b>Value added from the fishing activity: value of production less the cost of materials or supplies in producing it. Estimated as a proportion of the catch value.</b>	
			Amount captured by nationals (e.g. salaries to national crew or profits of national company) ( $FIS, LEG, DOM$ )	Amount captured by foreigners (e.g. salaries to foreign crew, or profits accruing to a foreign company) ( $FIS, LEG, FOR$ )
Indirect value-added			<b>Value added multiplier (based on catch tonnage) for knock-on effects on economy - boat building, port services, transport, packaging etc</b>	
			Amount captured by nationals or by the national economy	Amount captured by other economies or foreigners
<b>Illegal fleet (estimate)</b>			As above, but for illegal fishing activities. The domestic and exported split may well differ, according to where the benefits accrue	
Direct value-added			(FIS, ILLEG, DOM)	
Indirect value-added			(FIS, ILLEG, FOR)	
PROCESSING VALUE ADDED			DOMESTIC	EXPORTED
<b>Legal fleet</b>			<b>Value added from processing activity from legal catches. Estimated as a proportion of the catch value.</b>	
Direct value-added			Processing VA captured by national economy (e.g. if landing and processing takes place in the country) ( $PRO, LEG, NAT$ )	Processing VA captured by foreigners (e.g. if catches are landed and processed elsewhere, or if processing plants are foreign-owned) ( $PRO, LEG, FOR$ )
Indirect value-added			VA multiplier (based on catch tonnage) for knock-on effects on the economy from processing - packaging, transport of products etc	VA multiplier (based on catch tonnage) for knock-on effects on the economy from processing - packaging, transport of products etc
<b>Illegal fleet (estimate)</b>			As above but for illegal catches - may differ in terms of split between domestic and exported	
Direct value-added			(PRO, ILLEG, DOM)	
Indirect value-added			(PRO, ILLEG, FOR)	

In reality we only found estimates for direct fishing value added and direct processing value added. We split these into domestic (i.e. the portion of the value added that accrues within the country) and exported/foreign (i.e. the portion of the value added that accrues to other countries) value added based on the estimates of:

- for fishing value added, the proportion of the fleet and crews that are nationals and foreign;
- for processing value added, the proportion of the catch (by value) that is landed or retained in-country, and moved out of the country (e.g. domestic processing value added = total processing value added x proportion of catch value retained/landed in country).

Estimates of fishing value added by fleet and target species were obtained from FAO (2001) and for processing value added from a World Bank study in the region. The domestic/exported proportions were obtained from our in-country studies. The split between domestic and exported value added varied according to the legal and illegal activity, taking into account the behaviour of the respective fleets. For example, for legal catches, if half the catch is landed in-country and half is transhipped or landed elsewhere, the processing value added is split 50:50 between domestic and exported. If the illegal catches are all landed outside the country, all the processing value added was assigned to exported/foreign, with zero for domestic processing value added. The difference in behaviour and value added from legal and illegal fleets and their catches was therefore used to estimate the value added lost to illegal fishing.

The following were calculated:

- Direct value added from legal fishing activity, captured in-country:  $VA_{FIS,LEG,DOM} \cdot V_{LEG}$
- Direct value added from legal fishing activity, exported overseas:  $VA_{FIS,LEG,FOR} \cdot V_{LEG}$
- Direct value added from illegal fishing activity, captured in-country:  $VA_{FIS,ILLEG,DOM} \cdot V_{ILLEG}$
- Direct value added from illegal fishing activity, exported overseas:  $VA_{FIS,ILLEG,FOR} \cdot V_{ILLEG}$
- Direct processing value added from legal catches, captured in-country:  $VA_{PRO,LEG,DOM} \cdot V_{LEG}$
- Direct processing value added from legal catches, exported overseas:  $VA_{PRO,LEG,FOR} \cdot V_{LEG}$
- Direct processing value added from illegal catches, captured in-country:  $VA_{PRO,ILLEG,DOM} \cdot V_{ILLEG}$
- Direct processing value added from illegal catches, exported overseas:  $VA_{PRO,ILLEG,FOR} \cdot V_{ILLEG}$

Where  $VA$  represents a multiplier (proportion) applied to the catch value to calculate fishing and processing value added.

### **2.3.4. Intangible losses**

Tangible losses are relatively easy to model if the above data can be acquired. Intangible losses are not. Intangible losses include:

- Fish stock depletion due to the added extractions from illegal activity. In the West Africa region this includes the added extractions of juvenile fish, fish from closed areas and fish extracted by industrial fleets from inshore areas reserved for artisanal fleets.
- Sub-optimal management due to the illegal catch of undersized fish.



- Ecological damage and resulting knock-on impacts throughout the marine ecosystem from fishing in closed areas, particularly marine parks.

Intangible losses are described in qualitative terms in this report. However, as a case study to quantify intangible economic losses, a bioeconomic model was developed to investigate losses associated with illegal small mesh use in the Guinea Bissau industrial shrimp fishery (see section 4.2).

### 2.3.5. Scenarios

In order to investigate the consequences of solving the illegal fishing problem, we looked at two associated scenarios:

Scenario 1: the illegal vessels are eliminated from the system, but with the illegal catch being taken by legal vessels using the same effort. This assumes that every legal vessel is able to take more catch, with no increase in inputs (crew, fuel etc) so that the fishing value added that legal vessels experienced in the base case is increased by the value of the previously illegal catch, split between domestic and exported in the same ratio as the legal value added.

Scenario 2: the illegal vessels become legal, meaning that the country captures more in licence revenues, but the benefits are shared amongst a larger number of vessels, and the value added of the legal catch includes additional inputs but more of this is captured by the country than in the base case. Illegal vessels are assumed to adopt the same behaviour as the current legal fleet with respect to their fishing and landing patterns.

In calculating the potential government revenue from licensing the illegal vessels, the licence fee for an 'average' illegal vessel (i.e. taking into account tonnage, nationality and fishing patterns), was used.

Calculations for scenarios 1 and 2:

Variable	Scenario 1	Scenario 2
Number of legal vessels	$n_{LEG}$	$n_{LEG} + n_{ILLEG}$
Total reported legal target catch	$C_{LEG} + C_{ILLEG}$	$C_{LEG} + C_{ILLEG}$
Value of legal target catch	$V_{LEG} + V_{ILLEG}$	$V_{LEG} + V_{ILLEG}$
Catch per legal vessel	$(C_{LEG} + C_{ILLEG})/n_{LEG}$	$(C_{LEG} + C_{ILLEG})/(n_{LEG} + n_{ILLEG})$
Value of catch per legal vessel	$(V_{LEG} + V_{ILLEG})/n_{LEG}$	$(V_{LEG} + V_{ILLEG})/(n_{LEG} + n_{ILLEG})$
Number of nationals employed on legal fleet	$e_{NAT,LEG} \cdot n_{LEG}$	$e_{NAT,LEG} \cdot (n_{LEG} + n_{ILLEG})$
Government revenue from licences	$r_{LIC}$	$r_{LIC} + n_{ILLEG} \cdot l_{ILLEG}$
Government revenue in addition to licences	$r_{OTH}$	$(r_{LIC} + n_{ILLEG} \cdot l_{ILLEG}) \cdot s_{LIC} + (V_{LEG} + V_{ILLEG}) \cdot s_{CAT}$

Total government revenue	$r_{TOT}$	$r_{LIC} + n_{ILLEG} \cdot l_{ILLEG} + (r_{LIC} + n_{ILLEG} \cdot l_{ILLEG}) \cdot s_{LIC} + (V_{LEG} + V_{ILLEG}) \cdot s_{CAT}$
Domestic fishing value added	$VA_{FIS,LEG,DOM} \cdot V_{LEG} + (V_{ILLEG} \cdot VA_{FIS,LEG,DOM} / (VA_{FIS,LEG,DOM} + VA_{FIS,LEG,FOR}))$	$(V_{LEG} + V_{ILLEG}) \cdot VA_{FIS,LEG,DOM}$
Domestic processing value added	$VA_{PRO,LEG,DOM} \cdot (V_{LEG} + V_{ILLEG})$	$VA_{PRO,LEG,DOM} \cdot (V_{LEG} + V_{ILLEG})$

The calculation of domestic fishing value added in Scenario 2 is simply an up-scaling of the domestic value added in the base case, since the total catch value is increased, but the number of vessels and therefore the inputs are also increased correspondingly. In contrast, the domestic fishing value added in Scenario 1 represents ‘extra’ value added, due to the higher catch value, but with minimal extra input costs (the model assumes no extra input costs) since the higher catch is being obtained by the same number of vessels as in the base case. In reality, there may be extra inputs (i.e. fishing effort) required for the original number of vessels in the base case to realise the extra catch that was being taken by the illegal vessels, therefore the value added in Scenario 1 represents a ‘best case’ scenario.

## 2.4. Regional considerations

We also investigated the likely destination of illegal fish and their effect on other countries in the region. Consideration of the value added losses and gains also took into account the flows and where the value added accrued to, in particular if it accrued to another country within the sub-region, or to countries outside the sub-region. Illegal fishing continues to be undertaken by industrial vessels fishing in west African waters – fishing without licences, fishing in prohibited areas and undertaking prohibited transshipments at sea. However, considerable illegal fishing also appears to be undertaken by artisanal fishers, originating in many of the sub-Regional countries and, for instance, Ghana, with the majority of catches being exported from the country of capture. We examine these region-wide connections in section 5.1.

### 3. ILLEGAL FISHING IN WEST AFRICA

#### 3.1. Background: the importance of fishing to West Africa

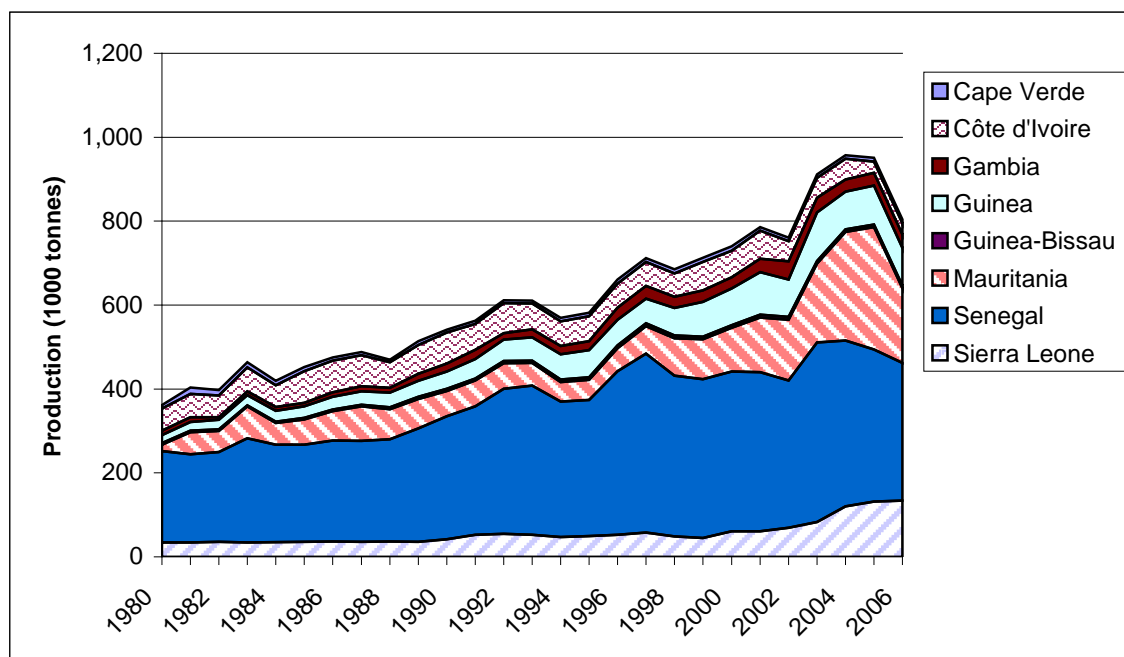
Marine fisheries play an important role in the economies and people's livelihoods in the coastal states of West Africa. Fish and fisheries products contribute to nutrition and food security in many countries in the region, providing more than 50 percent of the daily animal protein intake in some countries (Sierra Leone, Gambia). The sector contributes up to 9.4 percent (Senegal) of the GDP. The fishery sector is also a major contributor to rural income and employment, government revenue through licence fees and fishery agreements, and is a substantial source of foreign exchange.

##### 3.1.1. Capture production

Marine capture production in the eight coastal states in West Africa (CSRP member states and Cote d'Ivoire) increased steadily from the 1950s, reaching 957,000 tonnes in 2004. The total production dropped to 804,000 tonnes in 2006 (Figure 1).

In terms of species composition, low-value pelagic fish, such as sardine, anchovy and *bonga*, make up the majority of catch in most countries, constituting between 40 percent (Guinea) and 82 percent (Cape Verde) of the countries' total marine fish production. Demersal fish such as croakers, catfish and mullets are also an important component of catches, constituting up to 54 percent of total marine production in Guinea Bissau.

Catches by foreign vessels make up a significant proportion of the total catches in the region, generally representing between 10–15 percent of total catches. In some countries, such as Mauritania and Guinea-Bissau, foreign catches represent a much larger proportion of total catches – 70 and 88 percent, respectively (Table 2).



**Figure 1: Marine Capture Production (tonnes) in coastal countries in West Africa, 1980-2006**

Source: FAO Fishstat.

**Table 2: Marine capture production (2006) and major species by country**

Country	Catch by flag state (2005) (tonnes)	Industrial catch in each country's waters (tonnes)	Artisanal catch in each country's waters (tonnes)	Major Species
Mauritania	178,230	587,000**	15,000**	Jack and horse mackerel, European anchovy, European pilchard, sardinella, octopus
Senegal	327,685	52,047‡	338,209‡	Round Sardinellas, Bonga shad, grunts, Jack and horse mackerel
Gambia	32,412	26,867†	9,237†	Bonga shad, sardinellas nei
Guinea-Bissau	6,050	30,021*	20,000†	mulletts nei, marine fish
Guinea	90,000	53,962††	48,500††	Bonga shad, Bobo croaker, Sea catfish nei
Sierra Leone	134,146	14,345†	45,910†	Bonga shad, sardinellas nei, Bobo croaker
Cape Verde	9,673	3,844†	6,977†	pelagic fish

Source: FAO FISHSTAT 2008; Kelleher 2002

Notes: \* Catches in 1994; \*\* Catches in 1999; † Catches in 2000; †† Catches in 2001; ‡ Landings in 2000.

Note that for most countries FAO records are not complete.

### 3.1.2. Exports

In 2006, the eight countries combined, exported fishery products of 282,000 tonnes, worth US\$587 million (Table 3). The difference between fish imports and exports gave the region an average positive trade balance of \$343 million. For countries like Senegal and Mauritania where the trade balance is very large, the fishery sector is an important net provider of foreign currency to the national economy. The higher value fish (e.g. crustaceans, demersal fish and large pelagics such as tuna) are mainly exported to generate foreign exchange. On the other hand, relatively inexpensive small pelagic fish are used for domestic consumption, or traded within the region.

**Table 3: Fishery commodity trade in coastal countries in West Africa in 2006**

Country	Exports*		Imports	
	Quantity (tonnes)	Value (\$1,000)	Quantity (tonnes)	Value (\$1,000)
Mauritania	95,695	130,181	321	171
Senegal	108,516	277,577	453	1,085
Gambia	86	355	1,940	579
Guinea-Bissau	5,995	4,246	282	269
Guinea	7,352	25,809	8,924	7,967
Sierra Leone	5,468	11,081	631	1,420
Cape Verde	21,101	13,158	762	1,691
Total	281,613	587,487	275,409	243,701

Source: FAO FISHSTAT 2008. \*Export includes re-export.

### 3.1.3. Food security

Fish and fishery products are an important source of food in the region. The annual fish consumption per capita in coastal West African countries is significantly higher than the African average of 7 kg per year, except for Guinea-Bissau (Table 4). Some countries like Senegal far exceed the global average of 16 kg per year. In terms of fish as a percentage of animal protein supply, coastal countries in West Africa consume a much higher percentage of fish. In countries such as Gambia and Sierra Leone, fish provide more than 50 percent of animal protein intake. Marine fish are vital in many areas throughout the region where other protein sources are limited. According to FAO, both marine and inland small-scale fisheries in the region supply up to 80 percent of the fish products for domestic consumption in the region (FAO 2004a). In many African countries, various types of salted, fermented, sun-dried and smoked fishery products are used to prepare traditional food. In Senegal, a dried fish product locally called *Kethiakh* is consumed either as food fish or added to stews and soups.

**Table 4: Annual per capita fish consumption and fish contribution to nutrition**

Country	Fish consumption	Fish as a % of animal protein intake
	(kg/capita/yr)	(%)
Mauritania	13	9
Senegal	27	42
Gambia	24	54
Guinea-Bissau	1	0
Guinea	11	38
Sierra Leone	14	63
Cape Verde	18.8	15
Africa	7	17
World	16	14

Source: FAOSTAT online statistical service. Fish % was calculated from the food fish consumption divided by the animal protein consumption.

### 3.1.4. Employment

The fishery sector provides significant direct and indirect employment in the region, with an estimated 450,000 people employed in the sector (Table 5). In Senegal, the sector employs 125,354 people, including 59,428 full-time artisanal fishers, 2,850 people in 76 processing plants, and 59,976 employees in craft workshops for processing, maintenance, construction of boats and gears, transportation, marketing, etc. In Sierra Leone, artisanal fisheries alone employ 30,000 full-time and 200,000 part-time fishers. In Gambia, around the same number of people are directly or indirectly engaged in fisheries and fisheries-related income generating activities, and the sector contributes to approximately 4% of the GDP. Fisheries is an important sector as it provides employment and income to vulnerable groups such as women and young people. Even in countries like Côte d' Ivoire, where the sector represents relatively small percentage of GDP, fisheries (both marine and inland) provide livelihoods for more than 400,000 people (Anon, 2002). The post-harvest subsector provides women and youth with many jobs, playing an essential role in gender equality and empowerment of women.

### 3.1.5. Generating foreign exchange and government revenue

Fishing licences and fishery-related taxes are an important source of income for many coastal West African countries. In Mauritania, fishery access rights (domestic, foreign), export taxes (pelagic charter), miscellaneous taxes (monitoring etc.) and fines represent about 25-30% of the total government revenue. Fishing agreements with the European Union provide an average of €120 million (US\$ 167 million<sup>5</sup>) per year to eight West African Countries<sup>6</sup>, with the biggest share (72%) of this income directed to Mauritania (FAO 2006). For some countries these government revenues are critical to the public budget, particularly for very poor countries such as Guinea Bissau and Mauritania.

**Table 5: Employment, fishery contribution to GDP and government revenue**

Country	Employment (people)	Contribution to GDP (%)	Government revenue (US\$ m/year)	Contribution to government revenue (%)
Mauritania	30,422	5.2	109.1	27
Senegal	125,354	4.9	1.8	n/a
Gambia	3,100	2.4-12	n/a	7
Guinea	30,000	1.3	4.3	2.5
Guinea-Bissau	15,000	7-10	12.7	40
Sierra Leone	250,000	9.4	6.2	n/a
Cape Verde	8,800	1-2	0.9	n/a

Source: MRAG 2008 questionnaire; FAO 2006; Kelleher 2002 ; Anon 2002.

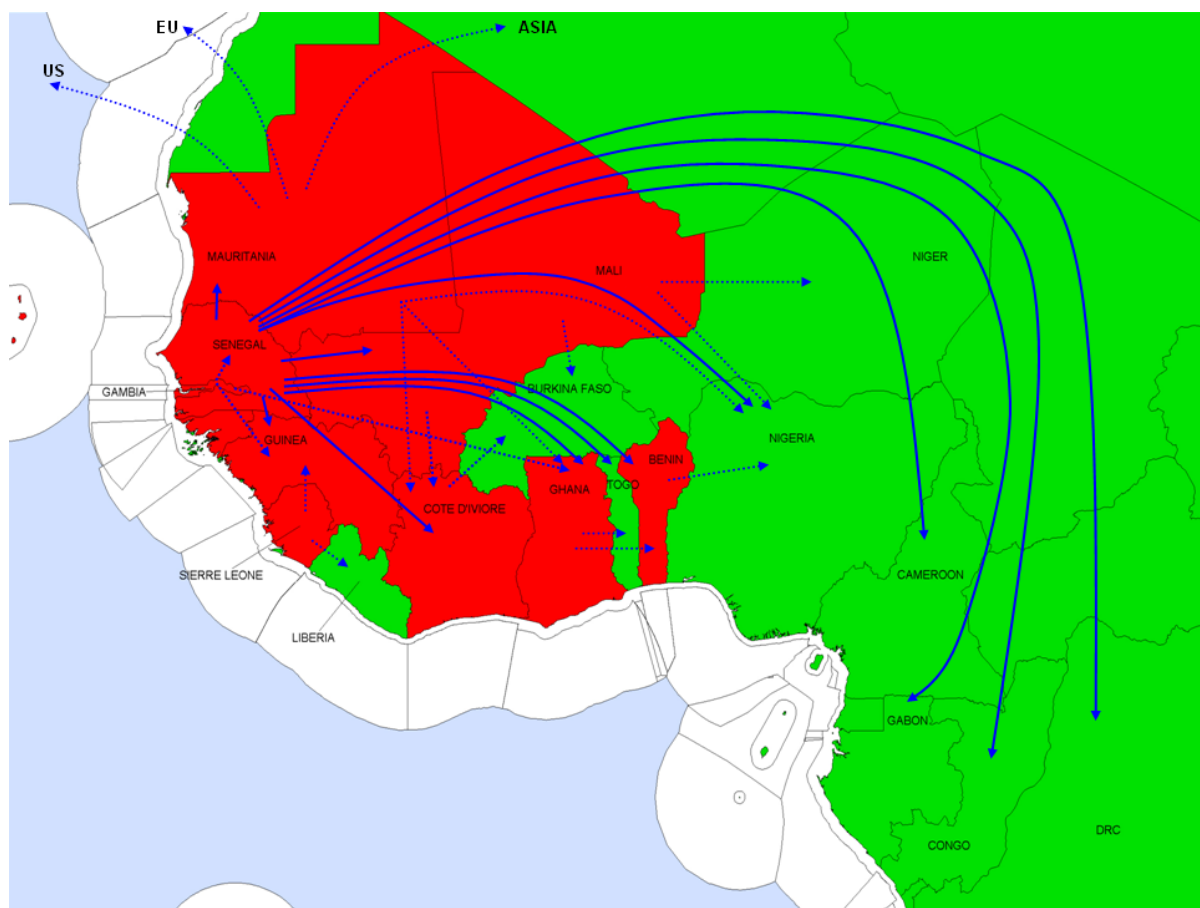
### 3.1.6. Resource status

In general most of the demersal resources off northwest Africa are considered fully to overexploited (FAO, 2005). Based on the 2004 review of the status of stocks (CECAF, 2004; FAO, 2004b), eighteen of the demersal stocks assessed were either fully exploited or overexploited. White grouper, *Epinephelus aeneus*, found mainly in Mauritania, Senegal and the Gambia, was assessed to be overexploited and at risk of extinction. *Sardinella aurita* in the northern CECAF (Fishery Committee for the Eastern Central Atlantic) region is showing signs of overexploitation (FAO, 2005). Common octopus (*Octopus vulgaris*) stocks off Dahkla and off Cape Blanc, are considered overexploited, while the state of the southern stock off Senegal and the Gambia is uncertain. The stocks of deep-sea shrimp (*Parapenaeus longirostris*) and shallow water shrimp (*Penaeus notialis*) are considered to be intensely exploited or even overexploited. In the Cape Verde area, spiny lobsters (*Palinurus charlestoni*) are now considered to be overexploited (FAO, 2005).

<sup>5</sup> Average exchange rate for 2009 (€1 = US\$1.39463).

<sup>6</sup> Cape Verde, Côte d'Ivoire, Gabon, Guinea, Guinea Bissau, Mauritania, Sao Tome & Principe, and Senegal

Figure 2 illustrates the major fish trading routes in the West African region. It shows the large volume of fish exports from Senegal, emphasising the country's importance as a major fish trading base in the region. It also alludes to the sheer size of the Senegalese fishing fleet required to meet the production volume to sustain exports as far south as Democratic Republic of Congo (DRC). To achieve this level of supply the fleet must therefore operate in both Senegalese and foreign waters.



**Figure 2: Major fish trading routes in the West African region**

Source: MRAG, 2005; [www.infopeche.org](http://www.infopeche.org).

### 3.2. Illegal fishing in West Africa

Illegal fishing is known to be a particular problem in the south of the sub-Region, in Guinea Bissau, Guinea and Sierra Leone. MRAG's (2005) study suggested that illegal catches ranged from very low (Cape Verde) to very high (Guinea).

Some surveillance data are given in Table 17 of MRAG (2005), presented here as Table 7, which confirm the general pattern above. The situation in Guinea, Guinea Bissau and Sierra Leone in particular has not improved in recent years.

In 2006, the Environmental Justice Foundation and Greenpeace investigated the extent and impact of illegal, unreported and unregulated (IUU) fishing in Guinea, observing 104 vessels, over half of which (53) were either engaged in, or linked to, IUU fishing activities (EJF, 2007). Investigators documented a range of IUU practices including: vessels fishing without a licence; vessels fishing in the 12-mile zone reserved for local artisanal fishermen; the illegal transshipping of fish between fishing vessels and to refrigerated cargo ships; the repackaging of fish products on IUU vessels into boxes stamped

with the name of a legal boat; the deliberate hiding of identities; and more than one vessel purporting to be a single ship. The key species affected, and being traded into European markets, was denton (*Dentex gibbosus* and *D. dentex*), caught as bycatch in shrimp trawls.

**Table 6: Estimates of levels of illegal catch in the region**

	IUU as percentage of current legal catch	Estimate method
Mauritania	9%	inferred
Senegal	8%	inferred
Gambia	12%	inferred
Guinea-Bissau	41%	Inferred
Guinea	102%	direct estimate
Sierra Leone	35%	direct estimate
Cape Verde	0%	inferred

Source: MRAG (2005).

**Table 7: Comparison of results of aerial surveillance during 1995-96, 2000 and 2001 from the LuxDev project**

	Infractions as % of sightings 1995-1996	Infractions as % of sightings 2000	Infractions as % of sightings 2001
Mauritania	4%	2%	1%
Senegal	1%	4%	9%
Gambia	19%	10%	8%
Guinea Bissau	9%	17%	23%
Guinea	59%	60%	60%
Sierra Leone	2%*	32%	30%
Cape Verde	8%	#	#
Total	11%	13%	15%

Source: AFR/010 database \*Sierra Leone data unreliable for technical reasons. # No surveillance done in Cape Verde. Taken from MRAG (2005).

