UNIDO PROJECT/PROGRAMME
GPRAF04004 BL 1186

Combating living resources depletion and coastal area degradation in the Guinea Current Large Marine Ecosystem through Ecosystem-based regional actions

FINAL REPORT

Subcomponents:

- Review on comparable economic valuations quantifying the economic benefits of environmental and social services provided by healthy marine and coastal eco-systems and the economic losses/damages resulting from losing these environmental and social services.

- Report on estimating/quantifying economic benefits of environmental and social services provided by healthy ecosystems in the GCLME/economic damage from using these services

- Report on generic list of economic instruments for the management of critical zone resources and pollution reduction/abatement in the Guinea Current Large Marine Ecosystem Area

Author: Eduard Interwies (InterSus – Sustainability Services)
Report prepared for the United Nations Industrial Development Organization (UNIDO)
September 2010

Background and Contents

The project "Combating Living Resources Depletion and Coastal Area Degradation in the Guinea Current LME through Ecosystem-based Regional Actions" has a primary focus on the priority problems and issues identified by the 16 GCLME countries that have led to unsustainable fisheries and use of other marine resources, as well as the degradation of marine and coastal ecosystems by human activities.

To combat the resulting environmental and social problems, it is considered crucial to integrate environmental concerns into policies and decision making more sustainably. To achieve this, the economic instrument of the monetary evaluation of ecosystem services is considered suitable. In the context of the project: "Combating Living Resources Depletion and Coastal Area Degradation in the Guinea Current LME through Ecosystem-based Regional Actions", such an evaluation has been performed by an international expert on ecosystem service valuation. The results are delivered in three separate reports, which were combined into a single document for better access and readability. The reports are as follows:

1. Report on the methodology used, generally conferred to as the “Methodology Report”.
2. Report on quantifying the economic benefits of ecosystem services in the GCLME, generally conferred to as the “Valuation Report”.
3. Report on generic economic instruments for the management of critical resources in the GCLME, generally referred to as the “Economic Instruments Report”.

The reports follow in the same order.

UNIDO PROJECT/PROGRAMME
GPRAF04004 BL 1186

Combating living resources depletion and coastal area degradation in the Guinea Current Large Marine Ecosystem through Ecosystem-based regional actions

Subcomponent: Economic Valuation

Review on comparable economic valuations quantifying the economic benefits of environmental and social services provided by healthy marine and coastal eco-systems and the economic losses/damages resulting from losing these environmental and social services.

Author: Eduard Interwies (InterSus – Sustainability Services)
Report prepared for the United Nations Industrial Development Organization (UNIDO)
December 2009

Table of Contents

1 Introduction

1.1 Background and rationale of this report

The project "Combating Living Resources Depletion and Coastal Area Degradation in the Guinea Current LME through Ecosystem-based Regional Actions" has a primary focus on the priority problems and issues identified by the 16 GCLME countries that have led to unsustainable fisheries and use of other marine resources, as well as the degradation of marine and coastal ecosystems by human activities. The long-term development goals for the project are: 1) recover and sustain depleted fisheries; 2) restore degraded habitats; and 3) reduce land and ship-based pollution by establishing a regional management framework for sustainable use of living and non-living resources in the GCLME.

In this context it will be important to estimate and understand the total value of the ecosystem's contribution to the society. This contribution does not only comprise the immediate economic gains deriving from raw materials, food, clean water etc. but also the benefits to which it is very difficult to attribute a certain value in monetary terms, such as landscape beauty, cultural nature sites, optional use for future generations etc. Economic valuation would help to demonstrate and quantify the economic value of ecosystems in terms of raw materials, protection of natural and human systems, and maintenance of options for future economic production and growth, as well as the costs associated with the loss of these beneficial values through resource degradation.

Ecosystems are systems consisting of biotic and abiotic factors. Ecosystems are dynamic. Thus an ecosystem is not a static composition of elements, but it consists of the interaction of animals, plants, micro-organisms, mineral resources, climatic and other factors. An ecosystem is somehow comparable with a living organism not with dead material. Thus the service of an ecosystem is the result of this specific interaction, the product of the output of ecosystem elements and their interaction. The task of ecosystem service valuation is to assess the economic value of this output. If we look at the extraction of crude oil, sand, gravel or other mineral resources, we can state that the extraction produces a value. But this value does not derive from the ecosystem but just happens to share the same origin area as the one of the ecosystem. Mineral resources and fossil fuels are inert substances. Even more fossil fuels like crude oil seldom have any influence on the functioning of ecosystems. They consist just of a layer deep in the earth, without any effect on living resource. As a result, The revenue from the extraction of non-renewable resources such as crude oil can in this context not be regarded as a service provided by the ecosystem. The economic valuation of ecosystem services provides for a value that derives directly from the existence of the considered ecosystem.

Economic valuation of ecosystem services is not about summing up every economic activity in the area of investigation but to valuate those goods and services that directly derive from the existence of an ecosystem and its functioning.

In this context it needs to be noted that the economic valuation of ecosystem services is only one aspect that policy makers need to take into consideration when taking decisions. The value of oil extraction and other mining activities should not be ignored by decision making. But the assessment of this value is not part of an ecosystem service valuation.

This report provides for a review of comparable economic valuations suitable for quantifying the economic benefits of environmental and social services