This variability reflects directly the level of monitoring, control and surveillance (MCS) in the region. Previous reports (Kelleher, 2002) have reported, for instance, that MCS coverage of the Mauritanian industrial fleet is high (60-80% of licensed vessels were inspected at sea) whereas capacity limits the number of inspections that are being undertaken in Guinea and Guinea Bissau.

### 3.3. Mauritania

#### 3.3.1. General description of the fisheries

Fisheries are an important part of Mauritania's economy in terms of foreign exchange earnings and its contribution to the government budget. Fisheries contribute 4% of GDP, account for approximately 30% of exports by value and provide some 25-30% of government revenue. The relative importance



of fisheries for GDP and exports has declined over the last decade, due to the growth of the overall economy, driven by iron ore exports and a growing oil and gas sector. The lack of infrastructure also limits the amount of value added through processing that Mauritania is able to capture.

Mauritania's EEZ lies within a productive upwelling area, resulting in rich fishing grounds, particularly for small pelagics. The main segments of the Mauritanian fishing fleet are:

- the artisanal fleet including some Senegalese vessels which consist of wooden, fibreglass and aluminium motorised canoes (pirogues);
- the semi-industrial fishing fleet based mainly in Nouadhibou; and,
- the industrial fishing fleet acquired under joint ventures and/or chartering arrangements.

The Mauritanian industrial fleet is mainly made up of vessels of Chinese origin that have reflagged to Mauritania or operate under leasing/chartering arrangements. The fisheries are also exploited by distant-water fleets fishing under access agreements, in particular the European fleets — fishing for crustaceans, demersals and cephalopods (Spain, Italy, Portugal, Greece); tuna and tuna-like species (Spain and France) and small pelagics (Netherlands, Lithuania, Latvia and Poland) under the Fisheries Partnership Agreement (EC 704/2008<sup>7</sup> and COM(2006) 506 final<sup>8</sup>). A number of other foreign vessels fish with private licences or under other private access agreements, including vessels from Russia, Iceland and with open registry flags such as Belize.

Catches of the industrial and the artisanal and coastal sectors, are shown in Table 8. Of the 720,000 tonnes of fish, crustaceans and cephalopods caught in Mauritanian waters, only 100,000 tonnes (the artisanal and coastal, and 20,000 tonnes of the industrial catch) are landed in Mauritania. The majority (620,000 tonnes) are transhipped or landed directly to Europe.

**Table 8: Catch volumes by species group and fleet segment in Mauritania, 2005**

	Industrial (national and foreign) (t)	Artisanal and coastal (t)	Total (t)
Small pelagics	557,000	19,000	576,000
Demersal fish	25,258	5,3942	79,200
Cephalopods	30,153	5,847	36,000
Crustaceans	7,188	12	7,200
Other	21,600	0	21,600
Total	641,199	78,801	720,000

Source: IMROP (2007).

### **3.3.2. Legal framework and key regulatory issues**

Mauritanian fisheries legislation (Code des Pêches) does not formally cover the concept of IUU fishing. However, the relevant international agreements and conventions have been adopted, and the major illegal fishing types are covered by Mauritanian legislation (see Table 9).

<sup>7</sup> Council Regulation (EC) No 704/2008 of 15 July 2008 on the Conclusion of the Protocol setting out the fishing opportunities and financial contribution provided for in the Fisheries Partnership Agreement between the European Community and the Islamic Republic of Mauritania for the period 1 August 2008 to 31 July 2012. OJ L 203 31.7.2008 pp.1-3.

<sup>8</sup> Proposal for a Council Regulation on the conclusion of the Fisheries Partnership Agreement between the European Community and the Islamic Republic of Mauritania. Brussels, 18.9.2006. COM(2006) 506 final.

**Table 9: Types of infraction, occurrence, detectability and legislation in Mauritania**

Infraction type	Occurrence and detectability	Legislation
Fishing without valid licence	1) Artisanal and coastal fishery, where the system is not well established; 2) Cross-border fishing (southern border); 3) Fishing for one species whilst holding a licence for a different species (e.g. fishing for octopus using a hake licence). Detection requires port and at-sea controls, patrol presence (dissuasive, surprise effect).	Code des Pêches Art. 63 Décret 2002-073 Art. 15 à 20
Fishing with unauthorised gear / techniques	1) Monofilament gillnets in the artisanal and coastal fishery (for fish, langoustine); 2) Double-ended cod-end (blindings); 3) Unauthorised mesh size (industrial trawlers; artisanal gillnets and seine nets); Detection requires surveillance and controls at sea.	Code des Pêches Art. 64 d) Décret 2002-073 Art. 25
Fishing in closed/restricted areas/times	1) Demersal trawlers in the artisanal zone (25m isobath), causing damage to vessels and people in the artisanal and coastal fishery. VMS in the industrial fishery helps control; 2) Pelagic trawlers (18 mile limit) (3% catch of demersals permitted); direct control needed; 3) Artisanal fishing during biological rest period (no VMS system).	Code des Pêches Art. 64 d) Décret Art. 32 à 35
Catching/landing of prohibited species	At-sea and port controls.	Code des Pêches Art. 32 Décret Art. 26 à 31
Unauthorised transshipment	National (industrial and artisanal). Detection by VMS, aerial and sea patrols.	Code des Pêches Art. 64 a)
Hiding/ disguising/ misreporting a vessel's identity	1) Pirate vessels; direct control by patrols and air surveillance; 2) Demersal trawlers, wooden pirogues (Senegalese); port and at-sea inspections.	Code des Pêches Art. 65 b)
Trading in mariculture species without authorisation of the Minister	Controls at sea and on land, including inland (inland fishing).	Code des Pêches Art. 64 b)
Not complying with landing requirements	Requires direct control at sea, VMS, port inspections etc.	Code des Pêches Art 64 a)
Import, export, construction, processing or modification of technical characteristics of fishing vessels, without authorisation of the Minister	Port and at-sea controls.	Code des Pêches Art. 64 c)

**Infraction levels and detection**

In Mauritania, infractions occur in both the industrial and artisanal fleets. In the industrial cephalopod, shrimp and pelagic fisheries, offences are mainly related to fishing in restricted areas, capture of juveniles, use of illegal gear and false catch declarations. There is a relatively low level of illegal fishing (ranging from 1.5% to 10% of vessels). The MCS presence in Mauritanian waters deters unlicensed 'pirate' vessels and the last report of an unlicensed vessel was in 2001. Details of illegal

activities of the industrial fleet are shown in Table 10. These data show that the overall rates of illegal activity in Mauritania are relatively low. Recent data on surveillance rates are not available; the most recent data available are shown in Table 11.

The type of infractions that occur in the industrial fisheries (fishing with unauthorised gears, fishing in restricted areas) generate mainly intangible losses in terms of:

- impacts on stock biomass through fishing in protected areas;
- growth overfishing through capture of juveniles;
- impacts on stocks fished by the artisanal fleet when fishing in the artisanal (restricted) zone, which may reduce the artisanal catch per unit effort (CPUE) and cause damage to both artisanal fishers and their vessels and gear;
- impacts on data quality for stock assessment, which may lead to management decisions being based on incorrect stock assessment estimates, as a result of false catch declarations.

A further infraction reported in the industrial sector is false nationalisation, whereby foreign vessels register as Mauritanian, thus qualifying for the reduced national licence fees for fishing, but do not complete the re-registration and reflagging process. The most recent scandal of this type involved 109 vessels of Chinese origin, revealed through a Government study in 2004. A further 44 vessels of the same type also fled the country in 1998–1999, resulting in a reduction of the national fleet.

**Table 10: Number of infractions and infraction rate by type for industrial fisheries in Mauritania**

		Industrial cephalopod fishery		Industrial shrimp fishery		Industrial pelagic fishery	
		Number of offences detected	Offence rate (as a % of number of vessels)	Number of offences detected	Offence rate (as a % of number of vessels)	Number of offences detected	Offence rate (as a % of number of vessels)
Fishing in restricted area	2007	6	3.5	4	6	8	10
	2008	4	2.3	2	3	7	8.75
Capture of juveniles	2007	8	4.6	2	3	4	5
	2008	7	4	1	1.5	3	3.75
Illegal gear	2007			4	6	4	5
	2008			3	3	3	3.75
False catch declaration	2007					4	6
	2008					2	3

Source: MRAG Questionnaire (2008). DSPCM Commission transcriptions.

**Table 11: Surveillance effort in Mauritania, 1997-2003**

	1997	1998	1999	2000	2001	2002	2003
Number of days at sea	550	752	889	1039	1227	1352	1398
Number of controls at sea and on land	3564	3694	3025	3101	3443	4249	3737
Number of observations	3258	4558	3319	3115	2529	2241	2373
Number of flying hours	380	433	395	418	364	290	301

Source: MRAG questionnaire (2008); DSCPM.

### **3.3.3. Case study descriptions**

The types of intangible losses incurred as a result of illegal fishing by the industrial fleets (described above and in Table 10) are very difficult to quantify in economic terms. As a result, this study focussed on the illegal (unlicensed) fishing occurring in the artisanal sector, mainly from Senegalese vessels crossing the border into Mauritania and fishing without the correct authorisation under the Senegal-Mauritania agreement.

The artisanal fleet comprises 4,022 Mauritanian and approximately 1,000 Senegalese pirogues (information from MRAG 2008 questionnaire), which target small pelagics, demersal fish, octopus and crustaceans. The Mauritania–Senegal agreement for artisanal fishing provides for 300 Senegalese pirogues to fish small pelagics in Mauritanian waters. Therefore the model assumes that 300 Senegalese vessels are legal and the remaining 700 are fishing illegally.

Artisanal catches in Mauritanian waters amount to 78,000–80,000 tonnes per year (IMROP, 2007). These estimates have been substantially revised upwards since the early 2000s, when artisanal catches were estimated at 23,898 (2003) to 35,386 tonnes (2005) (MPEM, 2006). For the purposes of the model, the total catch has been split between Mauritanian and Senegalese vessels in the ratio 86:14 — a split broadly corresponding to the composition of the legal fleet (93:7), but adjusted to take into account the fact that the Senegalese vessels have a greater catching capacity.

The main infractions by the artisanal fleet are:

- fictitious registration or lack of registration and not paying access fees;
- fishing without authorisation (unlicensed), including from the southern border;
- fishing in the Parque Nacional de Banc d'Arguin (PNBA);
- transshipment of catches at sea.

The artisanal and coastal fishery infractions are dealt with by a different committee from the industrial infractions, and no data were available on the numbers of infractions or surveillance rate.

The main implications of illegal fishing by the artisanal fleet are:

- Loss of licence fees from illegal vessels.

- Some of the illegal catch may be landed in Mauritania, but the main markets and trade routes for the catches (demersals, octopus and small pelagics) are either in or via Senegal. Catches that are landed locally are transported by road to Senegal and export species are transported onwards to markets in Europe and the far East. In the Mauritania-Senegal fishing agreement for small pelagics, Senegalese artisanal vessels should land 15% of their catches in Mauritania, but this has been a problem in the past, since it requires a 400km journey from the fishing grounds to the landing port, using valuable time and fuel.
- This also affects processing value added in Mauritania as illegal catches are unlikely to be landed and processed locally, resulting in a loss of value-added.

The annual cost of a licence for an artisanal vessel is based on a flat-rate fee (US\$ 21 for a national vessel and US\$127 for a foreign vessel) plus a fee based on catch volume by species (according to the categories: frozen cephalopods and crustaceans; fresh pelagics; frozen pelagics; fresh demersal fish; frozen demersal fish). The total licence fee payable per vessel was calculated based on the composition of catches by the whole artisanal fleet.

Whilst small pelagics are an important food fish in the region, they are mainly targeted by the industrial fleets in Mauritania; they represent less than one quarter of the artisanal fleet's catches. Demersal species make up two-thirds of the catches. Octopus only accounts for 7% of catches, but due to its high value, accounts for 37% of the value of artisanal catches (Table 12).

The total value of the artisanal catch was calculated based on the composition of the artisanal catch and values per tonne from the Ministry of Fisheries and Maritime Economy (*Ministère des Pêches et de l'Economie Maritime*, MPEM) and Customs export data. Value-added estimates for fishing and processing value-added were obtained, by species group, based on FAO (2001) estimates. The total catch value of the artisanal fishery is US\$ 86 million, and the total value-added is US\$ 141 million (see Table 12). Not all of this accrues to the Mauritanian economy, as some of the fishers are foreign (Senegalese pirogues) and much of the processing takes place outside Mauritania (also in Senegal and Europe).

The proportion of illegal (unlicensed) fishing in the artisanal fishery was estimated at 14% (based on 700 illegal vessels and 4,322 legal vessels), with upper and lower limits at 5% and 20%, respectively. The value of a fine for an illegal vessel was estimated at UM 500,000 (US\$ 2119). This is an upper estimate for the level of fines specified by law for vessels of an artisanal size: the fine for an unlicensed (industrial) vessel is UM 5–30 million; the fine for a 'very serious' infraction by a vessel up to 5 GRT is UM 0.05–0.5 million (US\$ 219–2119) (Cherif, 2006). The number of crew members was estimated at 3 per vessel for Mauritanian vessels (based on 12,000 employees in the fishing sector, most in the artisanal sector, on 4,022 vessels) and 6 for Senegalese vessels (based on Senegalese case study); Mauritanian crew in the Mauritanian pirogues and Senegalese crew in the Senegalese pirogues.

These figures form the basis for the model to estimate the economic losses of illegal fishing in the artisanal fishery and are summarised in Table 13.

Table 12: Composition of artisanal catches by species group, value of catches and value-added

	Small pelagics	Demersals	Cephalopods	Crustacea	TOTAL	Source
Catch (tonnes) (%)	19,000 (24%)	53,942 (69%)	5,847 (7%)	12 (0.02%)	78,801	6ème GT IMROP
Value per tonne (US\$)	300	900	5,500	3,880		Based on export data
Total value (US\$) (%)	5,700,000 (7%)	48,547,800 (56%)	32,158,500 (37%)	46,560 (0.05%)	86,452,860	MPEM and Customs export data
Fishing value-added	60%	65%	80%	75%		Estimate, based on FAO (2001)
Fishing value-added (\$)	3,420,000	31,556,070	25,726,800	34,920	60,737,790	
Processing value-added	120%	98%	80%	94%		World Bank VA spreadsheet
Processing value-added (\$)	6,840,000	47,576,844	25,726,800	43,766	80,187,410	
Total value-added (\$)					140,925,200	

Table 13: Summary of input data for Mauritanian artisanal fishery model

	Mauritanian	Senegalese	Total	Source
Number of licensed vessels ( $n$ )	4,022	300	4,322	Questionnaire
Licence fee (US\$) ( $l$ )	1,869	1,975		Based on tonnage caught plus fixed fee
Licence fee for illegal vessels (taking account of nationality) (US\$) ( $l_{ILLEG}$ )			1,975	
Annual production from legal vessels (tonnes) ( $C_{LEG}$ )			80,000	IMROP 2007
Value per tonne (first sale) (US\$) ( $p$ )			1,081	Calculated by species group, based on export data
First sale value of production (US\$) ( $V_{LEG}$ )			86,452,860	
Number employed per licensed vessel	2.792	0.416		Based on 3 Mauritians per Mauritanian vessel, 6 Senegalese per Senegalese vessel
Number employed per illegal vessel	0	6		Assumes all illegal vessels are Senegalese
Estimated proportion of illegal activity in relation to total fleet ( $a$ )			0.14	Questionnaire. Based on 700 illegal vessels, 4,322 legal vessels (total 5,022)
Number of offences detected ( $n_{DET}$ )			0	
Value of fine for illegal vessel if caught (US\$) ( $f$ )			2,118.6	Cherif, 2006

Estimates of fishing value added were derived for each species group, based on FAO (2001) estimates for artisanal fisheries. Processing value added was estimated based on estimates from a World Bank regional study (World Bank, undated). The Mauritanian vessels were assumed to be landing 80% of their catches into Mauritania, and 20% into Senegal. The Senegalese legal vessels were assumed to be landing 15% of their catches into Mauritania (they are required to do this under the terms of the Mauritania–Senegal agreement, although even this small percentage is difficult for them to comply with), and 85% into Senegal. The illegal vessels were assumed to be landing 100% of their catches into Senegal. These assumptions were used to calculate fishing and processing value-added as a multiplier (proportion) of landed value, split between domestic and foreign/exported value-added (Table 14). Indirect value-added (upstream value-added) was not included in the model, because of an absence of estimates for this parameter.

**Table 14: Value added estimates as a proportion of catch value, Mauritania artisanal sector**

	Fleet	Domestic	Exported	Source of estimate
Fishing value-added	Legal fleet	0.604	0.098	FAO (2001)
	Illegal fleet	0	0.703	
Processing value-added	Legal fleet/catches	0.658	0.270	World Bank (undated)
	Illegal fleet/catches	0	0.928	

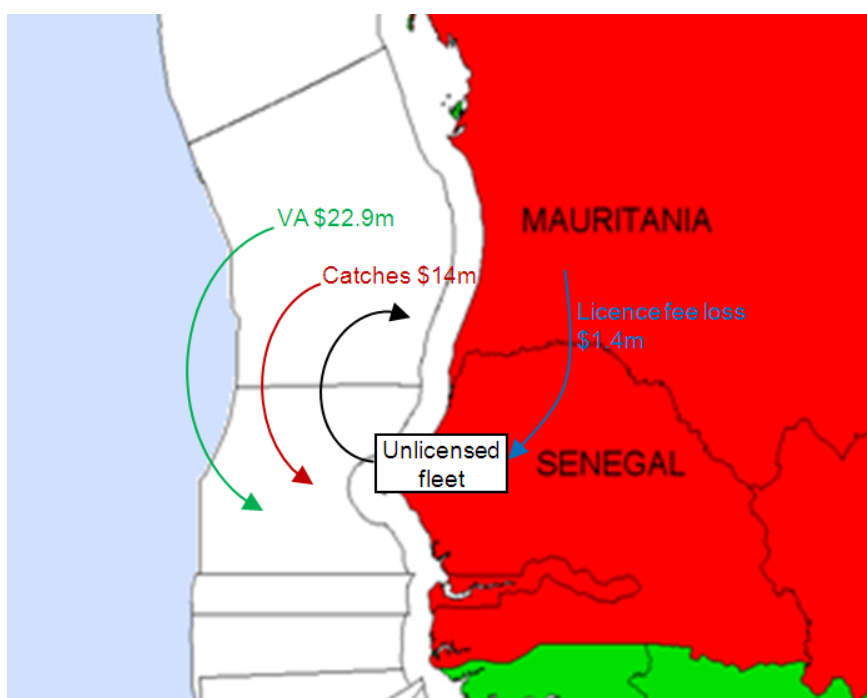
The two scenarios considered were:

- Scenario 1: Removal of the illegal vessels; legal vessels are able to take the catch of the illegal fleet with no extra inputs required (i.e. illegal activities implied a reduction in CPUE for the legal fleet);
- Scenario 2: Illegal vessels are licensed and integrated into the legal fleet, adopting the same operating characteristics as the current legal fleet.

### **3.3.4. Direct economic losses**

The input values for the model parameters, and the main economic losses due to illegal fishing in the artisanal fishery in Mauritania are shown in Table 15.

There are an estimated 704 undetected illegal artisanal vessels in Mauritanian waters, catching 13,000 tonnes of fish worth US\$ 14 million. This results in a loss to the state in terms of licence fees foregone of US\$ 1.4 million. However, the value-added losses are much greater, totalling between US\$ 8.5–12.1 million in fishing value-added, and a further US\$ 9.3 million for processing value-added (current situation compared with Scenarios 1 and 2). The value-added lost to Mauritania accrues mainly to Senegal, where much of the illegal catches are landed and from where the majority of the illegal vessels (and crew) originate (Figure 3). There is undoubtedly some leakage of processing value-added to European and far-Eastern countries, due to the limited landing and processing that takes place in Mauritania. However, this is not a consequence of illegal fishing *per se*, but of the structure of the supply chain, and is not modelled here.



**Figure 3: Diagram showing flows of losses from Mauritania due to illegal fishing in the artisanal sector**

Note: VA = direct fishing value added plus direct processing value added. The VA flows shown in the diagram are the current losses in the base case. The values do not represent what Mauritania could capture domestically if illegal fishing were controlled. This would be between \$ 8.5 million and \$ 12.1 million (for fishing value added) under Scenarios 2 and 1, respectively, and \$ 9.3 million (for processing value added).



**Table 15: Model input values and current economic losses to illegal fishing in the artisanal fishery in Mauritania**

Inputs	Catch (t)	value per tonne (\$)	Gvt revenue in addition to licence fees as % of licence revenue	N. licensed vessels	Illegal vessel fine	IUU estimate	Nationals employed per legal vessel	Nationals employed per illegal vessel
	80000	1081	0%	4322	2118.6	14%	2.792	0
Fishing direct value added % of landed value					Processing direct value added % of landed value			
	Legal Domestic	Legal foreign	Illegal domestic	Illegal foreign	Legal Domestic	Legal foreign	Illegal domestic	Illegal foreign
	60%	10%	0%	70%	66%	27%	0%	93%
Activities	Value of legal target catch (\$)	Total catch value per legal vessel (\$)	Number of nationals employed on legal fleet	Government revenue from licences (\$)	Other government revenue from legal vessels (\$)	Total number offences (est)	Estimated illegal catch target sp (t)	Total fish value loss (\$)
	86,452,860	20,003	12066	8,111,140	-	704	13,023	14,073,721
Tangible losses	Licence fee loss (\$)	Other government losses (\$)	Value of fines from illegal vessels (\$)	Net government loss (\$)				
	1,390,484	-	-	1,390,484				
Fishing direct value added					Processing direct value added			
Value Added	Legal fishing domestic	Legal fishing foreign	Illegal fishing domestic	Illegal fishing foreign	Legal processing domestic	Legal processing exported	Illegal processing domestic	Illegal processing exported
\$	52,239,388	8,498,402	-	9,887,547	56,856,857	23,330,554	-	13,053,764
	Domestic VA lost relative to Scenario 1	Domestic VA lost relative to Scenario 2			Domestic VA lost relative to Scenario 1	Domestic VA lost relative to Scenario 2		
\$	12,104,533	8,504,086			9,255,767	9,255,767		

### 3.3.5. Intangible losses

The intangible losses from illegal fishing by unlicensed artisanal vessels are mainly related to depressed CPUE for legal operators, resulting in less economically viable fishing operations. There may also be impacts on market prices, with illegal operators able to undercut the legal operators in their asking price, because they have lower outgoings as a result of not paying the licence fee.

Whilst not modelled here, illegal fishing by artisanal vessels in the PNBA restricted area is also significant, and this has a number of impacts, including stock depletion and impacts on the protected spawning stock of many species. This may affect the resilience of stocks and their potential growth rates due to the removal of large, mature, spawning fish. The PNBA is an area of outstanding natural biodiversity and fishing in this protected area will have negative impacts on biodiversity and the marine ecosystem.

### 3.3.6. Social impacts

If the illegal vessels were removed and the legal vessels were able to take the illegal vessels' catch (Scenario 1), this would result in an additional 3 tonnes of catch per vessel, worth US\$ 3,256. Whilst

this is not a huge sum, it represents a potential 15% reduction in revenue to the legal operators as a result of illegal fishing, which is significant for the small-scale sector.

The illegal vessels equate to 1,965 crew employed. However, this is not considered to be employment lost for nationals as a result of illegal fishing, because it is not clear whether Mauritians would take up these opportunities if they were available in the absence of illegal fishing.

### 3.3.7. MCS activities

The Fisheries Surveillance and Sea Control Delegation (*Délégation à la Surveillance des Pêches et au Contrôle en Mer*, DSCPM), based in Nouadhibou, is responsible for fisheries protection. It has 400 staff, many of which are seconded Navy personnel (220) (Kelleher, 2002). It is bestowed with the necessary powers to carry out its functions, together with management autonomy. It is well-equipped with MCS, VMS, long-range patrol vessels, high-speed patrol vessels, aeroplane, radar stations along the coast, and is staffed by a mixture of civilian and military personnel.

The legal basis for MCS activities is provided in the Fisheries Code (Code des Pêches, loi No 2000-025) and its Decree No 2002-073 of 1 October 2002. Two types of procedure are foreseen:

1. Ordinary procedures, when conditions allow the boarding of a ship, which has complied with an order to stop. This also includes the recording of violations at a distance by electronic or satellite surveillance. The evidence provided by these means is considered valid unless proven otherwise.
2. Observation procedures, when boarding of the vessel is not possible (e.g. due to bad sea conditions, refusal to comply or the vessel flees, or too many vessels to control). These procedures can only apply to failure to license, refusal to comply, fishing during closed periods or in a prohibited area and operations related to unauthorised fishing. In the case of aircraft, the information detected by the crew of the aircraft are considered authentic until proven otherwise.

DSCPM have powers of the right of hot pursuit which can go beyond the limits of the EEZ if the pursuit was initiated within waters under Mauritanian jurisdiction. Mauritania also has a bilateral agreement with Senegal which allows Mauritanian patrols to pursue suspected vessels into Senegalese waters and vice-versa.

Surveillance effort and detected infractions are given in Table 10 and Table 11. Older infraction data from 1996–2000 are shown in Table 16, and also demonstrate that the number of unlicensed (industrial) vessels is very low.

**Table 16: Violations by type in Mauritania, 1996–2000**

	1996	1997	1998	1999	2000	% (2000)
Administrative	204	315	527	359	266	59
Catch	39	45	189	97	81	18
Zone	42	66	116	72	61	14
Gear	48	57	85	76	41	9
No licence	1	1		4	2	0.4

Source: DSCPM (in Kelleher, 2002).

The most frequent types of violations during the period 1988–2002 were: fishing in restricted zone; logbook; vessel identification and markings; illegal mesh size; undersized fish; illegal net; refusal to stop and false catch declarations (Kelleher, 2002).

DSCPM is funded from the State budget, foreign agencies or states, fishing fines, donations, and remuneration from any services rendered. The main MCS physical assets are:

- Maritime communications centre to manage radio communications;
- Two offshore patrol vessels (54m);
- One coastal patrol vessel (18m);
- Three vessels with inboard engines;
- 15 coastal vessels with outboard motors;
- One surveillance aircraft (hired) with GPS camera;
- Four coastal inspection points in the zone south of Cape Timiris;
- Three terrestrial radar stations;
- An electronic database with specialised internet communications line;
- 14 light vehicles and eight 4x4 all-terrain vehicles.

There are also plans to develop (or already in progress): VMS; strengthening of the information system and analysis of fishing activities for integrated management of surveillance operations; strengthening of surveillance means in the southern coastal region by the installation of three radar stations; strengthening surveillance means in the PNBA by putting in place a communication system and a patrol boat; and strengthening the technical system by providing an equipped mobile workshop for repairs.

The problems faced by Mauritania in MCS are:

- Weak economy of the country in relation to the scope of the issues and the high costs of fisheries MCS;
- Large number of flag-of-convenience vessels in the region, and therefore a risk of incursions of unauthorised vessels into Mauritanian waters;
- Overexploitation of some stocks such as octopus and certain tuna species, leading to lower yields and increased competition for resources between vessels and fleets. This can result in regulatory infractions such as mesh size violations and increased catches of juveniles, violations of restricted zones and closed seasons (which can lead to accidents and even deaths, particularly as a result of incursions into the artisanal zone).

Mauritania faces a difficult challenge in controlling the numerous fishing vessels fishing in its waters and targeting its rich fisheries resources. Whilst Mauritania has a relatively well-established and effective MCS system and infrastructure, further reinforcements and capacity building are necessary to ensure illegal fishing is kept to a minimum and infractions such as mesh size and restricted area violations are detected and punished.

### ***3.3.8. Proposals for tackling illegal fishing***

No information was received from Mauritania regarding proposals for tackling illegal fishing.

## 3.4. Senegal

### 3.4.1. General description of the fisheries

The fisheries sector has a high social and economic value in Senegal. The sector is dominated by the artisanal fishing fleet both in terms of catch volume and its economic importance. The total estimated landed catch rose from 397,876 tonnes in 1996 to 543,569 tonnes in 2005, averaging 410,552 tonnes for this period. Artisanal fishery landings accounted for approximately 70 % of these landings in volume terms in 2005.

The main fisheries in Senegal are:

- Coastal demersal species (including fish and cephalopods) targeted by artisanal and industrial fleets;
- Ocean demersal species including shrimp targeted by industrial trawlers;
- Pelagic sardine fishery targeted by artisanal and semi-industrial fleets; and
- Tuna fishery targeted mainly by distant water fleets, but also a small number of national industrial vessels.

Marine fisheries create added value estimated at FCFA 196 billion (US\$ 372 million) in 2003 representing 4.9% of GDP, thought to include both fishing and ancillary activities. However, the 2005 estimate for the contribution of fisheries to the Senegalese economy was 1.9% of GDP, which presumably only includes fishing and not the supply chain activities linked to fisheries such as fish processing, storage, port activities etc.

**Table 17: Volumes of exported fishery products (tonnes)**

Type	2000	2001	2002	2003	2004
Fish					
Frozen	36,105	43,439	25,760	40,462	39,682
Fresh	9,171	9,731	8,004	4,897	5,882
Total fish	45,276	53,170	33,764	45,359	45,564
Crustaceans					
Frozen	6,778	7,681	8,195	5,574	6,079
Fresh	82	76	51	30	24
Total crustaceans	6,860	7,757	8,246	5,604	6,103
Molluscs					
Frozen	12,819	9,762	21,906	19,720	18,878
Fresh	195	123	150	153	183
Total molluscs	13,014	9,885	22,056	19,873	19,061
Total processed products	9,522	-	8,715	7,961	8,697
Manufactured products					
Artisanal production	2,988	3,430	4,582	6,387	4,620
Fish meal	1,542	2,179	1,118	1,032	733
Fish oil	10	0	0	0	0
Canned products	8,808	10,611	9,083	9,459	7,776
Total manufactured production	13,348	16,220	14,783	16,878	13,129
Grand total	88,020	87,032	87,564	95,675	92,494

Source: Departement des Pecheries Maritimes (DPM).

The level of exports varies significantly depending on the type of fishery. The majority of exported products are fresh or frozen with a relatively low proportion of manufactured products (tinned products, shelled shrimp) (Table 17). Approximately 65 % of exported Senegalese fisheries products are destined for the European market. These exports consist mainly of demersal fish products. Octopus is mostly exported to the Asian market and small coastal pelagics are sold on the African market. No export tax is applied on fishery products. The cost of transshipment for fisheries products was estimated to be FCFA 864,000,000 (US\$ 1.7 million) in 2006.

Senegal has bilateral fishing agreements with Guinea Bissau, Mauritania, Gambia and Cape Verde. Senegal currently has no protocol in force with the European Union, since the previous protocol was not renewed in 2006. As a result, European vessels fishing in Senegal now either fish under licences or have reflagged to Senegal.

### **Artisanal fleet**

The Senegalese artisanal fleet is the largest and most important in the sub-region. It consists of 13,902 fishing units (pirogues) with outboard motors (90%) and ice boxes<sup>9</sup>. These vessels are able to stay at sea for a number of days and land mainly in Senegal, but some land in neighbouring countries including Guinea and Mauritania.

There are 59,428 artisanal fishers, compared to 3,100 fishermen in the industrial fishing sector. Artisanal fishermen are almost all of Senegalese nationality. Several fishing communities (Guetndariens, Lébous, Nyominka) are organised into approximately 200 fisheries centres along the coast. Over 20 different types of fishing gear are used depending on the strategy employed in accordance with changing seasonal, biological and socio-economic factors. The main types of gear (representing about 95% of gears used in artisanal fisheries landings) are: gill nets, hand lines, drag nets and other nets.

Of the total artisanal landed catch, 77.6% is made up of small pelagic species, dominated by round sardinella ('sardinelle ronde', *Sardinella aurita*) (51.5 %) and Madeiran sardinella ('sardinelle plate', *Sardinella maderensis*) (30 %). A Senegalese artisanal shrimp fishery also exists, and the collection of a variety of coastal fishery products such as clams, octopus and cockles is practised by approximately 9,500 individuals (mostly all men) along the coast of Senegal called 'mareyeurs'.

The artisanal processing industry is particularly important with over 41,000 employees earning their living directly from this activity. Products include smoked, dried, salted and fermented fish. The majority of processors are Senegalese women (92%) with only 8% foreign processors, reflecting the national importance of the artisanal fish-processing sector. A variety of traditional dried and salted products are sold on the domestic and regional export markets, from pelagics, demersals, sharks and tunas.

### **Industrial fleet**

The industrial fleet consists of trawlers, purse seiners, pole and line vessels and sardine/small pelagic vessels. In 2007, a total of 138 industrial vessels were authorised to fish in Senegalese waters for coastal shrimp, fish and cephalopods, deep water crustaceans and pelagics. Industrial vessels are either Senegalese vessels with a Senegalese flag or foreign fishing vessels with private licences, fishing under a fishing agreement or chartered vessels flying a foreign flag. However, since the EU-Senegal agreement ended in 2005, there has been a change in the composition of the fleet, with fewer foreign vessels fishing in Senegalese waters. Now most vessels are Senegalese-flagged and

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<sup>9</sup> 2005 national survey of the artisanal fleet.

only a small number of Spanish and French pole and line vessels, Cape Verdean coastal pelagic vessels and Gambian coastal demersal trawlers remain.

The demersal industrial fishery is the most important, targeting shrimp, finfish, octopus and cephalopods. In 2005, demersal industrial fishery landings represented 12.9% of total landings (70,141 tonnes), the main species by weight being the rough-head sea catfish ('machoiron', *Arius gambiensis*) (23.5%), octopus, (*Octopus vulgaris*) (10.1%), rubberlip grunt ('dorade grise', *Plectorhinchus mediterraneus*) (7.5%) and the Senegalese tonguesole ('sole langue', *Cynoglossus spp*) (5.5%). There is also a small tuna fishery, made up of Senegalese, European and Cape Verdian pole and line and purse seiners. The semi-industrial fleet for coastal pelagic fish is composed of 3–5 small seiners between 15 and 28 metres length which make daily fishing trips. Other countries such as Cape Verde, Mauritania and Gambia are present in Senegalese waters through bilateral agreements, although the number of active vessels is very small.

Seventy-six fish processing factories (mostly serving the industrial fisheries sector) were recorded in 2005 which provide employment to 2,850 people, mostly contractual workers and with Senegalese nationality.

### 3.4.2. Legal framework and key regulatory issues

A new Fisheries Code (Code de Pêche) is being prepared which will include new concepts such as the ecosystem approach and precautionary principle. A vessel registry is being developed as is a regional approach to fisheries management and MCS with Guinea Bissau, Cape Verde, Guinea and Sierra Leone. The regional approach is being promoted through the CSRP. A summary of the inclusion of infractions in Senegalese fisheries law, and the detectability of infractions, is provided in Table 18.

The number of recorded violations, by infraction type, over the period 1997–2007 is provided in Table 19.

**Table 18: Types of infraction, legislation and detectability in Senegal**

Infraction type	Legislation	Estimate of detectability/issues
Use of unauthorised gear (minimum mesh size)	Artisanal fishery: DECRET N° 98-498 setting the terms for Law Enforcement Code of marine fishing Section I: fishing gear and mesh nets Article 28	No action taken to enable the measurement and control of mesh size of fishing gear. Strong lobbying and resistance to MCS from fishermen.
	Industrial fishery: DECRET N° 98-498 setting the terms for Law Enforcement Code of marine fishing Section I: fishing gear and mesh nets Article 32	Permanent patrol service at sea over the last two years with the support of Spanish cooperation in the framework of illegal immigration. Permanent control on land at the Autonomous Port of Dakar by the site-based team when landings occur.
Landing of undersized fish	DECRET N° 98-498 modalities for Law Enforcement Code of sea fishing Section II: Minimum size and weight of species Article 37	Permanent control on land at the Autonomous Port of Dakar by the site-based team when landings occur.

Fishing without a valid fishing licence	Law N° 98-32 Ship offences related to access to Senegalese waters.	Permanent patrol service at sea over the last two years with the support of Spanish cooperation in the framework of illegal immigration. 3 days / month at sea patrol by the Senegalese Merchant Marine.
Fishing with unauthorised fishing gear	DECRET N° 98-498 Ship offences related to access to Senegalese waters. setting the terms for Law Enforcement Code of sea fishing Section I: fishing gear and mesh nets Article 35	Permanent patrol service at sea over the last two years with the support of Spanish cooperation in the framework of illegal immigration. 3 days / month sea patrol by the Senegalese Merchant Marine.
Fishing in closed areas/seasons: Intrusion by trawlers in the area of 6-7 miles reserved exclusively for small-scale artisanal fishing	Law no 98-32 of 14 April 1998 Code of sea fishing. Section III: Fishing zones Articles 38 to 49	Lack of resources for MCS patrols at sea 9 coastal stations equipped with radar to control the area of 6-7 miles reserved exclusively for artisanal fishing Permanent patrol service at sea over the last two years with the support of Spanish cooperation in the framework of illegal immigration. 3 days / month sea patrol by the Senegalese Merchant Marine
Bycatch is prohibited for a) demersal trawlers fishing inshore to retain catches of deep water shrimp; b) demersal trawlers fishing inshore to retain catches of hake.	Law no 98-32 of 14 April 1998 Code of sea fishing Section IV: Bycatch Article 50	Permanent patrol service at sea over the last two years with the support of Spanish cooperation in the framework of illegal immigration. 3 days / month sea patrol by the Senegalese Merchant Marine. Permanent control on land at the Autonomous Port of Dakar by the site based team when landings occur.
Unauthorised gear: Minimum mesh size	Artisanal: DECRET N° 98-498 setting the terms for Law Enforcement Code of sea fishing Section I: fishing gear and mesh nets Article 28	No action taken to enable the measurement and control of mesh size of fishing gear Strong fishermen's lobby hostile to any form of control.
	Industrial: DECRET N° 98-498 setting the terms for Law Enforcement Code of sea fishing Section I: fishing gear and mesh nets Article 32	Permanent patrol service at sea over the last two years with the support of Spanish cooperation in the framework of illegal immigration. Permanent control on land at the Autonomous Port of Dakar.
Landing of undersized fish	DECRET N° 98-498 modalities for Law Enforcement Code of sea fishing Section II: Minimum size and weight of species Article 37	Permanent control on land at the Autonomous Port of Dakar by the site based team when landings occur.

Source: questionnaire

**Table 19: Recorded infractions, 1997–2007**

Number and average of infractions by type and by period	1997-2007		1997-2002		2003 -2007	
	Total infractions	Average per year	Total infractions	Average per year	Total infractions	Average per year
Fishing in a prohibited area such as a No Take Zone or other prohibited area	143	13.0	111	18.5	32	6.4
Non-compliant fishing activity (including incorrect marking, gear, mesh size including the use of cod end covers and other activities not compliant with the type of license held by the vessel)	115	10.5	71	11.8	44	8.8
Refusal to cooperate or comply (obstruction of fishery inspectors...)	51	4.6	34	5.7	17	3.4
Unauthorised fishing activity	45	4.1	32	5.3	13	2.6
Unlicensed vessel	33	3.0	22	3.7	11	2.2
Non-compliant with legislative requirements of operating fishing vessel (no licence on board)	25	2.3	21	3.5	4	0.8
Fishing during the biological rest period	14	1.3	0	0.0	14	2.8
Fishing juvenile, immature and undersized fish	13	1.2	4	0.7	9	1.8
Transshipment at sea	11	1.0	5	0.8	6	1.2
Non-compliant with legislative requirements of operating fishing vessel (no log book on board)	7	0.6	5	0.8	2	0.4
Dishonest or false declaration of information (false log book information, false verbal information to inspector, false information on location/position of vessel)	5	0.5	2	0.3	3	0.6
Catching prohibited fisheries (species such as hake)	3	0.3	0	0.0	3	0.6
Use of illegal gear (double nets, blinders)	2	0.2	2	0.3	0	0
Non-compliant with legislative requirements of operating fishing vessel (no observer on board)	1	0.1	1	0.2	0	0
<b>TOTAL</b>	<b>468</b>		<b>310</b>		<b>103</b>	

Source: DPM



### **3.4.3. Case study descriptions**

Three fisheries were selected as case studies for examining illegal fishing issues in Senegal, based on the occurrence of infractions in the fishery, and their social and economic importance to the country:

- artisanal small pelagic fishery (important in terms of its contribution to employment and food security);
- artisanal shrimp fishery (high-value artisanal fishery);
- Industrial demersal fishery (high value, export oriented fishery).

The levels of illegal fishing in each case study are estimated as follows:

- Industrial demersal fishery — control is relatively good, illegal fishing may account for 5–10% of activity. We have used 5% in our models.
- Artisanal fisheries: Although there were no records of fishing without a licence in the artisanal fisheries in Senegal, this may be because the licence requirements are limited and surveillance and control concentrate on other infractions. In particular, illegal fishing of juveniles is estimated by CRODT (2008) to be about 30% of the catch. We have used this figure in our models as a proxy for unlicensed activity.

While the control of illegal fishing by industrial fishing vessels is reported to be reasonably satisfactory by the national MCS agency, control of illegal fishing in the artisanal sector is relatively ineffective, due to the lack of personnel, patrol vessels and inspection. The majority of illegal fishing in Senegal is reported to be undertaken by the artisanal fishing sector.

#### ***Case study 1: the industrial demersal fishery***

This fishery mainly involves Senegalese and European trawlers. In 2005, there were 98 Senegalese trawlers and 30–50 European trawlers, but the latter have largely been absent from the fishery since 2006 following the cessation of fishing agreements with the EU. Recent figures indicate that 92% of the fleet is Senegalese with only 8% foreign vessels (2007). 2005 data have been used for the number of vessels (132 Senegalese demersal trawlers) since the infraction data and catch data available also relate to 2005. In 2005, the demersal catch was estimated at 70,141 tonnes (Table 20). Following the increased scarcity of the resource and the drive for maximising financial returns on the fishery to compensate for losses from reduced catches, increasingly non-selective and destructive practices have been used and have contributed to accelerating the decline in demersal resources. These include illegal practices such as the reduction of mesh size (using cod ends) to retain a greater catch. The use of large ribs (metal rollers) attached to the rope at the bottom of trawls is considered to be largely responsible for the gradual degradation of large areas of rocky habitats, important structural shelters for many fishery-related species and biological diversity. Furthermore, the use of shrimp trawl fishing gear for catching fish has led to a high level of by-catch and discards. Demersal trawlers have also been fishing illegally in restricted coastal zones. The two main infractions recorded in the industrial demersal fisheries are the presence of trawlers in the exclusively reserved area for artisanal fisheries of 6-7 miles (42.8% of infractions) and tampering with fishing nets (22%). Only five unlicensed vessels were recorded of the 63 noted (8%). These offences relate exclusively to Senegalese trawlers.

Licences are granted by the Ministry of Fisheries and are valid for between 6 months and one year. The licensing regime varies between national and foreign vessels. Licensing fees for the industrial

fleet are FCFA 24,600/GRT/year (\$49/GRT/year) for national vessels and FCFA 74,000/GRT/year (\$140/FCFA/GRT/year) for foreign vessels.

A summary of the input values used for the model to estimate the economic losses of illegal fishing in this fishery and are summarised in Table 21 and value added estimates in Table 22.

**Table 20: Catches and prices for main industrial demersal fleet**

Species or groups of species (local name)	Volume (tonnes)	Price at first point sale (national) (FCFA/kg)	Additional information
Rough-head sea catfish	16,500	203	- 80 % of tonnage is exported. - Factory costs transport, taxes : €3 per kg - Profit margin €1–2 per kilo
White grouper	855	3,858	
Lesser African threadfin	2,709	199	
Rubberlip grunt	5,293	677	
Canary drum	1,315	541	
Red pandora	4,866	448	
Southern common seabream	3,202	1,921	
Senegalese tonguesole	3,833	677	
Sharks	5,654	118	
West African goatfish	867	677	
Cuttlefish	2,889	118	
Octopus	7,108	1,646	
Others	15,049	1,015	

Source: Questionnaire

**Table 21: Summary of input data for Senegal industrial demersal fishery model**

	Senegalese	Foreign	Total	Source
Number of licensed vessels ( $n$ )	132	0	132	DPM, Questionnaire
Licence fee (US\$) ( $l$ )	7,002			Based on fixed fee per GRT
Licence fee for illegal vessels (taking account of nationality) (US\$) ( $l_{ILLEG}$ )			7,002	Questionnaire: unlicensed vessels are Senegalese
Annual production from legal vessels (tonnes) ( $C_{LEG}$ )			17,000	DPM
Value per tonne (first sale) (US\$) ( $p$ )			1,379	DPM. Calculated by species group
First sale value of production (US\$) ( $V_{LEG}$ )			23,445,020	
Number employed per licensed vessel	16.56	1.44		Based on total crew size of 18
Number employed per illegal vessel	16.56	1.44		
Estimated proportion of illegal activity in relation to total fleet ( $a$ )			0.05	Questionnaire, key informants, DPM
Number of offences detected ( $n_{DET}$ )			3	Average per year for 2003–2007.
Value of fine for illegal vessel if caught (US\$) ( $f$ )			15,000	Based on CFCA 120m revenue from fines, 20% value from unlicensed, average 3 unlicensed vessels caught per year.

**Table 22: Value added estimates as a proportion of catch value, Senegalese industrial demersal sector**

	Fleet	Domestic	Exported	Source of estimate
Fishing value-added	Legal fleet	0.23	0.02	FAO (2001)
	Illegal fleet	0.23	0.02	
Processing value-added	Legal fleet/catches	0.026	0.104	World Bank (undated)
	Illegal fleet/catches	0.026	0.104	

### **Case study 2: The artisanal shrimp fishery**

This fishery is particularly important in the Saloum and Casamance estuaries. Many gear types are used, the most important being drag nets ('filet traînant', local name *Killi*), channel nets ('filet filtrant', *filet canal*) and the drift net (*fêlé-fêlé à crevette*). In 2005 there were a total of 5,104 units including 1,493 drag nets, 2,344 channel nets and 1,267 driftnets.

Artisanal shrimp fishing is practised by Senegalese fishermen and other fishermen from the sub-region including Gambia, Guinea-Bissau and Mali. Approximately 80% of the crew on each vessel are Senegalese and the remaining 20% are foreign. The existence of a market for juvenile small fish and the lack of logistic capacity and manpower to monitor fisheries production activities has resulted in fishermen using nets with an 8 mm mesh size instead of the legally authorised 12mm mesh size. This has led to the intensive exploitation of large quantities of juvenile and undersized shrimp.

The artisanal shrimp fisheries catch 4,299 tonnes of shrimp, with a first sale price of FCFA 2,500 (US\$ 5) per kg. The production is for export, and the profit margin involved is US\$ 3.8/kg.

The artisanal shrimp fishery is subject to a number of management measures including regulated mesh size and temporal fishery closures (biological rest period). The main infractions are the use of non-compliant mesh sizes (37.9%), landing juveniles (22.4%) and non-compliance with not fishing during the biological rest period (17.2%).

Three types of licence exist in the artisanal sector, ranging from FCFA 5,000 to 25,000. The annual fee for an artisanal shrimp vessel is FCFA 15,000 (US\$ 30). In 2007, the reported revenue from all artisanal fleet licences was FCFA 75,645,000 (US\$ 145,000). This was significantly lower than the predicted income of FCFA 245 billion (US\$ 465 million) for that year.

A summary of the input values used for the model to estimate the economic losses of illegal fishing in this fishery are summarised in Table 23 and value added estimates in Table 22.

Table 23: Summary of input data for Senegal artisanal shrimp fishery model

	Senegalese	Foreign	Total	Source
Number of licensed vessels ( $n$ )	4,551	555	5,106	Questionnaire / DPM
Licence fee (US\$) ( $l$ )	30	30		DPM. Based on fixed fee per vessel.
Licence fee for illegal vessels (taking account of nationality) (US\$) ( $l_{ILLEG}$ )			30	Questionnaire: unlicensed vessels are Senegalese
Annual production from legal vessels (tonnes) ( $C_{LEG}$ )			4,299	DPM
Value per tonne (first sale) (US\$) ( $p$ )			4,744	DPM
First sale value of production (US\$) ( $V_{LEG}$ )			20,393,738	
Number employed per licensed vessel	8	2		Based on 10 crew per vessel
Number employed per illegal vessel	8	2		
Estimated proportion of illegal activity in relation to total fleet ( $a$ )			0.30	Questionnaire (illegal fishing of juveniles is estimated by CRODT (2008) to be about 30% of the catch)
Number of offences detected ( $n_{DET}$ )			0	DPM
Value of fine for illegal vessel if caught (US\$) ( $f$ )			100	DPM. Upper limit for fines for artisanal infractions.

Table 24: Value added estimates as a proportion of catch value, Senegalese artisanal shrimp sector

	Fleet	Domestic	Exported	Source of estimate
Fishing value-added	Legal fleet	0.7	0.05	FAO (2001)
	Illegal fleet	0.7	0.05	
Processing value-added	Legal fleet/catches	0.75	0	World Bank (undated)
	Illegal fleet/catches	0.75	0	

### Case study 3: the artisanal small pelagic fishery

The artisanal small pelagic fishery is primarily carried out using purse seine units, encircling gillnets and beach seines. In 2005, there were 250 purse seines, 350 encircling gillnets and 120 seines. Pelagic catches were estimated at 429,568 tonnes in 2005. The main species landed are round sardinella, Madeiran sardinella, yellow horse mackerel, mackerel, bonito, tuna and large jacks. This fishery is exclusively carried out by Senegalese fishermen. The pelagic species caught by the artisanal fleet are mostly sold on the domestic and regional markets. Twenty percent of the catch is processed by artisanal processors in various forms – smoked, salted, fermented and dried and part of the artisanal products are exported into regional markets.

In order to increase catch and profitability, artisanal fishermen use purse seines with a small mesh size which is extremely non-selective. Landing juvenile fish is fuelled by the high demand from fishmeal manufacturers (in Dakar) and traders from countries adjacent to the Gulf of Guinea (Guinea,

Benin, Sierra Leone and other countries). The use of nets with very fine mesh sizes commonly called mosquito nets results in a high level of juveniles being caught in beach seines.

The artisanal coastal pelagic fishery is not subject to any land surveillance for mesh sizes or for the size of individual landed fish despite the presence of decentralised fisheries management along the coast of Senegal. Sea-based patrols only concern the industrial fisheries industry. Therefore, no infractions were officially recorded for the artisanal small pelagic fishery. However, the most frequent offences committed in this fishery include the use of monofilament nets prohibited by the Fisheries Code, non-compliant mesh sizes and the landing of large quantities of juvenile fish (approximately 30% of the total landings).

The annual fee for an artisanal small pelagic vessel is FCFA 25,000 (US\$ 50).

**Table 25: Catch volume and value by species from the artisanal small pelagic fishery**

Species or groups of species (local name)	Volume (tonnes)	Price at first point sale (national) (FCFA/kg)	Additional information
Bonga shad	8,825	123	-60 % of tonnage is produced for the local and regional market, sold fresh. - 20 % of tonnage is processed artisanally for the local or regional market. - 20 % of tonnage is processed artisanally for export.
Round sardinella	221,023	66	
Madeiran sardinella	129,499	57	
Flathead mullet	2,697	466	
Pigsnout grunt	2,548	659	
Sompat grunt	1,832	659	
Bigeye grunt	1,438	100	
False scad	4,841	326	
Atlantic horse mackerel	5,972	90	
Senegal jack	5,573	327	
Atlantic bumper	5,119	75	
Mackerel	8,796	189	
Atlantic bonito	2,477	262	
Largehead hairtail	2,158	200	
Others	26,770	120	

The data for the estimations of the direct and indirect value added from fishing, fish processing and associated activities for the three case studies considered in this study come from a number of sources including the Ministry of Fisheries' annual yearbooks, Studies and Planning Unit (CEP), the Fisheries Research Institute (CRODT) and the MCS service (DPSP), the West Africa Sustainable Fisheries Livelihoods Programme (SFLP). The estimates of the value added losses attributable to illegal fishing include:

- Direct value added of fishing activities, estimated at 52% of landed value, and split between domestic landings (92%) and exported (8%);
- Direct value added of fish processing/export activities in the industrial fleet, estimated at 80% of landed value, only 20% of which is retained domestically;
- Direct value added of fish processing/export activities in the artisanal fleet, estimated at 21% of landed value, all of which is retained domestically;

With limited operations by foreign vessels and with most fish and other marine species landed in Senegal, there is relatively little leakage of value added to other countries, notably the EU and Asia. The main loss of value added which is linked to illegal fishing are the losses incurred from the artisanal fleet's targeting of small pelagic species which are mostly landed in Senegal for domestic consumption. Licence income lost from illegal fishing by artisanal fishing vessels is difficult to estimate, however total licence receipts from the artisanal sector were FCFA 75.6 million in 2007 (US\$ 143,454). It is likely that the loss of licence revenues from illegal fishing vessels in the artisanal sector is likely to be relatively low as vessel licence costs are low (between US\$30 and \$50).

Table 28 gives an indication of infractions committed by fishing vessels in the three case studies. These indicate that the majority of infractions and therefore value added losses from fishing activities were in the industrial and artisanal shrimp fisheries. MCS coverage of the artisanal fleet is relatively limited which is why local evidence shows no infractions committed by the artisanal small pelagic fishery.

A summary of the input values used for the model to estimate the economic losses of illegal fishing in this fishery are summarised in Table 26 and value added estimates in Table 27.

**Table 26: Summary of input data for Senegal artisanal pelagic fishery model**

	Senegalese	Foreign	Total	Source
Number of licensed vessels ( $n$ )	720		720	DPM Questionnaire
Licence fee (US\$) ( $l$ )	50			DPM Questionnaire
Licence fee for illegal vessels (taking account of nationality) (US\$) ( $l_{ILLEG}$ )			50	Questionnaire: unlicensed vessels are Senegalese
Annual production from legal vessels (tonnes) ( $C_{LEG}$ )			429,568	DPM
Value per tonne (first sale) (US\$) ( $p$ )			166	DPM
First sale value of production (US\$) ( $V_{LEG}$ )			71,382,956	
Number employed per licensed vessel	10	0		Based on 10 crew per vessel
Number employed per illegal vessel	10	0		
Estimated proportion of illegal activity in relation to total fleet ( $a$ )			0.30	Questionnaire (illegal fishing of juveniles is estimated by CRODT (2008) to be about 30% of the catch)
Number of offences detected ( $n_{DET}$ )			0	DPM
Value of fine for illegal vessel if caught (US\$) ( $f$ )			100	DPM. Upper limit for fines for artisanal infractions.

Table 27: Value added estimates as a proportion of catch value, Senegalese artisanal pelagic sector

	Fleet	Domestic	Exported	Source of estimate
Fishing value-added	Legal fleet	0.55	0.05	FAO (2001)
	Illegal fleet	0.55	0.05	
Processing value-added	Legal fleet/catches	1.8	0	World Bank (undated)
	Illegal fleet/catches	1.8	0	

Table 28: Main infractions in the three case study fisheries in Senegal

	Industrial demersal fishery		Artisanal shrimp fishery		Artisanal small pelagic fishery	
Type of infraction	Surveillance effort*	Number of recorded offences:	Surveillance effort	Number of recorded offences:	Surveillance effort	Number of recorded offences:
DL	- 15 aerial patrols (41h35mm) -364 inspected boats	5	-No logistic means for controls at sea. Control of landings by a team of 20 fisheries officers.		No surveillance effort	
NDLB		4				
MNC		2		22		
ZI		27		5		
OBS		14				
JUV				13		
NRRB				10		
Others		11		8		
Total		63		58		No offences officially recorded

Notes: DL: Unlicensed ; NDLB: Not retaining the licence on board ; MNC: Illegal mesh size ; ZI: Fishing in a prohibited zone ; OBS: Obstruction ; JUV: Landing undersized fish ; NRRB: Fishing during a prohibited period.

\* number of inspections, number of boats inspected, or total fleet size.

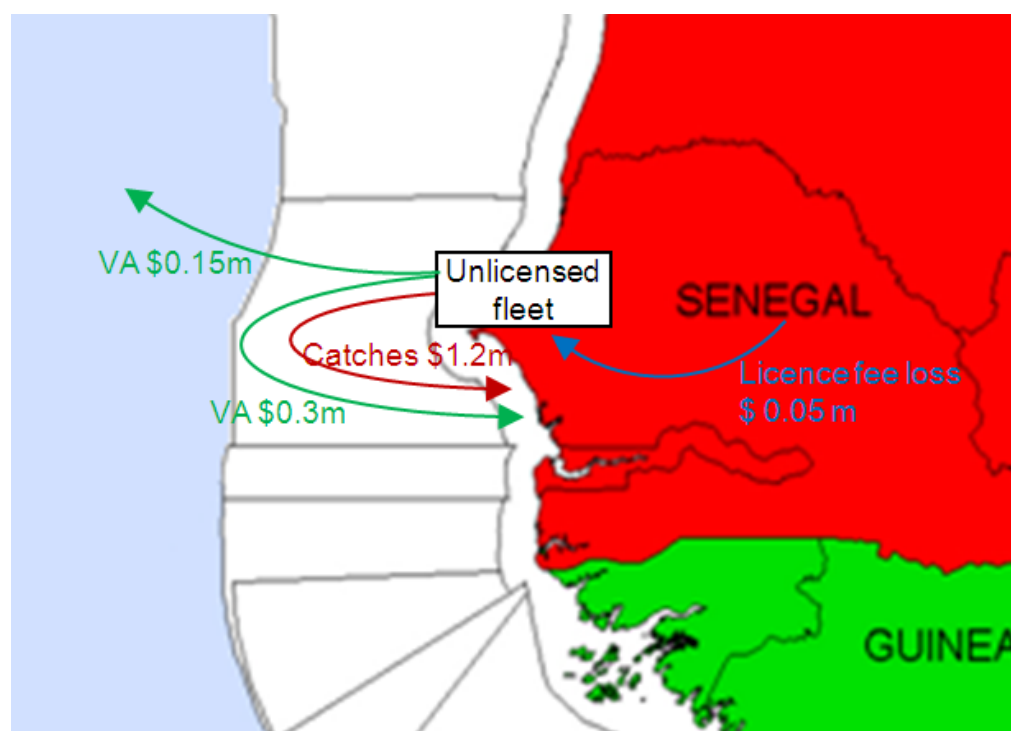
Estimates of the level of illegal fishing were obtained from surveillance data (see section 3.2) and the questionnaire. These levels are low in Senegal for industrial vessels, but relatively high for artisanal vessels which are much less well controlled. The illegal fishing is carried out by mainly Senegalese and a number of foreign fishing vessels which have licences to fish in Senegalese waters.

### 3.4.4. Direct economic losses

Our results indicated that government revenue is mostly lost through lost licence fees and associated port fees, but because these are so small in the artisanal fleet, and the level of illegal fishing in the industrial fleet is relatively low, the losses from this source are small (under \$ 0.2 million). The estimated value of illegal fish from the industrial fishery is lower (at \$ 1.2 million) than the estimated value of illegal fish from the artisanal fishery (\$ 39 million from the shrimp and pelagic fisheries combined, predominantly originating from the pelagic fishery). The model outputs are summarised in Table 29, Table 30 and Table 31. The destination of losses and gains from illegal fishing are shown diagrammatically in Figure 4, Figure 5 and Figure 6.

Senegal loses some value added through the marketing chain where fish, crustacean and cephalopods are exported to other countries and where the value added is obtained through additional processing and other value added outside Senegal. Such loss of value added will be associated with the export of fish and other species to the EU and other countries and in the case of processing undertaken where there are landings by Senegalese vessels (mainly artisanal vessels) in other West African countries. However, the losses from the artisanal fleet (both case studies combined) are relatively low because most of these fish are landed in-country – we estimate that combined shrimp and small pelagic value added losses (fishing and processing) are \$ 2 million from the artisanal fishery, compared to \$ 85 million value added from illegal fishing that is retained in-country. Senegal's economy thus benefits substantially from the unlicensed artisanal fishing that is taking place. The situation in the industrial fishery is that about half of the value added (fishing and processing combined) is lost from Senegal (about US\$ 153,000).

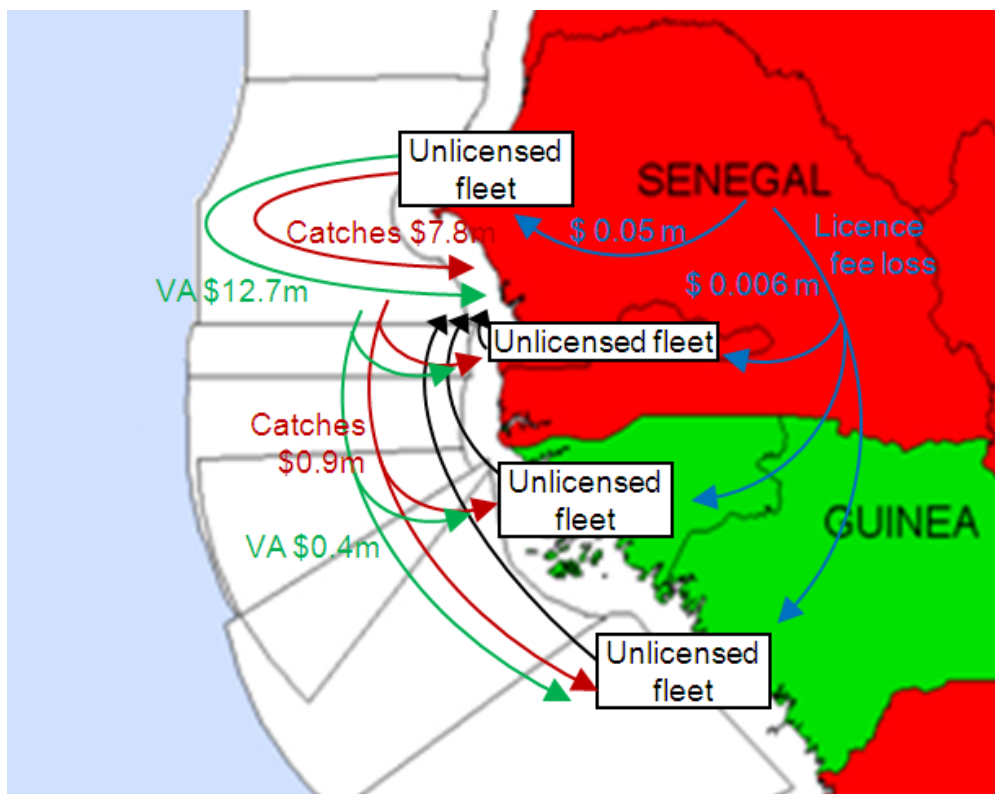
These results are reflected in the estimated value added lost relative to the domestic value added that could be obtained from adopting Scenario 1: \$ 850,000 for the industrial fleet and \$ 13 million for the two artisanal case studies combined.



**Figure 4: Diagram showing flows of losses from Senegal due to illegal fishing in the industrial demersal sector**

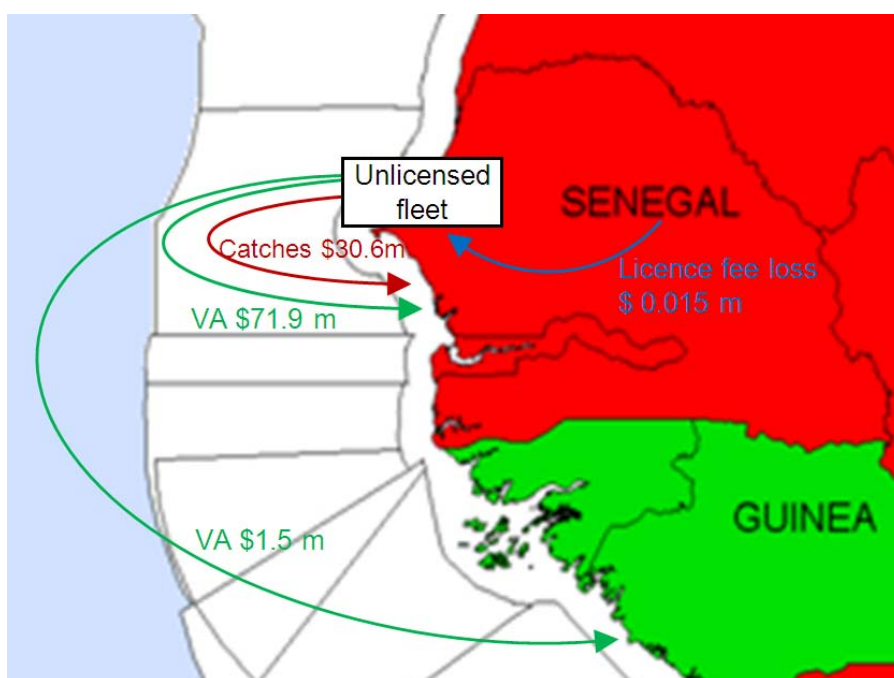
Note: VA = direct fishing value added plus direct processing value added. The VA flows shown in the diagram are the current losses in the base case. The values do not represent what Senegal could capture domestically if illegal fishing were controlled. This would be between \$ 851,000 for fishing value added (no processing value added lost) for Scenario 1 and \$ 0 for Scenario 2.





**Figure 5: Diagram showing flows of losses from Senegal due to illegal fishing in the artisanal shrimp fishery**

Note: VA = direct fishing value added plus direct processing value added. The VA flows shown in the diagram are the current losses in the base case. The values do not represent what Senegal could capture domestically if illegal fishing were controlled. This would be \$ 2 million for fishing value added under Scenario 1 (no processing value added lost), and \$ 0 for Scenario 2.



**Figure 6: Diagram showing flows of losses from Senegal due to illegal fishing in the artisanal small pelagic fishery**

Note: VA = direct fishing value added plus direct processing value added. The VA flows shown in the diagram are the current losses in the base case. The values do not represent what Senegal could capture domestically if illegal fishing were controlled. This would be between \$ 11.2 million for fishing value added (no loss for processing value added) under Scenario 1, and \$ 0 under Scenario 2.

**Table 29: Model input values and current economic losses to illegal fishing in the Senegal industrial demersal fishery**

<b>Inputs</b>	Catch (t)	value per tonne (\$)	Gvt revenue in addition to licence fees as % of licence revenue	N. licensed vessels	Illegal vessel fine	IUU estimate	Nationals employed per legal vessel	Nationals employed per illegal vessel
	17000	1379	0%	132	15000	5%	16.56	16.56
	Fishing direct value added % of landed value				Processing direct value added % of landed value			
	Legal Domestic	Legal foreign	Illegal domestic	Illegal foreign	Legal Domestic	Legal foreign	Illegal domestic	Illegal foreign
	23%	2%	23%	2%	3%	10%	3%	10%
<b>Activities</b>	Value of legal target catch (\$)	Total catch value per legal vessel (\$)	Number of nationals employed on legal fleet	Government revenue from licences (\$)	Other government revenue from legal vessels (\$)	Total number offences (est)	Estimated illegal catch target sp (t)	Total fish value loss (\$)
	23,445,020	177,614	2185.92	924,250	9,064	7	895	1,233,948
<b>Tangible losses</b>	Licence fee loss (\$)	Other government losses (\$)	Value of fines from illegal vessels (\$)	Net government loss (\$)				
	49,013	54,047	45,000	58,061				
	Fishing direct value added				Processing direct value added			
<b>Value Added</b>	Legal fishing domestic	Legal fishing foreign	Illegal fishing domestic	Illegal fishing foreign	Legal processing domestic	Legal processing exported	Illegal processing domestic	Illegal processing exported
\$	5,392,355	468,900	283,808	24,679	609,571	2,438,282	32,083	128,331
	Domestic VA lost relative to Scenario 1	Domestic VA lost relative to Scenario 2			Domestic VA lost relative to Scenario 1	Domestic VA lost relative to Scenario 2		
\$	851,424	-			-	-		

**Table 30: Model input values and current economic losses to illegal fishing in the Senegal artisanal shrimp fishery**

Inputs	Catch (t)	value per tonne (\$)	Gvt revenue in addition to licence fees as % of licence revenue	N. licensed vessels	Illegal vessel fine	IUU estimate	Nationals employed per legal vessel	Nationals employed per illegal vessel
	4299	4743.833017	0%	4551	100	30%	8	8
<b>Fishing direct value added % of landed value</b>				<b>Processing direct value added % of landed value</b>				
	Legal Domestic	Legal foreign	Illegal domestic	Illegal foreign	Legal Domestic	Legal foreign	Illegal domestic	Illegal foreign
	70%	5%	70%	5%	75%	0%	75%	0%
Activities	Value of legal target catch (\$)	Total catch value per legal vessel (\$)	Number of nationals employed on legal fleet	Government revenue from licences (\$)	Other government revenue from legal vessels (\$)	Total number offences (est)	Estimated illegal catch target sp (t)	Total fish value loss (\$)
	20,393,738	4,481	36408	153,180	214	1950	1,842	8,740,173
Tangible losses	Licence fee loss (\$)	Other government losses (\$)	Value of fines from illegal vessels (\$)	Net government loss (\$)				
	58,500	82	-	58,582				
<b>Fishing direct value added</b>				<b>Processing direct value added</b>				
Value Added	Legal fishing domestic	Legal fishing foreign	Illegal fishing domestic	Illegal fishing foreign	Legal processing domestic	Legal processing exported	Illegal processing domestic	Illegal processing exported
\$	14,275,617	1,019,687	6,118,121	437,009	15,295,304	-	6,555,130	-
	Domestic VA lost relative to Scenario 1	Domestic VA lost relative to Scenario 2			Domestic VA lost relative to Scenario 1	Domestic VA lost relative to Scenario 2		
\$	2,039,374	-			-	-		

**Table 31: Model input values and current economic losses to illegal fishing in the Senegal artisanal small pelagic fishery**

Inputs	Catch (t)	value per tonne (\$)	Gvt revenue in addition to licence fees as % of licence revenue	N. licensed vessels	Illegal vessel fine	IUU estimate	Nationals employed per legal vessel	Nationals employed per illegal vessel
	429568	166.173822	0%	720	100	30%	10	10
Fishing direct value added % of landed value					Processing direct value added % of landed value			
	Legal Domestic	Legal foreign	Illegal domestic	Illegal foreign	Legal Domestic	Legal foreign	Illegal domestic	Illegal foreign
	55%	5%	55%	5%	180%	0%	180%	0%
Activities	Value of legal target catch (\$)	Total catch value per legal vessel (\$)	Number of nationals employed on legal fleet	Government revenue from licences (\$)	Other government revenue from legal vessels (\$)	Total number offences (est)	Estimated illegal catch target sp (t)	Total fish value loss (\$)
	71,382,956	99,143	7200	36,000	50	309	184,101	30,592,696
Tangible losses	Licence fee loss (\$)	Other government losses (\$)	Value of fines from illegal vessels (\$)	Net government loss (\$)				
	15,450	22	-	15,472				
Fishing direct value added					Processing direct value added			
Value Added	Legal fishing domestic	Legal fishing foreign	Illegal fishing domestic	Illegal fishing foreign	Legal processing domestic	Legal processing exported	Illegal processing domestic	Illegal processing exported
\$	39,260,626	3,569,148	16,825,983	1,529,635	128,489,321	-	55,066,852	-
	Domestic VA lost relative to Scenario 1	Domestic VA lost relative to Scenario 2			Domestic VA lost relative to Scenario 1	Domestic VA lost relative to Scenario 2		
\$	11,217,322	-			-	-		

### 3.4.5. Intangible losses

The indirect costs of illegal fishing in Senegal are mainly due to the activities of the artisanal fishing fleet which is using small mesh size nets. The impacts of the artisanal fishing fleet are mainly on small pelagic species and shrimps, although they also have some impacts on demersal species, including cephalopods.

A direct estimate of the impact of these activities on the shrimp stock was not possible, but it is reported to be a large problem. Due to the low level of inspection activity on the artisanal fleet, however, these infractions are not often reported (Table 28). The bioeconomic model presented in Section 4.2 provides some assistance in understanding the impact that these activities will have on the Senegalese shrimp fishery. The activity of the industrial fleet also has some negative impacts on shrimp and other species with some fishing of juveniles.

### 3.4.6. Social impacts

Given that Senegal experiences relatively low levels of industrial illegal fishing, and that most of the illegal artisanal catches are landed in-country, illegal fishing is likely to be having a positive effect on employment in Senegal.

Total direct, indirect and induced employment in fisheries in Senegal has been estimated to be approximately 600,000 people. This includes employment in fishing, fish processing and other activities upstream and downstream in the supply chain, including storage, logistics and transport.

#### **3.4.7. MCS activities**

Monitoring, control and surveillance in Senegal is the responsibility of the Fisheries Protection and Surveillance Directorate (*Direction de la Protection et de la Surveillance des Pêches*, DPSP) which has the following resources:

- Two 20-metre patrol vessels, two 12-metre patrol vessels and two 6-metre patrol boats;
- One operational patrol aircraft which makes two flights a month;
- An integrated VMS system;
- A coordination centre and nine coastal stations equipped with radar covering the 6-7 mile zone reserved exclusively for artisanal fishing;
- Human resources which include 12 inspectors supervising aerial and maritime missions and 60 observers on foreign fishing vessels;
- An annual budget of CFAF 250 million (US\$ 475,000) of which 85% is financed by the Senegalese government and 15% from receipts from fines and infractions.

The principal focus of MCS in Senegal has been on the industrial fishing fleet and according to the DPSP, control of the activities in the sector through inspections and patrols have been fairly successful and the number of arrests for infractions has fallen considerable from 64 in 1997 to 18 in 2007. This suggests better control of illegal fishing, although this will also depend on the number and efficiency of patrols and inspections. By contrast, artisanal fisheries are subject to relatively few controls, and this is leading to relatively high levels of illegal fishing and, particularly, the use of undersized mesh.

#### **3.4.8. Proposals for tackling illegal fishing**

No information was received from Senegal regarding proposals for tackling illegal fishing.

The Senegal MCS system appears to be controlling industrial fishing vessels fairly well, but artisanal vessels are not well controlled. A number of actions could be taken to tackle illegal fishing in Senegal:

- Reinforcement of fishing patrols and inspection (personnel, transport, training);
- Development of fishing and co-management associations amongst artisanal fishers in order to develop peer pressure for compliance with regulations, notably controlling mesh size;
- Registration of artisanal fleet vessels and verification of licences, gear and equipment.

## 3.5. The Gambia

### 3.5.1. General description of the fisheries

The Gambia was not examined in detail with a case study. The following summarises the illegal fishing problems and the proposals to deal with them. The source of much of the information is the Gambian NPOA plan (Anon, 2004) and Kelleher (2002).

Fisheries production and exports from The Gambia are relatively low. In 2002, the volume of exports was 932.4 tonnes valued at 21,334,062 Dalasis (US\$ 817,000) (Statistics Unit, Fisheries Department, 2003) and in 2005 was 751 tonnes valued at 9,956,837 Dalasis (US\$ 382,000) (in-country contact). In 2005, the government obtained revenue of 13,737,200 Dalasis (US\$ 526,100) from fishing licences, and 2,312,180 Dalasis (US\$ 88,000) from fishing agreements. Additionally, income was obtained from penalties paid by the owners of the arrested vessels, totalling 1,780,000 Dalasis (US\$ 60,000). There is an industrial and an artisanal fleet: industrial fishing activities are restricted to coastal and marine waters up to the 200 nautical mile EEZ limit; artisanal fishing activities are conducted in coastal and inland waters (river and tributaries in estuarine/brackish and freshwater regimes).

#### *Artisanal fisheries*

The artisanal fisheries sector is composed of approximately 2,000 fishing units operating in the country, between 35 to 40 % of which are motorized. This fishery is dominated by foreign fishermen from Senegal and Ghana. The fishermen from these countries operate along the coastal area and Senegalese, Malian and Guinean fishermen operate along the river and tributaries. The artisanal fishery is an open access fishery and therefore largely unregulated. Artisanal fisheries are currently not covered in the MCS program and legislation does not comprehensively address issues relating to artisanal fisheries.

Artisanal fish production has shown an increasing trend. Artisanal fishing targets demersal and pelagic fish stocks. A large proportion of the annual catch is made up of pelagic finfish species, particularly *Bonga*. Annual production for pelagic stocks was approximately 30,000 tonnes in 2003, below the estimated Maximum Sustainable Yield of between 165,000 and 200,000 tonnes. These stocks were only exploited by the artisanal fleet. Artisanal fish production from the Statistics Unit of the Department of Fisheries in 2003 for the coastal/marine area was estimated at 32,000 tonnes. Artisanal fish products are sold fresh or processed (dried/smoked) for local and sub-regional markets.

Demersal species targeted by the artisanal fishermen also include high value cephalopods, shrimps and sole which are sold to industrial fishing companies for processing and export. This raw material is transported on ice to the fish factories located in and around the capital city Banjul.

#### *Industrial fisheries*

Industrial fishing activities are undertaken in coastal waters by trawlers targeting demersal species particularly cephalopods, shrimps and other high value species (barracuda, groupers, snappers etc). Production from the industrial fishery has remained stable at around 10,000 tonnes over the past few years. Industrial fishing exclusively targets the demersal stocks, and does not target any of the pelagic stocks.

Eighty industrial fishing vessels operated in Gambian waters in 2003 including 59 shrimp trawlers, 20 fish/cephalopod trawlers and one processing vessel. There were 20 locally registered fishing companies operating in The Gambia. Seven of these operate fish processing factories. Over 90 % of the total supply (raw material fish) to the industrial fishing companies/factories is from artisanal fishermen targeting high value demersal fish species.

The main industrial fishery products include fresh and frozen crustaceans, finfish fillets and cephalopods. The principal markets for export are the European Union, Asia and the United States. Although all registered industrial fishing companies are either Gambian-owned or joint venture companies, over 90 % of the industrial fishing vessels operating in Gambian waters are foreign-owned and they land all their catches in foreign ports.

### **3.5.2. Description of the illegal fishing problem**

Illegal fishing activities occur particularly for the demersal fish stocks which are subject to overfishing. Illegal activity is relatively high in Gambia and is carried out by both licensed vessels and unlicensed vessels, e.g. illegal mesh size, double layered codends, fishing in closed areas and unauthorised transshipment. Although the number of violations is high, the number of arrests is low due to the poor MCS in place.

The use of illegal fishing methods and techniques is particularly widespread in the artisanal fisheries, and the reporting rate for landings and catches is low. However, virtually no arrests or prosecutions have been made due to the lack of adequate legislation and the fact that no Monitoring Control and Surveillance system is in place for the artisanal fisheries sector.

### **3.5.3. Legislation and monitoring**

MCS is the joint responsibility of the Gambia Navy and the Fisheries Department. The Navy is responsible for maritime surveillance and holds an up-to-date list of licensed fishing vessels. The MCS Unit located at Fisheries Department headquarters assigns observers to work onboard licensed fishing vessels and monitors positions and catches of vessels via radio.

The legal provisions for the licensing of local and foreign industrial fishing vessels is set out in Part V of the Fisheries Act 1991. Part II and Part III of the Fisheries Regulations 1995 addressed issues relating to applications and renewals of fishing licenses, conditions for issuance of licences, fees etc. and Part IV addresses conservation measures including area and gear restrictions and mesh size limitations. A revision of the fisheries legislation (including the Regulations 1995) was being carried out in 2004.

Several penalties and fines were detailed in various sections of the Fisheries Act 1991 for infractions by industrial fishing vessels and aquaculture: These included Sections 18, 30, 31, 35, 37, 39, 40, 44, 47, 48, 49, 50, 51, 55 and 60. Only Section 40 referred to artisanal fisheries. This system was being reviewed in 2004 along with the regulations. The Fisheries Act 1991 provided for the prosecution of offending vessels. However, almost all offences were handled out of court.

In 2004, some owners of foreign vessels registered their vessels locally in Gambia under The Gambian flag to avoid paying higher licence fees. No background checks for previous records of illegal activity were made on the foreign fishing vessels prior to allowing them local registration.

Even though the law requires each licensed vessel to land a minimum of 10% of annual catches in the country (or pay a monetary equivalent to the Government), most vessel owners landed, processed and exported their catches in foreign ports. One of the main reasons for this was the absence of a fisheries port in the country. As a consequence, apart from revenue from licence fees and fines for not landing catches, other revenue to The Gambian Government was limited because over 90% of the licensed industrial fishing vessels did not land their catches in The Gambia.

There was one exception to the general licensing policy/rule which was the foreign fishing vessels operating under access agreements (e.g. Gambia/Senegal reciprocal fishing agreement and the



Gambia/Japan tuna fishing agreement). Under these agreements, fishing licences were issued in the name of the foreign fishing vessel. Catches were also not landed in The Gambia.

In 2004, there was still no licensing and registration scheme for artisanal fishing fleets which was open access, and therefore unregulated. From January 2009, however, a licensing scheme will be implemented and all vessels fishing in Gambian waters will have to possess some sort of permit.

#### **3.5.4. *Proposals for tackling illegal fishing***

The Gambia has developed a detailed National Plan of Action (NPOA) for IUU fishing. The proposals in the plan appear appropriate to tackle illegal fishing in The Gambia.

### **3.6. Guinea Bissau**

#### **3.6.1. *General description of the fisheries***

The coastline of Guinea Bissau extends over 274km from the border with Senegal in the north to the border of Guinea (Conakry) in the south, with a further 80 islands (of which only 20 are inhabited) of the Bijagos archipelago. Proportionally, it has one of the largest continental shelves of the region covering just over 45,000 km<sup>2</sup>. The coast harbours many different habitats rich in biodiversity and valuable fishery resources. Guinea Bissau's waters have several important fishing grounds for a great variety of species including crustaceans, cephalopods, demersal and pelagic finfish.

These resources are exploited by both national and foreign fleets. The industry comprises two major sub-sectors, the artisanal and the industrial:

- The artisanal or small-scale sub-sector operates in estuaries and coastal waters and around the islands. Fishermen use a variety of boats, from dugouts to planked canoes, and employ a diverse range of fishing gears including gillnets, drifts, beach seines, long lines and hooks. They target both pelagic and demersal finfish as well as crustacea and cephalopods. This fishery significantly contributes to total national fish production and food security. The sub-sector, especially concerning the national fleet is known to be highly inefficient, mainly due to the lack of investment and availability of materials, training and fishing gear. The same is not true for the foreign artisanal fleet operating in Guinean waters. This fleet comprises large 12-16 m boats with powerful outboard engines (25-60 bhp) which allows them to have an extended range of operation and a great autonomy (around 10 days at sea). There are several reports of foreign fishermen camping on the islands not only carrying out fishing operations from there but also processing part of the catch *in situ*. The sub-sector provides a significant contribution to national food security and employs directly and indirectly over 6,000 people.
- The industrial sub-sector is made up almost exclusively of foreign vessels with a few operating as joint ventures with national companies. The legal industrial fleet is highly mechanised and generally operates offshore in deeper waters. Industrial vessels include trawlers, shrimpers and longliners and it is ultimately oriented for exports. Very little is known to be landed in the country, and it has been reported that when landings are made, only the inferior quality fish is landed. Should all the catch be considered of prime quality, captains prefer to pay the fines for not landing the products and sell them on in Europe where they fetch much higher prices, rather than landing them in Guinea Bissau and for local consumption.

It was difficult to obtain accurate estimates of the total potential yield of the fisheries resources in Guinea Bissau. Indeed, a great deal of uncertainty is associated with these estimates, for reasons such as the lack of an appropriate catch recording system, the accessibility of information on landings by the foreign fleets and the large number of illegal vessels operating in Guinean waters.

**Table 32: Characteristics of artisanal fishing fleet operating in Guinea Bissau**

Fishing boat type	Length (m)	Beam (m)	Engine Power (BHP)	No. of crew	Fishing gear used
Salam	5 – 10	0.4 – 0.8	-	1-3	Usually used for transporting fish
Nhominca	5 – 10	0.4 – 0.8	-	1-3	All fishing boats use all types off fishing gear available, including traps, gillnets, hand lines and shrimp nets
Pirogue Monoxile	5 – 8	2.80	-	5-10	
Improved Monoxile	5 – 8	1.75	8-15	3-5	
Bote	9 – 10	2.50	15-40	10-16	

Apart from the value of the capture fisheries that are landed in national ports (mainly by the national fleet), Guinea Bissau also receives a large amount from industrial fishing agreements with other countries or groups of countries, e.g. China and the EU. The foreign artisanal fleets bring virtually no contribution to the national economy as they employ mostly foreign crew and land very little or none of their production in national ports, while paying very low licence fees relative to the actual value of the catch.

### **3.6.2. Legal framework and key regulatory issues**

The major infractions in industrial and artisanal fisheries, level of detectability and MCS actions required for detection are provided in Table 33. No information was received on the details of fisheries law relating to these infractions.

**Table 33: Major infractions and level of detectability in Guinea Bissau**

	Industrial fisheries	Artisanal fisheries
Surveillance effort	In 2006, 99 vessels were inspected and 40 were arrested and fined	In 2006, 260 were inspected and 132 were arrested and fined.
Type of infraction	Number of detected infractions (detectability; action)	Number of detected infractions (detectability; action)
Fishing without licence	Estimated number of boats that have paid fines for fishing without a licence – 15 paying a total of US\$ 2.6 million (Ministry of Fisheries records 2006). (low detectability; it requires active intervention of the fisheries patrol; actions hampered by the lack of physical means)	No data on the fines applied to artisanal vessels (low detectability; it requires active intervention of the fisheries patrol; actions hampered by the lack of physical means)

Violating Inshore Exclusion Zone (IEZ)	Estimated number of boats that have paid fines for fishing in closed areas – 5 paying a total of US\$ 800,000 (Ministry of Fisheries records 2006) (high detectability, vessels can be spotted from shore; intervention needed for interception and arrest; actions hampered by the lack of physical means)	No data on the fines applied to artisanal vessels (high detectability, vessels can be spotted from shore; intervention needed for interception and arrest; actions hampered by the lack of physical means)
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Note: the number of boats arrested was estimated from the government's total revenue from fines; an average value of US\$ 150,000 per fine per boat was used; the government has received just over US\$ 3.5 million in 2006.

### 3.6.3. Case study descriptions

In Guinea Bissau both the artisanal and the industrial fleets (national and foreign) are involved in numerous offences to the fishing regulations. These range from the use of unregulated or illegal fishing gear, fishing in illegal areas, to ultimately fishing with no licence at all (Table 33). Unlicensed fishing is a particular problem and for the purpose of this study two fleets were chosen for analysis to illustrate the magnitude of the problem. The first example selected provides a good representation of the operation of the industrial fleet, i.e. the rose shrimp fishery (*Parapenaeus longirostris*). It was chosen as it represents a highly valuable catch which attains high prices in international markets.

#### Case study 1: Unlicensed shrimp trawlers

The industrial fleet catches a wide range of highly valuable species, and unlicensed fishing is a problem. The rose shrimp fishery was selected for the case study because of its high value. The following are the implications of illegal fishing by the industrial fleet:

- Fishing vessels tranship their catch to larger freezer vessels that transport the fish products to be sold in distant markets. The country therefore does not get any direct or added value benefit from the landing of the fish.
- In the licensed fleet, bycatch is sold on-shore and forms an important source of food and income for coastal communities. Illegal fishing and discarding at sea prevents Guinea Bissau from realising the benefit from these additional catches.
- Fishing vessels may fish very close to shore within artisanal fishing areas, leading to:
  - Stocks and habitat being affected - a large number of juvenile fish species are caught;
  - Conflicts arising with coastal communities - sightings of large trawlers operating very close to shore during the night are often reported;
  - Low levels of detection – no or very limited surveillance operations are carried out during the night, favouring offenders as they realise that they will not get caught during that period.

For the industrial fleet, data were obtained from the latest CECAF information and the results of the latest FAO working group report. All other information regarding the fleet characteristics, licensing fees and the value of fines was obtained directly from the Ministry of Fisheries. The estimation of the catch of the legal fleet was based on the historical catch of Spanish industrial vessels for the industrial fishery. The level of illegal fishing was estimated from MCS records and previous reports and personal communications. The arrest of five industrial vessels was witnessed during the in-country visit (three Chinese and two Italian-flagged vessels). The value added estimates were obtained from FAO (2001) and the World Bank regional value added model.

It should be noted that Guinea Bissau *per se* does not have either the technical or financial capacity to capture the full economic rent of this fishery. As such the country relies on foreign investment and joint ventures with local partners to be able to access the resource and benefit from it. Legal fleets generally gain access under the scope of fishing access agreements. These agreements account for a large proportion of government revenue and are crucial to the economy. The fishing agreement with the EU alone has represented around €10 million (US\$ 14 million) per year of direct revenue to the government. The presence of illegal vessels would constitute a real threat to the economy if foreign operators were to lose interest in accessing Guinean waters due to overexploitation of resources. Thus even more emphasis should be put into increasing the country's MCS capabilities.

A summary of the input values used for the model to estimate the economic losses of illegal fishing in this fishery are summarised in Table 34 and value added estimates in Table 38.

**Table 34: Summary of input data for Guinea Bissau industrial rose shrimp fishery model**

	Guinea Bissau	Foreign	Total	Source
Number of licensed vessels ( $n$ )	4 (national) 2 (chartered)	14 (Chinese) 19 (EU)	39	Ministry of Fisheries
Licence fee (US\$) ( $l$ )	59,488 (national) 54,471 (chartered)	88,843 (Chinese) 39,047 (EU)		Ministry of Fisheries. Cost in a year, taking into account fishing patterns (e.g. EU vessels take out licences for less than 1 year)
Licence fee for illegal vessels (taking account of nationality) (US\$) ( $l_{ILLEG}$ )			89,000	Based on foreign vessel operating all year
Annual production from legal vessels (tonnes) ( $C_{LEG}$ )			1,500	Ministry of Fisheries
Value per tonne (first sale) (US\$) ( $p$ )			19,052	Eurostat landings database. Average price 2004-2008.
First sale value of production (US\$) ( $V_{LEG}$ )			28,578,291	
Number employed per licensed vessel	3			Ministry of Fisheries
Number employed per illegal vessel	0			Ministry of Fisheries
Estimated proportion of illegal activity in relation to total fleet ( $a$ )			0.33	Key informants, questionnaire, Ministry of Fisheries
Number of offences detected ( $n_{DET}$ )			1	Ministry of Fisheries
Value of fine for illegal vessel if caught (US\$) ( $f$ )			200,000	Ministry of Fisheries

Table 35: Value added estimates as a proportion of catch value, Guinea Bissau industrial shrimp fishery

	Fleet	Domestic	Exported	Source of estimate
Fishing value-added	Legal fleet	0.13	0.22	FAO (2001)
	Illegal fleet	0.05	0.3	
Processing value-added	Legal fleet/catches	0	0.11	World Bank (undated)
	Illegal fleet/catches	0	0.11	

### ***Case study 2: Unlicensed artisanal vessels***

The artisanal fleet catches valuable pelagic and demersal fish species. The illegal activity having the greatest impact is large numbers of highly efficient artisanal fishing boats coming from neighbouring countries, particularly Senegal. There are several types of artisanal fishing boats yet those with the greatest capacity are the canoes. These are 12 m wooden boats with 20 to 55 hp engines which are able to remain at sea for periods of over a week. This period is generally limited by the lack of conservation capabilities of these vessels, which limit the fish conservation capacity to a maximum of 5 days. Beyond this period fish quality suffers greatly and subsequently loses a great deal of its value. The implications of illegal fishing by the artisanal fleet are:

- Some of the illegal artisanal catch is landed in Guinea Bissau, but the highest value, freshest fish, is generally landed in Senegal and exported to major markets at significantly high prices. In this case the direct value added goes to Senegal rather than to Guinea Bissau).
- It has also been reported that these fishermen are engaged in transshipping their most valuable catch across to foreign trawlers in exchange for food items, fuel and money. This is a further loss to Guinea Bissau's revenues, brought on by the extended capacity of artisanal vessels.
- Detectability of offences is low, as they operate within artisanal fishing areas with a much slimmer chance of being caught by the authorities. In addition to this, accounts of camps of foreign fishermen in remote parts of the islands have also been confirmed.
- Several conflicts between interested parties are also known to occur; some reached a worrying degree of violence which included the use of firearms (pers. comm.).

This artisanal fleet comprises several types of boats ranging from 12m long boats which have a considerable autonomy (up to 10 days at sea, essentially limited by the capacity to store fish) and great mobility, to the smaller dugouts operated by one or two fishermen. The latter are however circumscribed to near-shore areas as their operating range is very short. The larger artisanal vessels on the other hand, have a greater autonomy and an extensive fishing capacity, and as they are classed artisanal they can legally explore fish-rich areas very close to shore where highly valuable species can be found.

In order to demonstrate the impact of the illegal fleet, detailed observations and notes were taken during the country visit. Information for this sub-sector is notoriously scarce and in many cases inaccurate. For this reason in addition to the referred observations, interviews were conducted with people from all the relevant institutions, including both private and public sectors. This approach helped to improve the accuracy of the produced estimates. The proportion of illegal fishing was estimated from direct observations and reports for the artisanal fleet. All species landed in the local port were documented and photographed, and first and second sale market prices obtained from the

landing site and local market traders using a local technician to avoid prices being inflated by the presence of the consultant.

Data on the proportion of the catch landed in-country and that landed elsewhere were obtained from various reports and field observations. All other information regarding numbers of legal vessels, the licensing fees and the value of fines was obtained directly from the Ministry of Fisheries. The value added estimates were obtained from FAO (2001) and the World Bank regional value added model.

A summary of the input values used for the model to estimate the economic losses of illegal fishing in this fishery are summarised in Table 36 and value added estimates in Table 37.

**Table 36: Summary of input data for Guinea Bissau artisanal fishery model**

	Guinea Bissau	Foreign (Senegalese)	Total	Source
Number of licensed vessels ( $n$ )	862	300	1,162	Ministry of Fisheries
Licence fee (US\$) ( $l$ )	278	278		Ministry of Fisheries
Licence fee for illegal vessels (taking account of nationality) (US\$) ( $l_{ILLEG}$ )			278	
Annual production from legal vessels (tonnes) ( $C_{LEG}$ )			17,883	Ministry of Fisheries
Value per tonne (first sale) (US\$) ( $p$ )			1,150	Market vendors
First sale value of production (US\$) ( $V_{LEG}$ )			20,565,450	
Number employed per licensed vessel	3.26	6.74		Ministry of Fisheries. 5 per vessel. Takes into account 300 national vessels with Senegalese crew.
Number employed per illegal vessel	0	5		Ministry of Fisheries
Estimated proportion of illegal activity in relation to total fleet ( $a$ )			0.54	Key informants, Ministry of Fisheries, observations.
Number of offences detected ( $n_{DET}$ )			120	Ministry of Fisheries
Value of fine for illegal vessel if caught (US\$) ( $f$ )	116	1157		Ministry of Fisheries

**Table 37: Value added estimates as a proportion of catch value, Guinea Bissau artisanal fishery**

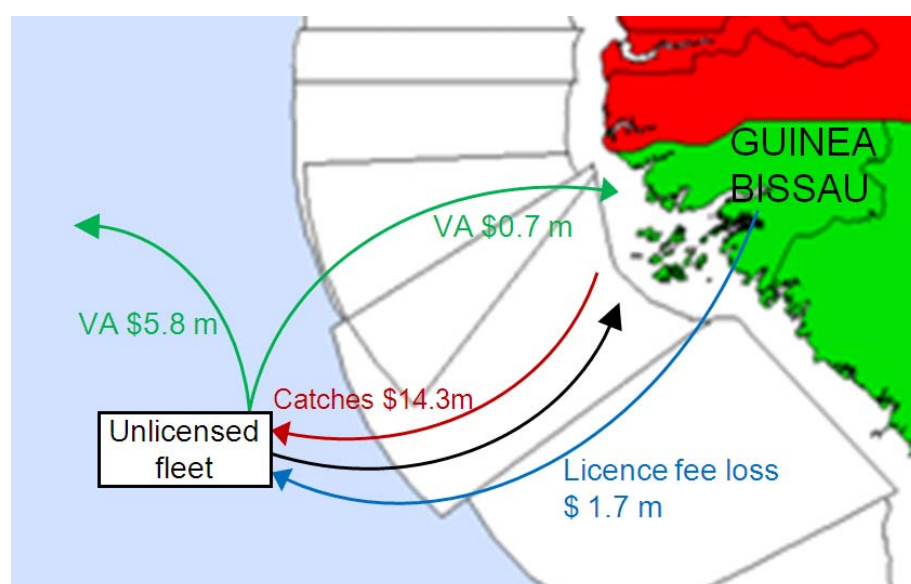
	Fleet	Domestic	Exported	Source of estimate
Fishing value-added	Legal fleet	0.273	0.357	FAO (2001). Domestic/exported split based on nationality of vessels and their catches.
	Illegal fleet	0.05	0.580	
Processing value-added	Legal fleet/catches	0.729	0.763	World Bank (undated)
	Illegal fleet/catches	0	1.492	

### 3.6.4. Direct economic losses

The economic losses generated from the illegal industrial fleet are considerable and result mainly from loss of licence fee revenue and fishing value added. Guinea Bissau has limited export capabilities mainly due to the lack of conformity with general foreign export regulations. This has an impact on the overall processing value added as exports of processed products are equally limited. The loss of processing value added due to illegal fishing is low, because none of the legal catches are processed locally. Guinea Bissau would also be able to capture more economic benefits from its fisheries if losses due to illegal fishing were reduced and if more local processing were to take place.

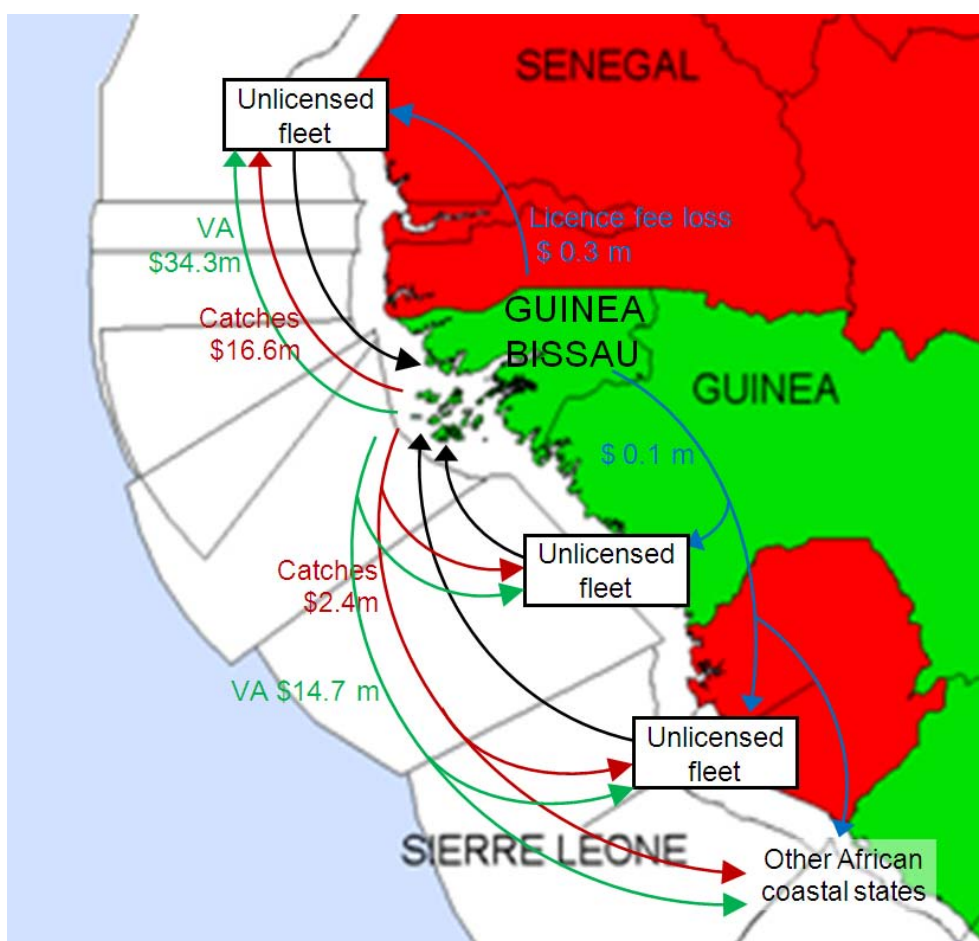
The industrial fishery also suffers from illegal fishing in prohibited zones and fishing with undersized mesh. The latter problem is investigated in the bio-economic model described in Section 4.2.

The model outputs are summarised in Table 38 and Table 39. The destination of losses and gains from illegal fishing are shown diagrammatically in Figure 7 and Figure 8.



**Figure 7: Diagram showing flows of losses from Guinea Bissau due to illegal fishing in the industrial shrimp fishery**

Note: VA = direct fishing value added plus direct processing value added. The VA flows shown in the diagram are the current losses in the base case. The values do not represent what Guinea Bissau could capture domestically if illegal fishing were controlled. This would be between \$ 1.1 million and \$ 4.6 million for Scenarios 2 and 1 respectively. This is all fishing value added, there is no processing value added as even the legal fleet does not process its catch in-country.



**Figure 8: Diagram showing flows of losses from Guinea Bissau due to illegal fishing in the artisanal fishery**

Note: VA = direct fishing value added plus direct processing value added. The VA flows shown in the diagram are the current losses in the base case. The values do not represent what Guinea Bissau could capture domestically if illegal fishing were controlled. This would be between \$ 5.3 million and \$ 9.1 million for fishing value added for Scenarios 2 and 1 respectively, and \$ 17.2 million for processing value added.



**Table 38: Model input values and current economic losses to illegal fishing in the industrial shrimp fishery in Guinea Bissau**

<b>Inputs</b>	Catch (t)	value per tonne (\$)	Gvt revenue in addition to licence fees as % of licence revenue	N. licensed vessels	Illegal vessel fine	IUU estimate	Nationals employed per legal vessel	Nationals employed per illegal vessel
	1500	19052.19403	37%	39	200000	33%	3	0
	<b>Fishing direct value added % of landed value</b>				<b>Processing direct value added % of landed value</b>			
	Legal Domestic	Legal foreign	Illegal domestic	Illegal foreign	Legal Domestic	Legal foreign	Illegal domestic	Illegal foreign
	13%	22%	5%	30%	0%	11%	0%	11%
<b>Activities</b>	Value of legal target catch (\$)	Total catch value per legal vessel (\$)	Number of nationals employed on legal fleet	Government revenue from licences (\$)	Other government revenue from legal vessels (\$)	Total number offences (est)	Estimated illegal catch target sp (t)	Total fish value loss (\$)
	28,578,291	732,777	117	2,332,589	858,393	19	749	14,267,723
<b>Tangible losses</b>	Licence fee loss (\$)	Other government losses (\$)	Value of fines from illegal vessels (\$)	Net government loss (\$)				
	1,691,000	622,288	200,000	2,113,288				
	<b>Fishing direct value added</b>				<b>Processing direct value added</b>			
<b>Value Added</b>	Legal fishing domestic	Legal fishing foreign	Illegal fishing domestic	Illegal fishing foreign	Legal processing domestic	Legal processing exported	Illegal processing domestic	Illegal processing exported
\$	3,715,178	6,287,224	713,386	4,280,317	-	3,143,612	-	1,569,449
	Domestic VA lost relative to Scenario 1	Domestic VA lost relative to Scenario 2			Domestic VA lost relative to Scenario 1	Domestic VA lost relative to Scenario 2		
\$	4,586,054	1,141,418			-	-		

**Table 39: Model input values and current economic losses to illegal fishing in the artisanal fishery in Guinea Bissau**

Inputs	Catch (t)	value per tonne (\$)	Gvt revenue in addition to licence fees as % of licence revenue	N. licensed vessels	Illegal vessel fine	IUU estimate	Nationals employed per legal vessel	Nationals employed per illegal vessel
	17883	1150	0%	1162	1157	54%	3.26	0
<b>Fishing direct value added % of landed value</b>					<b>Processing direct value added % of landed value</b>			
	Legal Domestic	Legal foreign	Illegal domestic	Illegal foreign	Legal Domestic	Legal foreign	Illegal domestic	Illegal foreign
	27%	36%	5%	58%	73%	76%	0%	149%
<b>Activities</b>	Value of legal target catch (\$)	Total catch value per legal vessel (\$)	Number of nationals employed on legal fleet	Government revenue from licences (\$)	Other government revenue from legal vessels (\$)	Total number offences (est)	Estimated illegal catch target sp (t)	Total fish value loss (\$)
	20,565,450	17,698	3788.12	323,036	-	1337	20,575	23,661,324
<b>Tangible losses</b>	Licence fee loss (\$)	Other government losses (\$)	Value of fines from illegal vessels (\$)	Net government loss (\$)				
	371,686	-	118,056	253,630				
<b>Fishing direct value added</b>					<b>Processing direct value added</b>			
<b>Value Added</b>	Legal fishing domestic	Legal fishing foreign	Illegal fishing domestic	Illegal fishing foreign	Legal processing domestic	Legal processing exported	Illegal processing domestic	Illegal processing exported
\$	5,622,354	7,337,759	1,183,066	13,728,032	14,988,380	15,699,290	-	35,307,320
	Domestic VA lost relative to Scenario 1	Domestic VA lost relative to Scenario 2			Domestic VA lost relative to Scenario 1	Domestic VA lost relative to Scenario 2		
\$	9,081,685	5,285,664			17,244,695	17,244,695		

With respect to the illegal artisanal fleet, previously reported information (Djafal, 2007) as well as accounts obtained during the country visit, suggest that the Senegalese illegal artisanal fleet is responsible for the major losses. A large volume of the valuable fish exported over to the European market originates from Guinea Bissau waters rather than from Senegal as it has been officially reported (pers. comm.). An example of this is a particular variety of snapper (*Lutjanus* spp), locally called '*bica*', commonly found in Guinea Bissau waters, that has become quite scarce in Senegal and yet is still being exported from Senegal in considerable quantities. This species in particular fetches high prices locally and in international markets. The same applies to other species such as a particular variety of grouper (*Epinephelus* spp) and the barracuda *Sphyrnaena afra*. Overall it is clear that illegal operations result in significant economic losses to the country, including losses from licence fees, direct and indirect value added, through to employment and all inherent taxes.

Both modelled scenarios have indicated significant potential benefits from eliminating illegal fishing in terms of an increase in revenue from fishing activities. Scenario 1 indicates that the removal of the illegal fleet would result in an overall increase in value added by the legal fleet of US\$ 4.6 million for the industrial fleet and US\$ 26.3 million for the artisanal fleet, whereas Scenario 2 would result in a greater increase in government revenue than Scenario 1, mainly due to the income from fishing licences and taxes (US\$ 2.1 million from the industrial sector and US\$ 0.4 million from the artisanal sector) and a lower increase in domestic VA (US\$ 1.1 million for the industrial sector and US\$ 22.5 million for the artisanal sector).

### **3.6.5. Intangible losses**

Intangible losses are difficult to estimate and result from the use of illegal fishing gear, fishing in restricted areas which are important spawning and/or nursery grounds, and the level of discards. All of the above are known to occur extensively throughout Guinea Bissau waters and potentially have a considerable impact on the overall revenue to both the government and the general population.

### **3.6.6. Social impacts**

Illegal fishing in Guinea Bissau gives rise to an extensive range of social problems; it has been reported that violent acts directly related to illegal fishing are not uncommon. Examples are clashes between Guinea Bissau nationals and the crew of Senegalese fishing vessels who regularly camp on the various islands of the Bijagos archipelago. Clashes are also known to occur between small-scale fishermen and large industrial vessels, as a result of industrial vessels damaging artisanal fishing gear and trawling within artisanal fishing areas. Several reports have been made of large industrial vessels fishing during the night (when there is no surveillance capacity) within restricted areas. This type of fishing is indeed highly destructive and known to directly affect the livelihood of a large number of people from the various coastal communities. The economic model does not take directly into account the biodiversity loss and inherent economic impact of these illegal actions. This would require an in-depth study focussed solely on this issue.

It is also important to emphasise that in general terms Guinea Bissau nationals are not traditionally fishermen; they are known to divide their activities between fishing and agriculture. An example of this is the average number of days per year that national artisanal vessels spend out at sea (estimated at around 60 days per year); the remaining time of the year being spent in agricultural activities. In light of this, it is clear that a small reduction in the CPUE will bring a strongly negative effect on the productivity of national artisanal vessels.

### **3.6.7. MCS issues**

The MCS activities in Guinea Bissau are carried out by the fisheries control and surveillance unit, *Fiscalizacao e Controlo de Actividades de Pesca* (FISCAP), which is part of the Ministry of Fisheries. FISCAP's operation is funded directly by the Ministry of Fisheries and by external donors such as the EU. In fact most of the surveillance fleet was acquired directly or indirectly with these funds. The surveillance fleet is reduced and its operational range very limited. It comprises two 18-metre patrol vessels with autonomy for three days at sea and a crew of 8 men, a smaller 15-metre patrol vessel with similar autonomy and 3 smaller rapid-reaction boats with powerful outboard engines. The latter have, however, a very limited range of action as they only operate in full daylight and are not prepared, in terms of facilities and equipment, to allow the crew spend the night at sea. In addition to the limited range, all these rapid-reaction boats are extremely fuel-demanding as a result of their powerful engines (average 160 hp). This is an extremely relevant issue since fuel shortages are common in the country, even at governmental level. Anecdotal reports suggest that due to the overall fuel scarcity and frequent shortages, whenever FISCAP buys fuel to operate its fleet, the whole fishing community knows about it, especially because it buys large quantities. This gives the opportunity for the people on land to communicate with fishing crews at sea and warn them about the surveillance presence or intention. This clearly has had an effect on the overall success (detection rate of infractions) of the various surveillance operations. In addition to this, several other problems were also identified and confirmed by ministerial staff, namely:

- Weak institutional coordination, i.e. deficiencies in the coordination of surveillance operations between the ministries of Fisheries, Defence, Justice, the Fisheries Research Institute (CIPA), etc.;
- Weak management of the fining process, often cancelled without apparent reason;
- Inadequate management of the revenue generated from fines;
- Poor surveillance mission programmes;
- Weak compliance to the operational strategy;
- Lack of transparency in the chain of command;
- Lack of an autonomous funding mechanism to support the surveillance operations;
- Weak budget compliance and lack of budgetary planning;
- Significant delays in the payment of salaries and expenses of MCS staff (delays of up to 6 months), fuelling institutional corruption;
- Weak qualification of MCS and support staff;
- MCS operatives have inadequate access to updated information on fishing licences; crews are often sent to joint sub-regional missions without updated information;
- Inexistence of a fine standardisation scheme, value of fines appears to be random;
- Large distance of the surveillance means from the 12 nm base line, Bissau city sits 60 nm from the 12 nm base line;
- Inexistence of a long-term strategic plan for the development and sustainability of national maritime surveillance.

In 2006, the two 18-metre patrol vessels accomplished a total of 60 days at sea each. Yet, up until the beginning of 2006 only one vessel was operational (no information on how long the other was out of service for). The repairing of the vessel was jointly funded by the EU and the African Development Bank (ADB).

### **3.6.8. *Proposals for tackling illegal fishing***

No proposal has been directly submitted by Guinea Bissau, but during the in-country visit a number of options were described.

Tackling illegal fishing involves activities that require expensive technical means which are not available in Guinea Bissau. Capacity is insufficient and all its surveillance missions are inherently limited in scope and to a restricted area, i.e. close to the coast. A large future investment and a great deal of coordination are needed to bring MCS capabilities in Guinea Bissau to desirable levels. Meanwhile, effort is being made in order to optimise the use of existing means. In order to do so the government has drawn attention to some of the issues identified above in section 4.4.1.

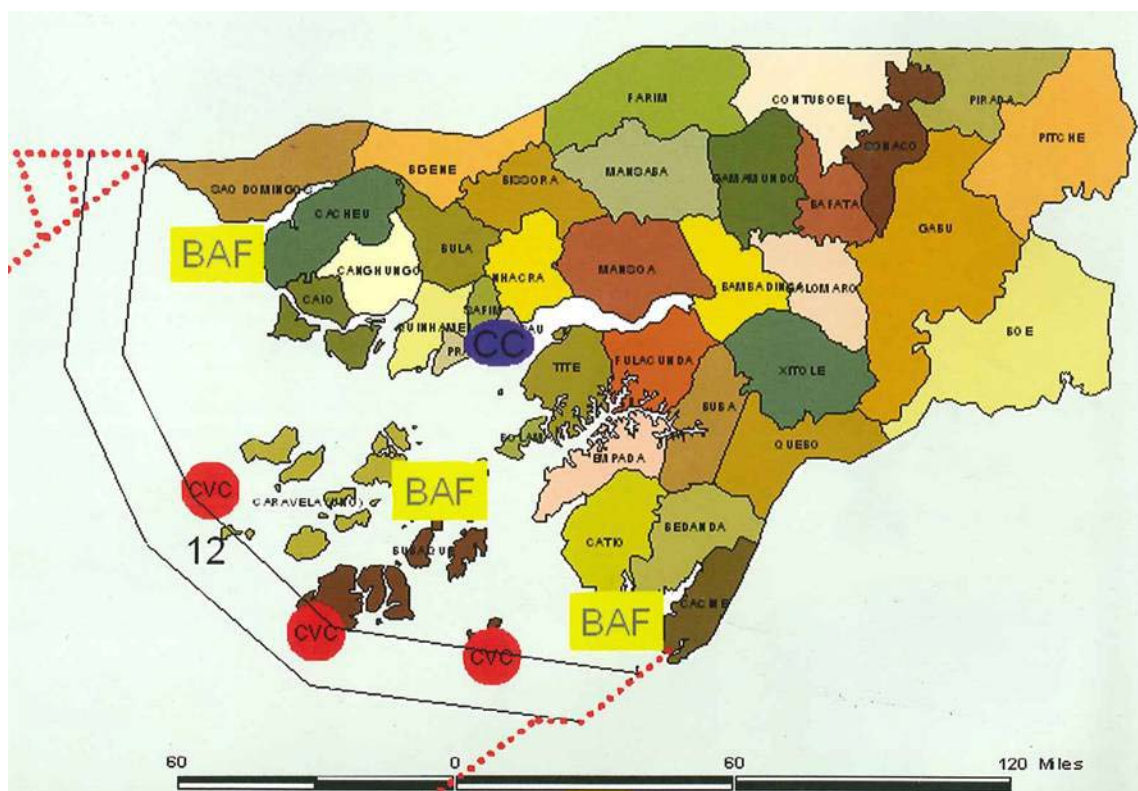
In order to help the local government tackle problems in the management of the fishing industry and help maximise the overall benefits from the fisheries resources, international donors such as the World Bank, EU and individual European countries (France, Spain and Portugal) have been funding several programmes ranging from biodiversity (World Bank) to ecosystem and coastal management. Yet despite the continuous efforts no effective results have come to fruition with respect to improving the current situation, indeed further efforts involving a great deal of grassroots work are still needed in order to achieve this goal. Emphasis should be given to the critically-needed work to help form a solid basis to improve the sustainability of the fishery and the management system. During the country visit it was possible to perceive the vast problems resulting from the poor coordination of actions involving the various management parties (government, surveillance, research, prosecution, etc.) and the subsequent magnification of the problem resulting from the lack of overall capacity. Further investment in capacity building is greatly needed to improve the management and its robustness.

During recent months, government officials have focussed on MCS issues in order to improve them, particularly (a) problems related to the chain of command, (b) the fining procedures and (c) the financial autonomy of FISCAP. These issues were addressed as follows: regarding the chain of command, all operations are now coordinated solely by FISCAP through its director; with respect to the fine management, a legal department was created within FISCAP to deal with the legal procedures and processing of the fines; and concerning FISCAP's financial status and autonomy, it has now been given a higher degree of autonomy and is able to operate with a greater degree of freedom from the Ministry, nonetheless, an action plan and operational strategy still have to be submitted to the Minister for coordination with other ministries and for general approval.

With respect to the issues related to the distance of the existing surveillance base (Bissau) to the 12 nm base line (a total distance of over 60 nm), a decentralisation process is in course to mitigate the effect of distance on the efficiency of the surveillance operations. The decentralisation process consists of deploying further means of Surveillance in Advanced Bases (BAF) in Cacheu, Bubaque and Bolama (Figure 9) which are closer to important fishing grounds. Also under discussion is the creation of Coastal Surveillance Centres (CVCs) located in the islands Joao Vieira, Caravela and Orangozinho (Figure 9). These centres will be provided with MCS equipment including radars and rapid-reaction boats. The greater proximity of these centres to the actual fishing grounds allows a quicker and more efficient interception of potentially illegal fishing boats. Only rapid-reaction boats would be used at the CVCs.

To optimise the overall efficiency of the surveillance effort in Guinea Bissau, further capacity building and qualification courses should be provided to the MCS staff and various other acting parties ranging from producers' organisations to ministerial staff. The EU has provided some funding for this purpose nevertheless further capacity building initiatives are needed.

In general terms it is clear that without the financial help and technical support from other surrounding nations, Guinea Bissau will struggle to meet the national MCS requirements. As such, government officials welcome a concerted sub-regional approach which should involve shared means and expertise.



**Figure 9 Location of the Advanced Surveillance Bases (BAF), Coastal Surveillance Centres (CVC) and Surveillance Headquarters (CC) in Guinea-Bissau.**

### 3.7. Guinea

Although questionnaires were sent to contacts in Guinea, no responses were received, and the study did not allow a country visit by the consultants. However, given the importance of the country, and the generally very high levels of illegal fishing that are reported in its waters, a preliminary model was developed based on the model for the Guinea Bissau artisanal fishery.

Guinea is a very productive fishing area, the upwelling from the Canary Current creating favourable conditions for small pelagics. It also has a broad shelf of over 100 nm breadth providing trawling grounds for demersal fishes as well as cephalopods, which are currently much sought-after. The EEZ also extends into the northern equatorial tuna belt in regions where the valuable yellow fin tends to predominate.

The national catch is between 90,000–110,000 tonnes per year including an artisanal catch of 48,500 tonnes (Kelleher, 2002). The commercial catch has been recorded at 72,357 tonnes (2001) or more generally at 54,000 (Kelleher 2002). Fisheries generally provide around 1.3% of GDP.

#### 3.7.1. Description of the illegal fishing problem

Guinea is acknowledged to have considerable problems with IUU fishing. A comparative survey by the LuxDev project showed the level of illegal fishing in Guinea to be the highest of all neighbouring countries at around 60%. The industrial fishery contains around 200 licensed vessels, depending on the number of licences each year, only about 20 of which are flagged in Guinea. The same industrial

illegal fishing problems are reported from Guinea as from Guinea Bissau (unlicensed industrial fishing, illegal transshipment, fishing with small mesh nets and in areas reserved for artisanal fisheries; MRAG, 2005) and by implication we assume similar problems as Guinea Bissau for the artisanal fishery.

Due to a lack of data from Guinea, we were not able to model the industrial illegal fishing losses. However, due to the importance of the country and the general perception in the region that the main impact of illegal fishing is from the artisanal fleets, we constructed our model based on the Guinea Bissau artisanal model with an appropriate adjustment for catch value, catch volume and proportion of illegal fishing. The value added and export proportions were the same as for Guinea Bissau.

Results are shown in Table 56.

## **3.8. Sierra Leone**

### **3.8.1. General description of the fisheries**

The continental shelf in Sierra Leone extends out around 100km in the North (Yeliboya) and only 13km in the South (Sulima). With a coastline of about 560km, it is estimated that the shelf covers an area of approximately 25,000 km<sup>2</sup>. The coastline is characterised by the presence of extensive mangrove swamps, bays and large estuarine areas which are notoriously rich in biodiversity, including several valuable species which form the basis of the national fishing industry. The fishing industry in Sierra Leone comprises two major sub-sectors:

- The artisanal or small scale sub-sector which operates in estuaries and coastal waters extending from the shoreline to a depth of 60 m. Fishermen use a variety of boats, from dugouts to planked canoes, and employ a diverse range of fishing gears including gillnets, driftnets, beach seines, long lines and hooks. This fishery significantly contributes to total national fish production and food security. It has been estimated that the sub-sector contributes well over 75% of total national fish supplies, employing directly and indirectly over 200,000 people, and sustains the growth of the sector.
- The industrial sector which is highly mechanised and operates in deeper waters. These comprise large vessels including trawlers, shrimpers, long liners, canoe support vessels (mother ship) and carriers, and the fishery is ultimately oriented for exports.

The vast majority of the industrial fishing vessels are owned by foreign companies which currently dominate the industrial sub-sector. These are mainly shrimp and demersal finfish trawlers with GRT between 75–200 and 100–300 tonnes, respectively. In addition to these there are a few larger vessels, with GRT between 1,000–3,000, which include tuna purse seiners and long-liners.

The total number of artisanal fishing boats increased from around 6,000 in the late 1970s, to approximately 8,000 in 2003, yet the total number of outboard engines has not followed the same rate of increase. Indeed it declined approximately 2% and is now estimated at 8% in total. The artisanal vessels range from 5–15 meters length with between 1 and 16 crew. The main gears used are handlines, driftnets, gillnets, beach seines, ringnets, and longlines.

Not all coastal areas in Sierra Leone are open to fishing. The Ministry has created an Inshore Exclusion Zone (IEZ) that is restricted to artisanal fishing operations. Yawri Bay is considered a major breeding ground and an important nursery area for both pelagic and demersal species. It is thus crucial to conserve the biodiversity and richness in natural resources at this location. Nonetheless,

despite surveillance efforts this bay is still being targeted by a great number of illegal fishermen and poachers.

### 3.8.2. Legal framework and key regulatory issues

National fisheries legislation provides for penalties for all different infractions (Table 40) yet their detectability is still low (Table 41), since the implementation of the law requires a great deal of surveillance effort which is not readily available in the country.

Illegal foreign fleets rely on the fact that Sierra Leone does not have an effective surveillance capacity. The Fisheries Ministry is fully aware of these activities and acknowledges the fact that the EEZ's outer reaches remain virtually open to illegal fishing and piracy (see Table 41 for the list of most common infractions).

With respect to the artisanal or small-scale fleet, records show that around one third of the vessels regularly engage in illegal fishing, especially by operating in closed areas. Since 2006 over 30% of the fleet has been arrested for breaking the fishing ban within the channel area.

**Table 40 Types of infraction, detectability and surveillance effort and legislation.**

Infraction type	Detectability and application of the law	Legislation
Fishing without license	Requires a great surveillance effort to detect this type of infraction. It is necessary to intercept each fishing vessel to request the documents that prove that they are entitled to fish within national waters and/or the EEZ.	Supplement to the Sierra Leone Gazette Vol. CXXV. No. 58 Dated 8 <sup>th</sup> December 1994. The Fisheries (Management and Development) Decree, 1994
Fishing with unauthorised gear / techniques	Requires a great surveillance effort to detect this type of infraction. It is necessary to intercept each fishing vessel and carry out inspections to the fishing gear. This involves a certain degree of technical expertise from the patrolling staff as well as appropriate equipment (e.g. mesh measuring gauges).	Supplement to the Sierra Leone Gazette Vol. CXXV. No. 58 Dated 8 <sup>th</sup> December 1994. The Fisheries (Management and Development) Decree, 1994
Fishing in closed/restricted areas/times	Easier surveillance task as it is not necessary to differentiate between vessels. Interception only necessary if vessels are caught fishing within closed areas or during a closure.	Supplement to the Sierra Leone Gazette Vol. CXXV. No. 58 Dated 8 <sup>th</sup> December 1994. The Fisheries (Management and Development) Decree, 1994
Catching/landing of prohibited species	Easier surveillance task as it only requires inspections at port. It does not require expensive physical means.	Supplement to the Sierra Leone Gazette Vol. CXXV. No. 58 Dated 8 <sup>th</sup> December 1994. The Fisheries (Management and Development) Decree, 1994
Unauthorised transshipment	Very difficult task to survey. It generally occurs at high seas. It not only involves expensive means but it poses complex legal issues as it is necessary to prove the origin of the catch. Extremely difficult application of the regulation.	Supplement to the Sierra Leone Gazette Vol. CXXV. No. 58 Dated 8 <sup>th</sup> December 1994. The Fisheries (Management and Development) Decree, 1994
Hiding/ disguising/ misreporting a vessel's identity	Requires a great surveillance effort to detect this type of infraction. It is necessary to intercept each fishing vessel to request the documents prove their identity.	Supplement to the Sierra Leone Gazette Vol. CXXV. No. 58 Dated 8 <sup>th</sup> December 1994. The Fisheries (Management and Development) Decree, 1994
Failure to report daily activities/allow observer to relay	It is difficult to monitor catches even if there is an observer on board. It is know that in the majority of cases the mandatory presence of a national observer on board has more to do with an attempt to provide employment to national	Supplement to the Sierra Leone Gazette Vol. CXXV. No. 58 Dated 8 <sup>th</sup> December 1994. The Fisheries (Management and Development)



reports	fishermen rather than carry out full monitoring tasks of the activity.	Decree, 1994
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Source: Questionnaire (Ministry of Fisheries and Marine Resources, MFMR)

**Table 41: Major infractions and level of detectability in Sierra Leone**

	Industrial fisheries	Artisanal fisheries
Surveillance effort	From 2006 to date 12 vessels were inspected.	From 2006 to date 51 vessels were inspected.
Type of infraction	Number of detected infractions (detectability; action)	Number of detected infractions (detectability; action)
Fishing without licence	6 did not have licence and/or observers (low detectability; it requires active intervention of the fisheries patrol; actions hampered by the lack of physical means)	12 did not have licence (low detectability; it requires active intervention of the fisheries patrol; actions hampered by the lack of physical means)
Violating IEZ	2 arrested for violating the IEZ fishing ban (high detectability, vessels can be spotted from shore; intervention needed for interception and arrest; actions hampered by the lack of physical means)	1 arrested for violating the IEZ fishing ban (high detectability, vessels can be spotted from shore; intervention needed for interception and arrest; actions hampered by the lack of physical means)
Ban on channel fishing violation	No record	23 were arrested for breaking ban on channel fishing (high detectability, vessels can be spotted from shore; intervention needed for interception and arrest; actions hampered by the lack of physical means)

Source: Questionnaire (MFMR)

### 3.8.3. Case study descriptions

Two case studies were chosen for Sierra Leone, one industrial and one artisanal.

#### **Case study 1: industrial shrimp fishery**

One of the main species targeted by the illegal fleet is the rose shrimp (*Parapenaeus longirostris*) which fetches high prices in international markets. Shrimp has been chosen as an example of a valuable fishery product, widely sought after by illegal operators, to illustrate the economic impact of illegal industrial fishing in Sierra Leone. This fishery is known to generate large revenues to both the country in terms of licences, fishing agreements and in added value, as well as to individual operators. In terms of revenue, for six years from 2001 to 2005, exports yielded an annual average of US\$ 7.8 million (Sierra Leone, Ministry of Fisheries Bulletin, 2006).

Along with shrimp, several other demersal species are also targeted, namely Sparids and *Epenephelus* spp. which also attain high prices. The fish species are however, caught considerably closer to shore than the deepwater shrimp, as such illegal boats are also more prone to being detected than those that operate further offshore. There are several reports of foreign vessels being arrested by carrying out fishing operations close to shore and not possessing any sort of fishing licence to operate in Sierra Leone.

In addition to the illegal fleet, legal vessels are also known to engage in illegal activities such as using unauthorised fishing gear or fishing in closed areas. During the last five years, 15 shrimp and finfish bottom trawlers (largely Chinese and Korean) have been arrested (all with valid licences) because

they were operating within the Inshore Exclusion Zone (IEZ) which is restricted to artisanal and recreational fisheries. These industrial vessels were mainly targeting coastal shrimp resources (*P. notalis* and *P. kerathurus*) and inshore demersal fish species (*Pseudolithus* spp, *Galeiodes decadactylus* and *Pomadasyss* spp.) often using illegal mesh sizes, i.e. smaller than 42 mm.

Mesh size is also a common offence even by fully licensed boats. Indeed, Sierra Leone's Navy has, during the same five-year period, arrested five vessels (Chinese and Korean) as they were using bottom-trawl nets with an illegal codend mesh size (minimum mesh size is 42mm for shrimp and 60mm for demersal fish trawlers).

It has been estimated that legal shrimp trawlers catch around 1,300 tonnes per year with the catch comprising mainly of *Parapenaeus longirostris*, *Penaeus notialis*, *Parapenaeopsis atlantica* and *Penaeus kerathurus*. In addition to shrimp, trawlers also catch croakers (*Pseudolithus* spp) and threadfin (*Galeodes decadactylus*). According to the most recent biomass estimates (Fridjof Nansen Survey, 2007) and based on current unit prices, the fishery was valued at US\$ 23.7 million. It has, however, been noted that the potential yield may be considerably underestimated as many coastal areas were not surveyed due to the research vessel's inability to operate in waters shallower than 20 m.

Our model uses value added estimates from FAO (2001) and World Bank (undated). We assumed 33% illegal activity for the industrial fleet.

A summary of the input values used for the model to estimate the economic losses of illegal fishing in this fishery are summarised in Table 42 and value added estimates in Table 43.

**Table 42: Summary of input data for Sierra Leone industrial shrimp fishery model**

	Sierra Leonean	Foreign	Total	Source
Number of licensed vessels ( $n$ )	2 (SL) 14 demersal fish trawlers (all nationalities)	23 (Chinese & Korean) 2 (EU/SL)	41	MFMR. Demersal fish trawlers included because they also catch shrimp.
Licence fee (US\$) ( $l$ )	26,667 (SL) 13,333 (fish trawlers)	22,000 (Chinese & Korean) 20,000 (EU/SL)		MFMR. Based on GRT and number of months fishing
Licence fee for illegal vessels (taking account of nationality) (US\$) ( $l_{\text{ILLEG}}$ )			22,000	MFMR
Annual production from legal vessels (tonnes) ( $C_{\text{LEG}}$ )			1,300	MFMR
Value per tonne (first sale) (US\$) ( $p$ )			8,500	
First sale value of production (US\$) ( $V_{\text{LEG}}$ )			11,050,000	
Number employed per licensed vessel	8			
Number employed per illegal vessel	0			
Estimated proportion of illegal activity in relation to total fleet ( $a$ )			0.33	
Number of offences detected ( $n_{\text{DET}}$ )			2	MFMR
Value of fine for illegal vessel if caught (US\$) ( $f$ )			200,000	MFMR

**Table 43: Value added estimates as a proportion of catch value, Sierra Leone industrial shrimp fishery**

	Fleet	Domestic	Exported	Source of estimate
Fishing value-added	Legal fleet	0.13	0.22	FAO (2001)
	Illegal fleet	0.05	0.3	
Processing value-added	Legal fleet/catches	0	0.11	World Bank (undated)
	Illegal fleet/catches	0	0.11	

### **Case study 2: artisanal fishery**

The artisanal fishery in Sierra Leone suffers from the same problems as that in Guinea Bissau – large numbers of unlicensed vessels illegally fishing in inshore waters originating from other countries in the sub-Region, and particularly from Guinea. Our correspondent reports that from 2006 to date, out of 51 inspections, 12 did not have a licence (24%), 32 (45%) were arrested for breaking the ban on channel fishing violation and 21.5% were engaged in smuggling. We assumed overall 30% illegal fishing in the artisanal fleet based on the questionnaire data (above) and Table 7, most of which is exported. As with Guinea Bissau, the licence fee for a national artisanal vessel is very low and fines are also reported to be low. Our model uses value added estimates from FAO (2001) and World Bank (undated).

A summary of the input values used for the model to estimate the economic losses of illegal fishing in this fishery are summarised in Table 44 and value added estimates in Table 45.

**Table 44: Summary of input data for Sierra Leone artisanal fishery model**

	Sierra Leonean	Foreign	Total	Source
Number of licensed vessels ( $n$ )	1,910 (artisanal vessels) 6,032 (dugouts)	15	7,957	MFMR
Licence fee (US\$) ( $l$ )	46 (artisanal) 19 (pirogues)	1000		MFMR
Licence fee for illegal vessels (taking account of nationality) (US\$) ( $l_{ILLEG}$ )			1000	MFMR
Annual production from legal vessels (tonnes) ( $C_{LEG}$ )			34,851	MFMR
Value per tonne (first sale) (US\$) ( $p$ )			450	
First sale value of production (US\$) ( $V_{LEG}$ )			15,683,148	
Number employed per licensed vessel	2.96	0.01131		Based on 2 per dugout, 6 per artisanal vessel. Nationals on national vessels and foreigners on foreign fleet
Number employed per illegal vessel	2.96	0.01131		
Estimated proportion of illegal activity in relation to total fleet ( $a$ )			0.3	MFMR, Questionnaire
Number of offences detected ( $n_{DET}$ )			12	MFMR MCS records
Value of fine for illegal vessel if caught			0	No information

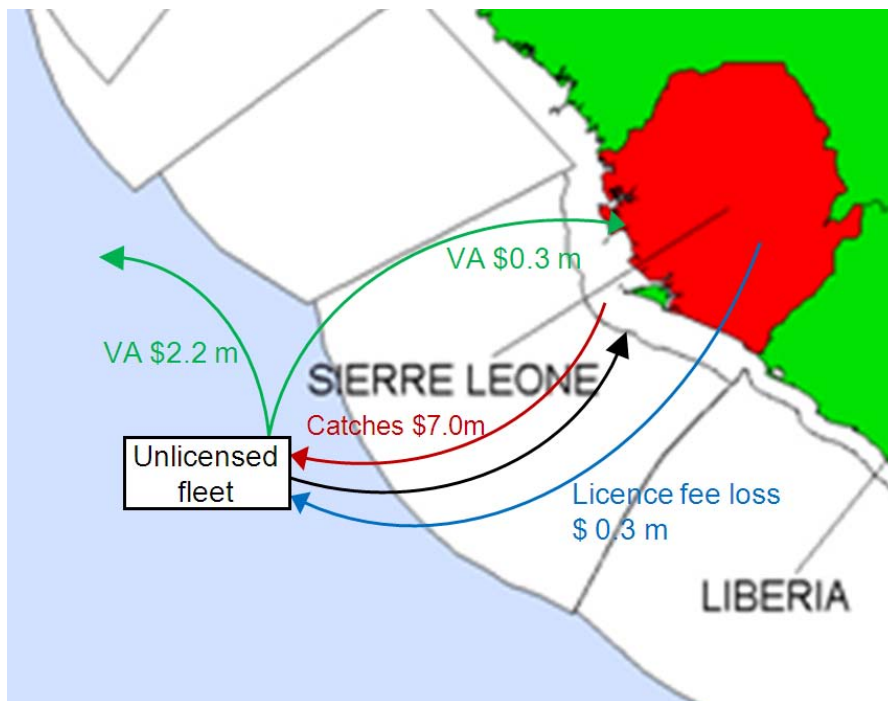
(US\$) (f)				available
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**Table 45: Value added estimates as a proportion of catch value, Sierra Leone artisanal fishery**

	Fleet	Domestic	Exported	Source of estimate
Fishing value-added	Legal fleet	0.6474	0.0026	FAO (2001)
	Illegal fleet	0.6474	0.0026	
Processing value-added	Legal fleet/catches	1.2953	0.0047	World Bank (undated)
	Illegal fleet/catches	1.2953	0.0047	

### 3.8.4. Direct economic losses

The results show a similar pattern to that observed for Guinea Bissau. Should there be an intensification of surveillance and a subsequent reduction/elimination of illegal fishermen, revenues generated by each individual vessel would increase, if on the other hand all the illegal operators were to be licensed, government revenues would increase considerably as a result of the income generated from licensing, taxes and value added. However, Sierra Leone is still unable to meet the required standards to reach more demanding or tightly regulated markets and therefore is unable to maximise the benefits from its resources. The results suggest considerable losses for the industrial fishery – US\$ 2.2 million lost in value added – and gains for the artisanal fishery (US\$ 15 million in value added). The model outputs are summarised in Table 46 and Table 47. The destination of losses and gains from illegal fishing are shown diagrammatically in Figure 10 and Figure 11.



**Figure 10: Diagram showing flows of losses from Sierra Leone due to illegal fishing in the industrial shrimp fishery**

Note: VA = direct fishing value added plus direct processing value added. The VA flows shown in the diagram are the current losses in the base case. The values do not represent what Senegal could

capture domestically if illegal fishing were controlled. This would be between \$ 0.4 and 1.7 million for fishing value added for Scenarios 2 and 1, respectively (no processing value added).



**Figure 11: Diagram showing flows of losses from Sierra Leone due to illegal fishing in the artisanal sector**

Note: VA = direct fishing value added plus direct processing value added. The VA flows shown in the diagram are the current losses in the base case. The values do not represent what Senegal could capture domestically if illegal fishing were controlled. This would be \$ 2.8 million for fishing value added in Scenario 1 (no processing value added).

**Table 46: Model input values and current economic losses to illegal fishing in the industrial shrimp fishery in Sierra Leone**

Inputs	Catch (t)	value per tonne (\$)	Gvt revenue in addition to licence fees	N. licensed vessels	Illegal vessel fine	IUU estimate	Nationals employed per legal vessel	Nationals employed per illegal vessel
	1300	8500	2903	41	200000	33%	8	0
	<b>Fishing direct value added % of landed value</b>				<b>Processing direct value added % of landed value</b>			
	Legal Domestic	Legal foreign	Illegal domestic	Illegal foreign	Legal Domestic	Legal foreign	Illegal domestic	Illegal foreign
	13%	22%	5%	30%	0%	11%	0%	11%
Activities	Value of legal target catch (\$)	Total catch value per legal vessel (\$)	Number of nationals employed on legal fleet	Government revenue from licences (\$)	Other government revenue from legal vessels (\$)	Total number offences (est)	Estimated illegal catch target sp (t)	Total fish value loss (\$)
	11,050,000	345,610	328	786,000	290,280	20	640	6,979,254
Tangible losses	Licence fee loss (\$)	Other government losses (\$)	Value of fines from illegal vessels (\$)	Net government loss (\$)				
	297,660	142,974	400,000	40,634				
	<b>Fishing direct value added</b>				<b>Processing direct value added</b>			
Value Added	Legal fishing domestic	Legal fishing foreign	Illegal fishing domestic	Illegal fishing foreign	Legal processing domestic	Legal processing exported	Illegal processing domestic	Illegal processing exported
\$	1,436,500	2,431,000	272,127	1,632,761	-	1,215,500	-	598,679
	Domestic VA lost relative to Scenario 1	Domestic VA lost relative to Scenario 2			Domestic VA lost relative to Scenario 1	Domestic VA lost relative to Scenario 2		
\$	1,749,387	435,403			-	-		

**Table 47: Model input values and current economic losses to illegal fishing in the artisanal fishery in Sierra Leone**

Inputs	Catch (t)	value per tonne (\$)	Gvt revenue in addition to licence fees as % of licence revenue	N. licensed vessels	Illegal vessel fine	IUU estimate	Nationals employed per legal vessel	Nationals employed per illegal vessel
	34851	530	0%	7957	0	30%	2.96	2.96
<b>Fishing direct value added % of landed value</b>				<b>Processing direct value added % of landed value</b>				
	Legal Domestic	Legal foreign	Illegal domestic	Illegal foreign	Legal Domestic	Legal foreign	Illegal domestic	Illegal foreign
	65%	0%	65%	0%	130%	0%	130%	0%
Activities	Value of legal target catch (\$)	Total catch value per legal vessel (\$)	Number of nationals employed on legal fleet	Government revenue from licences (\$)	Other government revenue from legal vessels (\$)	Total number offences (est)	Estimated illegal catch target sp (t)	Total fish value loss (\$)
	18,471,263	2,321	23,553	214,452	369,425	1642	14,936	7,932,201
Tangible losses	Licence fee loss (\$)	Other government losses (\$)	Value of fines from illegal vessels (\$)	Net government loss (\$)				
	44,254	158,644	-	202,898				
<b>Fishing direct value added</b>				<b>Processing direct value added</b>				
Value Added	Legal fishing domestic	Legal fishing foreign	Illegal fishing domestic	Illegal fishing foreign	Legal processing domestic	Legal processing exported	Illegal processing domestic	Illegal processing exported
\$	11,957,953	48,368	5,124,837	20,729	23,925,580	87,062	10,253,820	37,312
	Domestic VA lost relative to Scenario 1	Domestic VA lost relative to Scenario 2			Domestic VA lost relative to Scenario 1	Domestic VA lost relative to Scenario 2		
\$	2,759,528	-			-	-		

### 3.8.5. Intangible losses

The intangible losses resulting from fishing with highly damaging gear (small mesh size) or by vessels fishing in protected areas, are complicated to obtain and would require an in-depth study with much more data. Currently-available data are not sufficient to provide coherent estimates. Further work into this matter is advisable, emphasising that for example fishermen in small coastal communities using mosquito nets to catch fish fry and small-sized shrimp are having a far-reaching impact on the natural population of the targeted resources by contributing to a drastic reduction in standing stock biomass. This is particularly true for species whose early stages develop close to shore or in estuarine environments.

No conclusions can be drawn from the available data as to the intangible losses for the analysed fisheries.

### 3.8.6. Social impacts

Illegal fishing usually contributes to unsustainable impacts on both target species and the ecosystem. This is likely to reduce productivity, biodiversity and ecosystem resilience. This in turn is likely to lead to a reduction in food security for artisanal fishers. This is particularly important in those communities which are heavily dependent on fish as a source of animal protein.

Direct conflicts between illegal and other fishery users often occur. Kelleher (2002) reports that in some West African states there is conflict between industrial and artisanal fishermen, especially

where fishing grounds are narrow and close to shore. Conflict between artisanal and illegal industrial vessels is common in Sierra Leone, because 'fishing activity is concentrated in the inshore areas, i.e., on the continental shelf which narrows to a thin band towards the Liberian border. In this area trawlers frequently fish to within 100 meters of the shoreline. The main shrimp ground is in Yawri Bay, off Banana Island, and offshore from several important artisanal fishing villages. Gear conflicts between artisanal fishermen and trawlers are frequent as the trawlers fish inshore at night and damage the unmarked fishermen's nets.'

Conflicts between illegal industrial and artisanal or semi-artisanal fishers are particularly prevalent in shrimp fisheries in West Africa. Conflicts may be direct (vessels running others down) or indirect (removing all available fish or shrimp), the former often leading to accidents, death and injury amongst artisanal and other local inshore fishers which in itself will have economic and social consequences for fishers and their families.

The incidence of armed resistance to surveillance and enforcement operations appears to be increasing. Countries vulnerable to illegal fishing tend to be those with poorer governance structures and law enforcement generally. Illegal fishing further undermines the rule of law and other social values, and can also have an effect on gender issues (Table 48).

**Table 48: Impacts of illegal fishing on social parameters**

PARAMETER	INDICATORS	IMPACTS
Nutrition and food security	Availability of fish on local markets at affordable prices.	In some cases IUU fishing through its negative impact on fish stocks and availability may have a detrimental impact on the availability of fish, an important source of protein in some countries.
Conflicts with local artisanal fleets	Incidences recorded of conflict between IUU fishing vessels and local fishing fleets.	Increased health and safety risks because of conflicts between the artisanal and industrial fleets. Loss of family/ community cohesion and workforce through conflict.
Employment	Employment rates in marine fishing communities	IUU fishing may lead to lower employment if it has a negative impact on stocks and the activities of artisanal and local coastal fishing activities. Less opportunities for new generations of fishers to participate in fishing
Household incomes	Gross and net household incomes	IUU fishing through conflicts with local fishing fleets and by over exploitation of certain species may lead to reduction in household incomes and therefore exacerbate poverty. Possible negative impacts on income distribution.
Gender issues	Employment of women in fishing and fish marketing	IUU fishing may have a negative impact on shore fishing by women and on the marketing opportunities for women who in many societies have an important role in basic fish processing and marketing.

### **3.8.7. MCS issues**

The government of Sierra Leone has fully acknowledged the various IUU problems the country is currently facing. Indeed, the surveillance means are scarce and clearly insufficient to cover the whole EEZ as well as patrolling artisanal fisheries which operate closer to shore. The MFMR recognises that effective MCS is crucial for efficient and responsible management of the sector and has implemented a series of actions to tackle the problem, yet these are clearly insufficient and illegal fishing is still being reported.



The measures devised by the government to tackle IUU include placing fisheries observers on all licensed vessels, for the industrial sub-sector, and having observers or sampling staff at landing sites for monitoring purposes. Control is carried out by research institutions, such as the Institute of Marine Biology and Oceanography and the University of Sierra Leone, and is based on scientific information, namely fishing effort, mesh size, catch composition, etc. Monitoring and control are activities which have been consistently carried out throughout the years and have yielded satisfactory overall results, however these activities are more focussed on the UU (unreported and unregulated fishing) problem.

In addition to these, surveillance activities are required to tackle illegal fishing problems. These activities are, however, considerably more complex and involve the use of expensive means, i.e. surveillance vessels or patrol boats and duly trained staff. For this purpose the Ministry has signed a Memorandum of Understanding with the Sierra Leone Navy to run surveillance operations, by making available 3 cutters for inshore operations and a long-range patrol boat. Due to the scarcity of resources, the Navy combines fisheries with security patrols, yet fisheries inspections are carried out by assigned fisheries personnel who are taken on board for these particular operations. There are however substantial limitations to the reach of these operations, namely:

- the limited autonomy of the surveillance vessels which compromises the reach of the patrolling operations, rendering them ineffective to provide a good coverage of the EEZ;
- limited number of days at sea due to tight financial restraints;
- inadequate training of personnel.

To curb some of these problems, the government has, in the past, made contractual arrangements with private companies to carry out these operations yet all initiatives have failed and proven highly impractical. Sierra Leone has also benefited from the Luxemburg-funded Aerial Surveillance Programme that was implemented jointly with sea-borne operations however this programme was brought to a halt in the late 1990s. More recently the African Development Bank has provided, through the Artisanal Fisheries Development Project, funding to carry out close-to-shore surveillance operations, and despite limited funding, the number of reported illegal fishing operations has declined, nonetheless more needs to be done to bring illegal fishing down to a level which causes no impact on the fisheries and livelihoods of local fishing communities. Indeed as these last results were particularly encouraging, the government has set up the Joint Maritime Authority (JMA) to coordinate combined fisheries and security patrols. The full implementation details of this scheme are still being discussed but should be ready in the near future.

## 4. INTANGIBLE ECONOMIC LOSSES TO ILLEGAL FISHING

### 4.1. Adjustments due to recovering fish stocks

In addition to the economic losses, several of the infractions identified in the study also create intangible losses:

- unlicensed fishing and illegal extractions cause stocks to be overexploited;
- fishing in prohibited coastal zones causes overfishing of coastal resources;
- fishing in prohibited marine areas causes environmental damage;
- fishing with illegal mesh sizes causes growth overfishing in fish stocks.

In most cases where demersal stocks are overexploited the current catch is estimated to be higher than MSY. This implies that no additional advantage will be obtained in terms of catches as the stock recovers. However, if a stock does recover it will increase its biomass, and this can be expressed as a gain in fishing value added (since fixed costs will not increase, profits will increase). The increase in fishing value added is unlikely to be in direct proportion to the increase in biomass. However, it is worth noting that some species (eg *Pseudolithus*) have significant recovery potential. Taken as a whole, the average increase in stock size that might be expected would be in the region of 10-20%.

**Table 49: Estimates of stock status in the region**

Country	Sub-group/Stock	State	Catch (tonnes)	MSY (tonnes)	Fcur/Fsy curB (%)	B/BMSY (%)	Potential for biomass increase
Demersals (All catches in 2002 except: * = 2001, ** = 1999)							
Morocco & Mauritania	Dentex macrophthalmus	Fully exploited	3761	6316	89	158	
Mauritania	Merluccius polli	Fully exploited	14038*	15209	97	78	28%
Morocco & Mauritania	Pagellus bellottii	Fully exploited	5918	5499	131	143	
Morocco & Mauritania	Sparus spp.	Fully exploited	3397	5187	79	141	
Mauritania, Senegal & Gambia	Epinephelus aeneus	Risk of extinction	1803	292	2296	15	567%
Senegal & Gambia	Merluccius senegalensis	Moderately exploited	2398*	4189	64	68	47%
Senegal & Gambia	Arius spp.	Uncertainty in the evaluation	12536	-	-	-	
Senegal & Gambia	Pagellus bellottii	Fully exploited	8375	10657	93	140	

Senegal & Gambia	Pseudolithus spp.	Overexploited	4807	3121	612	13	669%
Guinea	Arius spp.	Overexploited	8812*	6411	139	112	
Guinea	Cynoglossus spp.	Overexploited	7469*	2518	317	74	35%
Guinea	Galeoides decadactylus	Fully exploited	4836*	1735	279	101	
Guinea	Pomadasys spp.	Overexploited	2011*	1554	182	46	117%
Guinea	Pseudolithus elongatus	Uncertainty in the evaluation	9975*	-	-	-	
Guinea	Pseudolithus spp.	Fully exploited/in danger of overexploitation	8528*	7610	113	110	
Guinea	Sparidés	Overexploited	7397*	6349	127	72	39%
Sierra Leone	Arius spp.	Uncertainty in the evaluation	771	-	-	-	
Sierra Leone	Cynoglossus spp.	Uncertainty in the evaluation	633	-	-	-	
Sierra Leone	Galeoides decadactylus	Uncertainty in the evaluation	752	-	-	-	
Sierra Leone	Pomadasys spp.	Uncertainty in the evaluation	495	-	-	-	
Sierra Leone	Pseudolithus elongatus	Uncertainty in the evaluation	3234	-	-	-	
Sierra Leone	Pseudolithus spp.	Uncertainty in the evaluation	1633	-	-	-	
Sierra Leone	Sparidés	Uncertainty in the evaluation	796	-	-	-	
Shrimp (All catches in 2002 except: * = 2001, ** = 1999)							
Mauritania	Parapenaeus longirostris	Fully exploited	1828	2049	89	98	2%
Mauritania	Penaeus notialis	Fully exploited	2049	2351	108	144	
Senegal & Gambia	Parapenaeus longirostris	Fully exploited in data up to 1999	1424**	2559	56	112	
Senegal & Gambia	Penaeus notialis	Inconclusive use of data until 1999	2689**	-	-	-	
Guinea-Bissau to Angola	Parapenaeus longirostris	Not evaluated due to lack of data	-	-	-	-	
Guinea	Penaeus notialis	Overexploited	950*	498	205	74	35%
Sierra Leone	Penaeus notialis	Fully exploited	1188	3000	89	174	

Cephalopods (All catches in 2002 except: * = 2001, ** = 1999)							
Stock Senegal- Gambia	Octopus vulgaris	Uncertainty in the evaluation	2126*	-	-	-	
Senegal- Gambia	Sepia spp.	Overexploited	1089	2680	142	58	72%
Guinea	Sepia spp.	Overexploited	5820*	5093	206	33	203%
Pelagics (All catches in 20039)							
Mauritania (zone C stock)	Sardina pilchardus (sardine)	underexploited	121000		81	215	
Mauritania - Senegal – Gambia	Sardinella aurita	fully exploited	270000		122	93	8%
Mauritania - Senegal – Gambia	Sardinella sp	fully exploited	130000		105	100	
Mauritania - Senegal – Gambia	Trachurus trecae	underexploited	100000		52	122	

Source: CECAF, 2006.

The status of demersal resources in Guinea Bissau was also examined by an IMROP survey (Diop *et al.*, 2004) which suggested that demersal yield could be as high as 77,000 tonnes (currently demersal catches are 39,000 tonnes in Guinea Bissau). These results suggest a much healthier position for the resources than suggested by the CECAF assessments for neighbouring countries Guinea and Senegal.

Both the issues of the potential gains from generating recovery, and from removing growth overfishing, are approached through a case study of the Guinea Bissau rose shrimp fishery.

## 4.2. Guinea Bissau rose shrimp study

### 4.2.1. Introduction

The deep-water rose shrimp *Parapenaeus longirostris* (Lucas, 1846) is distributed in the eastern Atlantic from the north of Spain to the south of Angola and throughout the whole Mediterranean (Olaso, 1990). The resource is targeted by a large fishing fleet in eastern Atlantic waters off the south of Spain and Portugal off Morocco, Mauritania, Senegal, Guinea Bissau, Gabon and Angola (Deval *et al.*, 2006). In Guinea Bissau, rose shrimp is targeted by bottom trawl gears by both national and international fleets, including Chinese and EU vessels (Table 1).

Table 50: Number of licensed vessels and landings of rose shrimp in Guinea Bissau in 1992

Fleet nationalities	Chinese	EU	National	Afretado	Overall
Number of licensed vessels	14	19	4	2	39
Av. GRT of vessel	196	147	233	158	174
Av. months fishing	11	7	12	10	9
Annual landings (tonnes)					1500

Source: Ministério das Pescas, Economia Marítima, Guinea-Bissau.

Although the current status of the stock is unknown, both industry and expert opinions suggest that the stock is fully exploited and likely to be experiencing growth overfishing. This is attributed mainly to the illegal fishing activities by both licensed and unlicensed vessels. It has been reported that a large number of operators have been using illegal mesh sizes of around 20mm while the legal requirement is 55mm.

The aim of this case study is to assess the economic impacts of illegal fishing of rose shrimp in Guinea Bissau using a spreadsheet-based Thomson and Bell bioeconomic model.

#### 4.2.2. Material and methods

There were 39 licensed trawlers operating in the waters of Guinea-Bissau in 1992. Catch and effort data of trawlers were collected from the Guinea-Bissau Ministry of Fisheries (*Ministério das Pescas*), Maritime Economy Department. The price of rose shrimp was obtained from the price at first sale in European markets (Eurostat landings database).

The economic impacts of illegal fishing activities, particularly the use of illegal mesh size for the deep water shrimp were analysed using the BEAM (Bio-Economic Analytical Model), developed by FAO. The underlying biological model is an age-based yield per recruit model of Thompson and Bell (1934). It is a spreadsheet-based simulation model, which allows assessing the impact of changes in management regimes on different classes of fishers.

The inputs data required include fishing efforts; trawl catchability coefficient<sup>10</sup>; natural mortality; asymptotic length; curvature (growth) coefficient, trawl selection parameter, and recruitment number at zero age<sup>11</sup> (Table 51). Due to the absence of both commercial and scientific fishing data in Guinea Bissau, the biological and technical parameters were taken from peer-reviewed papers and fisheries reports on similar fisheries targeting the same species in different geographic areas. Although most of the parameters available were estimated in the Mediterranean waters, we assume that those parameters are transferable to *P. longirostris* in West African waters, including Guinea Bissau.

10 Due to the lack of commercial fisheries data in Guinea Bissau, it is not possible to calculate the actual catchability coefficient for the deep trawl nets in Guinea Bissau. Therefore, the catchability coefficient estimated to as those required to achieve a fishing mortality of  $F = 0.9$  ( $F_{max}$ ) (1.26 including unlicensed fleet's fishing effort) and  $F = 1.8$  based on available literature, assuming that the species is fully or overexploited.

11 The recruit number at zero age was estimated as when the estimated catches from the observed efforts were the same as the observed catches (1,500 tonnes for licensed fleet).

**Table 51: Input parameters**

Input Parameters			
Fishing effort - licensed with legal mesh	X (L)	7,500	boat-days
Fishing effort - licensed with small mesh	X (Liuu)	5,000	boat-days
Fishing effort - illegal bottom trawl	X(IUU)	5,000	boat-days
Catch. coefficient	q(L)	1.029E-04	
Nat. mort. coef. -males	M(m)	1.20	/yr.
Nat. mort. coef. -females	M(f)	1.20	/yr.
Recruit no. at zero age -sexes combined	R(m)	900,795	'000
Asympt. carapace length - males	$L_{\infty}$ (m)	38	mm.
Curvature coef - males	K(m)	0.65	/yr.
Age at zero length - males	to(m)	-0.15	yr.
Asympt. carapace length - females	$L_{\infty}$ (f)	46.0	mm.
Curvature coef - females	K(f)	0.75	/yr.
Age at zero length - males	to(f)	-0.01	yr.
Carapace length/weight coef. - males	a(m)	0.00028	
Carapace length/weight coef. - females	a(f)	0.00056	

*Trawl gear selectivity parameters*

There are several studies on trawl gear selectivity and the effect of mesh size for rose shrimp *P. longirostris* in waters off the Mediterranean and Eastern Atlantic coasts. Sobrino *et al.* (2000) studied the effects of mesh size changes on the rose shrimp fishery off the gulf of Cádiz (SW Spain) based on research vessels' and commercial fishing vessels' surveys. Campos *et al.* (2002) analysed the effects of mesh size and configuration from diamond to square mesh on the capture of rose shrimp off the Portuguese south coast. More recently, Deval *et al.* (2006) studied the Turkish twin rigged beam trawl fishery, and Ragonese & Bianchini (2006) studied in Sicilian waters. While a comprehensive review of selectivity parameters for different *P. longirostris* stocks is beyond the scope of our case study, we selected the parameters from Sobrino *et al.* (2000) due to the availability of parameters for wide range of mesh size.

**Table 52: Gear selectivity parameters**

	55mm	25mm	20mm
CL25	19.2	10.0	8.5
CL50	23.7	10.4	8.8
CL75	28.1	10.9	9.2
a=	5.82	25.84	22.85
b=	0.25	2.48	2.60

Source: Sobrino *et al* 2000 (values for 20mm were estimated using CL50 for mesh size 60 mm).

### Estimation of trawl net selectivity

The bottom trawl net selectivity parameters<sup>12</sup> with 25 mm and 55mm mesh were taken from Sobrino *et al.* (2000). 20mm mesh selectivity parameters were estimated by using their reported SF value for mesh size 60mm. Based on the lengths of 25%, 50% and 75% retention (CL25, CL50, CL75), gear selectivity for rose shrimp was calculated by finding the different age class corresponding to the different length, using the inverse Von Bertalanffy growth function:

$$t(L) = t_0 - \frac{1}{K} \ln \left( 1 - \frac{L}{L_{\infty}} \right) \quad (1)$$

where  $t$  is the age,  $L_{\infty}$  is the maximum possible size,  $K$  is the rate of growth.

The selection curve for rose shrimp was then calculated by:

$$S_{Lest} = \frac{1}{1 + \exp(a - bL)} \quad (2)$$

where  $a$  is the intercept and  $b$  is the slope of the selection curve, respectively. By applying the mean CL in the equation above, gear selectivities at different age classes were calculated.

### Baseline assumptions

The total fishing effort of licensed vessels is reported to be 12,500 boat-days in 1992. The information on how many vessels are using illegal mesh is limited to anecdotal estimates, but we assume that about 40% (5,000 boat-days) of them use illegal mesh size (20 mm) and the rest use legal mesh size.

We considered three types of fleet targeting rose shrimp: 1) licensed boats using legal mesh size; 2) licensed boats using illegal mesh size; and 2) unlicensed boats using illegal mesh size. All unlicensed boats use small mesh size (20mm) and their effort is assumed to be 5,000 boat-days, equivalent to 40% of the licensed effort.

We assume that the landing price of rose shrimp caught by small mesh size is 10% lower (\$27,000/tonne) than the legal landing price of \$30,000/tonne. This is because, in general, the larger shrimp gets a higher market price than the smaller shrimp. Besides, the shrimp caught by a very small mesh tend to be of lower quality due to the damage during the fishing operation.

Other assumptions include:

- Fixed costs (\$225,000/boat/year) and trip costs (\$802.5/boat/day) are the same for both licensed and unlicensed boats regardless of the mesh size;
- Number of crew members per boat (6 persons) is also the same for both groups;
- The rose shrimp stock is assumed to be fully exploited, and likely to be experiencing growth overfishing (fishing mortality is at  $F_{max}$  or higher).

### **4.2.3. Resource management scenarios**

We considered the following four scenarios as alternative to the current (baseline) resource management.

- Scenario 1:** Removing all illegal fishing activities including unlicensed vessels and the use of illegal mesh by the licensed fleet. Under this scenario, one can reduce the juvenile mortality with proper mesh size as well as an overall reduction in fishing effort. Possible benefits include: more adult animals in the catch composition and an overall increase in catch volumes; higher revenue due to the price premium from larger shrimp; and possibly larger future stock due to increased numbers of recruitment, and higher reproductive success.
- Scenario 2:** Converting unlicensed boats to licensed boats. All operators use legal mesh. Under this scenario, overall effort remains the same, but juvenile mortality will be reduced.
- Scenario 3:** Removing the unlicensed fleet. The use of illegal mesh by the licensed fleet continues. Under this scenario, overall fishing mortality will be reduced and higher catch per unit effort may be possible with increased overall biomass. Moreover, discard of non-targeted fish would be halted, and the stocks of non-targeted fish may increase (although it is not included in our model).
- Scenario 4:** Converting unlicensed boats to licensed, but the use of illegal mesh continues. Under this scenario, there will be no intangible benefits because overall fishing mortality and juvenile mortality remain the same. Discarding of non-targeted fish may be stopped (they will be landed) but their fishing mortalities remain the same.

### **4.2.4. Results**

The total catch, including both the licensed and unlicensed fleets' catches, increased by between 53% and 82% from the baseline. Significant gains in profit can be achieved in Scenario 1 and Scenario 2, between 150% and 200% depending on whether fishing mortality is assumed to currently be 1.26 or 1.8. These results suggest that very considerable increases in profit would accompany the adherence to the legal mesh size (Scenario 2), but even larger increases in profitability would attend the recovery of the stock implied by the removal of illegal catches in Scenario 1.



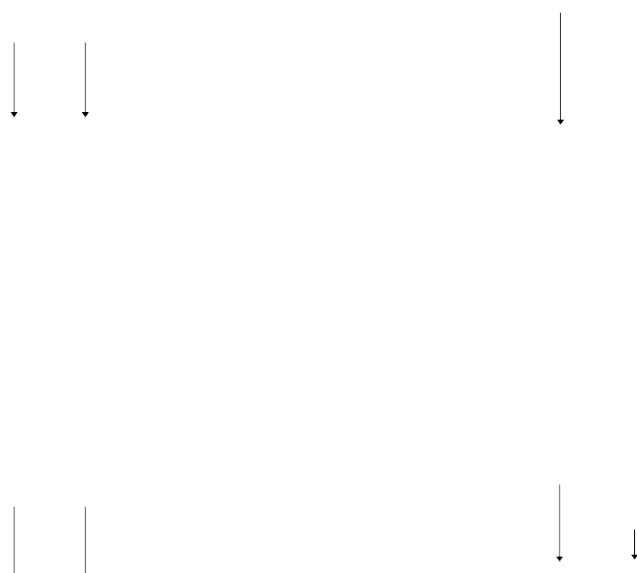
**Table 53: Scenario summary, F=1.26**

	Baseline	Scenario1	Scenario2	Scenario3	Scenario4
F=1.26					
Effort (boat-days):					
Licensed, legal mesh	7,500	12,500	17,500	7,500	7,500
Licensed, small mesh	5,000	0	0	5,000	10,000
Unlicensed, small mesh	5,000	0	0	0	0
Licensed Total	12,500	12,500	17,500	12,500	17,500
Grand Total	17,500	12,500	17,500	12,500	17,500
Catch (tonnes):					
Licensed, legal mesh	699	2,476	2,728	1,141	699
Licensed, small mesh	801	0	0	1,183	1,601
Unlicensed, small mesh	801	0	0	0	0
Licensed Total	1,500	2,476	2,728	2,324	2,301
Grand Total	2,301	2,476	2,728	2,324	2,301
Profit (US\$ million/year)					
Licensed, legal mesh	6	43	42	17	6
Licensed, small mesh	11	0	0	19	21
Unlicensed, small mesh	11	0	0	0	0
Licensed Total	17	43	42	37	28
Grand Total	28	43	42	37	28
Potential gain for licensed fleet					
Catch	0%	65%	82%	55%	53%
Catch per unit effort	0%	65%	30%	55%	10%
Profit	0%	154%	148%	115%	62%
Profit per unit effort	0%	154%	77%	115%	16%

**Table 54: Scenario summary, F=1.8**

	Baseline	Scenario1	Scenario2	Scenario3	Scenario4
F=1.8					
Effort (boat-days):					
Licensed, legal mesh	7,500	12,500	17,500	7,500	7,500
Licensed, small mesh	5,000	0	0	5,000	10,000
Unlicensed, small mesh	5,000	0	0	0	0
Licensed Total	12,500	12,500	17,500	12,500	17,500
Grand Total	17,500	12,500	17,500	12,500	17,500
Catch (tonnes):					
Licensed, legal mesh	652	2,934	3,088	1,219	652

Licensed, small mesh	848	0	0	1,375	1,697
Unlicensed, small mesh	848	0	0	0	0
Licensed Total	1,500	2,934	3,088	2,593	2,348
Grand Total	2,348	2,934	3,088	2,593	2,348
Profit (US\$ million/year)					
Licensed, legal mesh	5	55	51	19	5
Licensed, small mesh	12	0	0	24	23
Unlicensed, small mesh	12	0	0	0	0
Licensed Total	17	55	51	43	29
Grand Total	29	55	51	43	29
Potential gain for licensed fleet					
Catch	0%	96%	106%	73%	57%
Catch per unit effort	0%	96%	47%	73%	12%
Profit	0%	224%	203%	153%	69%
Profit per unit effort	0%	224%	116%	153%	21%



**Figure 12: Yield curves for the four scenarios**

## 5. CONCLUSIONS

### 5.1. Regional analysis

The results of the individual case studies are summarised in Table 55. Our estimates of illegal artisanal catch are probably more representative of the total illegal losses from the artisanal fishery in the region than are our estimates of losses from the industrial fishery. This is because most of our artisanal case studies dealt with the whole of the artisanal fleet in a country, and we have augmented this by estimates made for The Gambia and Guinea.

Our approach with The Gambia and Guinea has been relatively simple, since we did not have good case studies in these countries. We have simply taken the total estimated artisanal catch in these countries, applied the levels of illegal fishing estimated for those countries in section 3.2, applied appropriate prices per tonne based on the catch composition reported above and used the Guinea Bissau artisanal model inputs for domestic/exported and value added calculations. Our results are not, therefore, as robust as those for the case study countries. Nevertheless, they do allow us to examine the region as a whole (Table 55).

The value added (fishing and processing) lost from countries in the region as a result of illegal fishing totals US\$ 82 million, 90% as a result of illegal fishing in the artisanal fisheries. However, not all of this value added would necessarily accrue to the countries in the region if the illegal activity were eliminated, because the countries currently do not capture all the value added from the legal fleets. However, there are still substantial gains to be had from controlling illegal fishing, either by eliminating the illegal vessels and allowing the legal vessels to catch what is currently being caught by the illegal fleets (assumed to be possible with no extra inputs/intermediary consumption) — this would result in a total value added gain of US\$ 71 million for the countries — or US\$ 42 million if the illegal vessels are licensed and operate within the parameters of the current legal fleet. It should be noted that whilst the potential gains from scenario 1 (excluding the illegal vessels) appear considerably higher than scenario 2 (licensing the illegal fleet), in practice the legal vessels would likely have to fish more to increase their catches, therefore the difference in potential gain between the two scenarios is probably less. Furthermore, whilst eliminating illegal fishing — particularly the artisanal illegal fishing — would result in net gains for the individual countries, because much of the benefits from this illegal activity accrue within the region, some countries (particularly Senegal) would suffer a substantial loss as a result.

In Table 57 we explore these regional flows of fish. Using the case studies and assumptions about the origin of illegal industrial and artisanal vessels we estimate where the exported value added (fishing and processing) will end up. The total value added accruing to a country is the sum of the domestic value added from the illegal activity and the imported value added from other countries. For instance, we assume that all the exported illegal artisanal catch taken in Mauritania is landed in Senegal, and all the exported illegal industrial catch taken over the region is lost to international distant water fishing nations.

The results of this analysis suggest that of the total illegal artisanal value added taken in the region (\$ 356 million), 89% of it stays in the sub-Region, and most of it ends up in Senegal (65%). Only 11% of total illegal artisanal value added is exported, we estimate, to African countries further south and east. On the other hand, all the industrial illegal exported value added is lost from west Africa. The reason this appears to be a relatively low figure (\$8 million) is that this is only for our relatively limited set of case studies. These flows are shown schematically in Figure 13.

**Table 55: Summary of case studies**

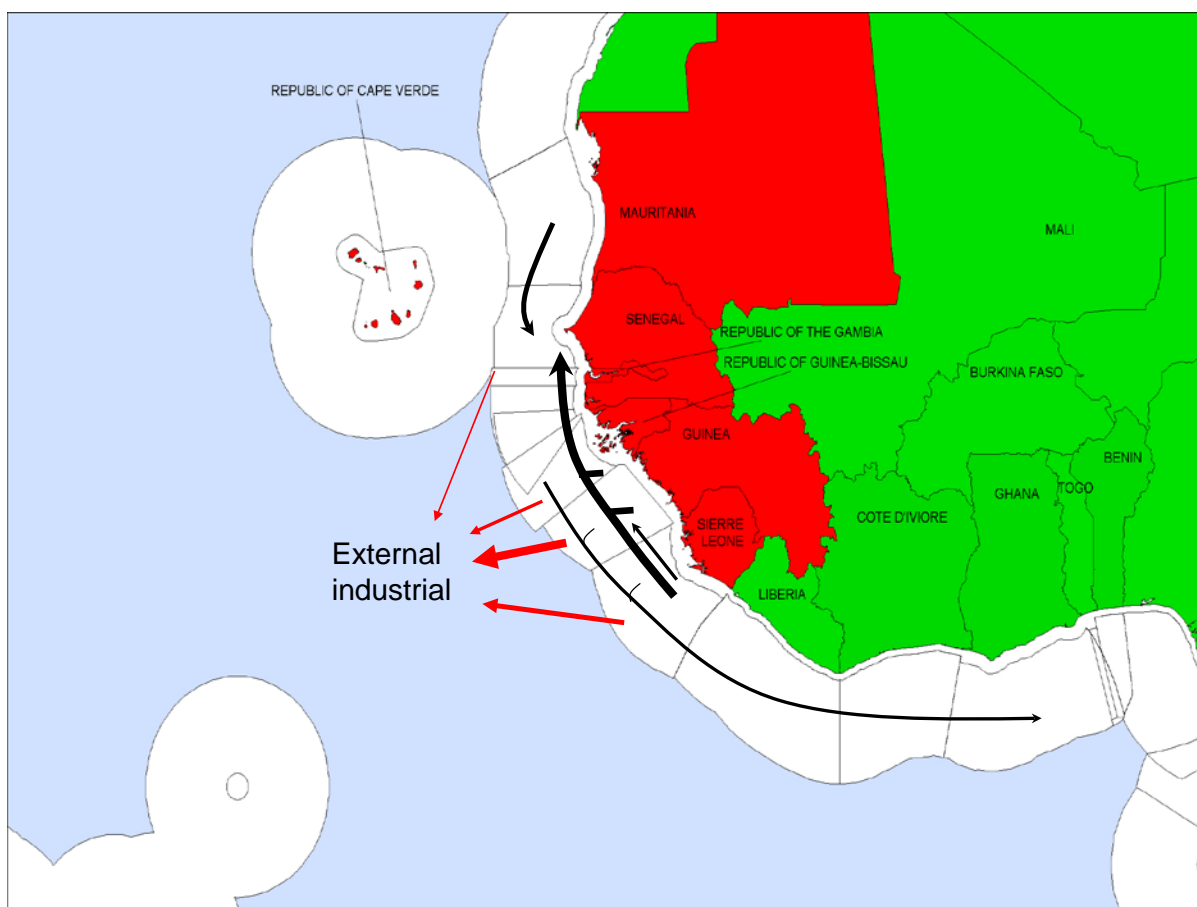
Case study	Characterisation of the problem				Legal activity				Losses to illegal activity						
	No. Licensed vessels	Fine (\$)	Number of detected offences	Estimate of illegal activity	Annual reported catch (t)	Price per tonne (\$)	Value of legal catch (\$million)	Domestic VA (legal and illegal) (\$million)	Value of illegal catch (\$million)	Loss in Government Revenue (\$millions)	Domestic illegal VA	Illegal lost (exported) VA (\$million)	Lost domestic VA relative to Scenario 1 (\$million)	Lost domestic VA relative to Scenario 2 (\$million)	Lost employment of nationals due to illegal activities
Mauritania artisanal m	4322	2119	0	14.0%	80,000	1,081	86	52.2	14.1	1.4	0.0	22.9	21.4	17.8	1,965
Senegal artisanal sma	720	100	0	30.0%	429,568	166	71	56.1	30.6	0.0	71.9	1.5	11.2	0.0	-
Senegal artisanal shri	4551	100	0	30.0%	4,299	4,744	20	20.4	8.7	0.1	12.7	0.4	2.0	0.0	-
Guinea Bissau artisan	1162	1157	120	53.5%	17,883	1,150	21	6.8	23.7	0.3	1.2	49.0	26.3	22.5	4,359
Sierra Leone artisanal	7957	0	12	30.0%	34,851	530	18	17.1	7.9	0.2	15.4	0.1	2.8	0.0	-
Senegal industrial demersal	132	15000	3	5.0%	17,000	1,379	23	5.7	1.2	0.1	0.3	0.2	0.9	0.0	-
Guinea Bissau industr	39	200000	1	33.3%	1,500	19,052	29	4.4	14.3	2.1	0.7	5.8	4.6	1.1	57
Sierra Leone industria	41	200000	2	33.0%	1,300	8,500	11	1.7	7.0	0.0	0.3	2.2	1.7	0.4	160
Total artisanal					566,601		217	153	85	2	101	74	64	40	6,324
Total industrial					19,800		63	12	22	2	1	8	7	2	217
Combined total					586,401		280	164	107	4	102	82	71	42	6,541

**Table 56: Estimated calculations for Guinea and The Gambia**

Fishery	Characterisation of the problem				Legal activity				Losses to illegal activity						
	No. Licensed vessels	Fine (\$)	Number of detected offences	Estimate of illegal activity	Annual reported catch (t)	Price per tonne (\$)	Value of legal catch (\$million)	Domestic VA (legal and illegal) (\$million)	Value of illegal catch (\$million)	Loss in Government Revenue (\$millions)	Domestic illegal VA	Illegal lost (exported) VA (\$million)	Lost domestic VA relative to Scenario 1 (\$million)	Lost domestic VA relative to Scenario 2 (\$million)	Lost employment of nationals due to illegal activities
Gambia artisanal	2000	0	0	10.0%	30,000	500	15	4.2	1.7	0.0	0.1	3.5	1.9	1.6	222
Guinea artisanal	2000	0	0	60.0%	48,500	1,150	56	19.4	83.7	0.8	4.2	173.4	93.1	79.7	9,780

**Table 57: Estimates of the destination of value added losses**

Losses from:	Illegal domestic VA (\$m)	Illegal exported VA (\$m)	Mauritania	Senegal	The Gambia	Guinea Bissau	Guinea	Sierra Leone	Other African Coast	Inter national
<b>Value Added Losses</b>										
Mauritania artisanal mixed fishery	0	22.9		1.0						
Senegal artisanal small pelagic	71.9	1.5					1.0			
Senegal artisanal shrimp	12.7	0.4			0.3	0.3	0.3			
Guinea Bissau artisanal	1.2	49.0		0.7			0.1	0.1	0.1	
Sierra Leone artisanal	15.4	0.1		0.4		0.1	0.2		0.3	
Guinea artisanal	4.2	173.4		0.5		0.1		0.2	0.2	
Gambia artisanal	0.1	3.5		1.0						
<b>Total artisanal losses</b>	<b>105.4</b>	<b>250.8</b>								
Senegal industrial demersal	0.3	0.15								1.0
Guinea Bissau industrial shrimp	0.7	5.8		0.0						1.0
Sierra Leone industrial shrimp	0.3	2.2		0.0						1.0
<b>Total industrial losses</b>	<b>1.3</b>	<b>8.2</b>								
<b>Value Added Gains</b>										
Domestic illegal VA				84.9	0.1	1.9	4.2	15.7		
Imported illegal VA				147.4	0.1	17.5	6.6	39.6	39.6	8.2
<b>Totals</b>	<b>106.7</b>	<b>259.1</b>	<b>0.0</b>	<b>232.3</b>	<b>0.2</b>	<b>19.4</b>	<b>10.8</b>	<b>55.2</b>	<b>39.6</b>	<b>8.2</b>



**Figure 13: Schematic representation of illegal catch flow within West Africa. Black represents artisanal catches, red represents industrial. The size of the arrows is roughly indicative of the size of catch flow.**

## 5.2. MCS issues

The status of MCS was only a peripheral concern of this study. Most of the information on MCS is readily obtainable from reports such as Kelleher (2002) and MRAG (2005).

Efforts to tackle illegal activities have been made at a sub-regional level, coordinated by the CSRP based in Dakar (Senegal). As part of the strategy to mitigate the illegal fishing problem, conjoint sub-regional fisheries patrols have been undertaken in all the CSRP countries (Mauritania, Senegal, Gambia, Cape Verde, Guinea Bissau, Guinea Conakry and Sierra Leone). These operations have yielded positive results as several vessels were arrested as they were caught fishing with no licence. Yet again, all these operations are severely hampered by the lack of means and financial resources. The following sections describe in more detail MCS problems related to each specific country.

This study has identified that in the north of the CSRP area, illegal fishing by industrial vessels has been brought under control, although legal vessels may still fish with illegal gear and in prohibited areas on occasion. In the south, however, industrial vessels are still often fishing in prohibited areas and with prohibited nets. This leads to depression of fish stocks and growth overfishing, clearly shown by the general state of demersal resources in the south. The benefits of dealing with this problem are clearly illustrated in Section 4.

One area of illegal fishing that has attracted relatively little attention until recently is the large amount of illegal fishing by artisanal fleets. These fleets fish without licences and controls, and are also using undersized mesh. Unlike the illegal industrial activities, however, the fish generally remain within the region, contributing added value at least within the region. Although artisanal fishers in all of the countries of the sub-region appear to be engaged in some level of illegal fishing, the majority appear to be landing into Senegal to supply the very active export market from Senegal.

Domestic laws are inadequate in some cases to deal with registration and licensing of artisanal vessels, and MCS services are overwhelmed by the very large numbers of highly mobile artisanal vessels. Clearly the southern countries within the sub-region require assistance with MCS capacity to deal with both industrial and artisanal fishing, which would yield significant benefits.

### 5.3. Potential gains from solving the IUU fishing problem

Table 58 gives a summary of all the analyses presented in the report. Clearly significant gains can be made to sub-Regional countries if illegal fishing is eliminated. These gains are expressed both in monetary terms and in qualitative terms. The gains expressed from solving industrial fishing are not good global estimates because the case studies cover only a small proportion of the total industrial illegal fishing in the region, albeit chosen because of their major significance as high value important fisheries.

Our models show that government revenue is maximised by licensing the illegal fleet; governments in the region could raise an extra US\$ 4 million in revenue from licensing the illegal fleets. However, the maximum societal gain would be realised by scenario 1 (excluding illegal vessels, with a value added gain of US\$ 71 million) compared to the alternative scenario of licensing illegal vessels (value added gain of US\$ 42 million) (Table 57). Adopting scenario 1 would have the additional advantage of reducing capacity of the fleets, which is currently causing many of the stocks to be fished beyond sustainable limits. Note, further, that these calculations of monetary gains have been made only from a subset of countries and fisheries in the area; additional gains would be realised if IUU fishing and overcapacity were eliminated in all fisheries and in all countries of the region equally.

**Table 58: Summary of the gravity of illegal fishing problems in the sub-Region, and the benefits of their solution. Green = low level or no problem; yellow = intermediate level problem; red = high level of problem.**

	Unlicensed fishing		Illegal transshipments	Illegal gear (undersized mesh)		Fishing in closed area	
	Industrial	Artisanal	Industrial	Industrial	Artisanal	Industrial	Artisanal
<b>Mauritania</b>		Part of the Senegalese fleet is unlicensed		Illegal mesh used in the shrimp fishery	Illegal mesh used in the shrimp, demersal and small pelagic fisheries		Fishing in Banc D'Argun national park
<b>Senegal</b>		Some incursion by other country fleets, most landed in Senegal			Illegal mesh used in the shrimp, demersal and small pelagic fisheries	Fishing in artisanal areas	

<b>Gambia</b>				no information	no information	no information	no information
<b>Guinea Bissau</b>	Unlicensed foreign vessels, or foreign vessels licensed by other regional countries	Artisanal vessels from Senegal and elsewhere in the region	Foreign vessels transshipping at sea	Illegal mesh used in the shrimp fishery	Illegal mesh used in the demersal and small pelagic fisheries	Fishing in areas preserved for artisanal fishers and in the national park	Fishing in national park by foreign artisanal vessels
<b>Guinea Conakry</b>	Unlicensed foreign vessels, or foreign vessels licensed by other regional countries	Artisanal vessels from Senegal and elsewhere in the region	Foreign vessels transshipping at sea	no information	no information	no information	no information
<b>Sierra Leone</b>	Unlicensed foreign vessels, or foreign vessels licensed by other regional countries	Artisanal vessels from Senegal and elsewhere in the region	Foreign vessels transshipping at sea	Illegal mesh used in the shrimp fishery	Illegal mesh used in the inshore demersal fishery	Fishing in areas preserved for artisanal fishers	
<b>Legal problems</b>	Legislation is adequate	Legislation is not adequate to cover licensing and registration across the region	Legislation is clear	Legislation is clear	Legislation is clear but not communicated to artisanal fishers well	Legislation is clear	Legislation is clear
<b>Enforcement problems</b>	Inadequate MCS resources in the south	Inadequate control of artisanal vessels throughout the region	Inadequate ability to enforce transshipment requirements				
<b>Damage/cost</b>	Estimated illegal catch value \$22 million and estimated \$8 million value added lost to the region just from case study fisheries	Estimated illegal catch value \$170 million and estimated value added exported from countries of \$251 million of which 11% is lost from the region	Transshipment/ port fees lost (no direct estimate in this report)	Overexploited stocks and Sub-optimal economic benefit from fisheries, particularly in the south and particularly for demersal fisheries	Catching juvenile and small species. Growth overfishing. Overexploited stocks and Sub-optimal economic benefit from fisheries, particularly in the south and particularly for demersal fisheries	Catching protected species. Overexploited stocks, particularly of shallow demersals. Habitat and other environmental damage. Conflict with artisanal fishers and depression of artisanal catch rates	Catching protected species. Overexploited stocks, particularly of shallow demersals. Habitat and other environmental damage



<b>Solutions</b>	Enhance MCS cooperation particularly across the south	Require better reporting and more inspections in port for artisanal vessels; cooperation between Senegal and other countries	Require observers and VMS reports from all foreign vessels	Increase inspections at sea	Increase inspections in port to enforce mesh provisions	Require observers and VMS reports from all foreign vessels	Education and increase at-sea patrols
<b>Benefits</b>	Potential gain government revenue \$2 million and in total value added \$7 million from Scenario 1	Potential gain government revenue \$3 million and in total value added \$159 million from Scenario 1	Increased control and revenue	Increased yield and estimated 100 - 200% increase fishing value added (bioeconomic model)	Increased yield and biomass, recovery of stocks: in the south, potential 10-20% increase in stock status could translate to similar increase in VA	Protection of marine ecosystems, recovery of inshore demersals	Protection of marine ecosystems

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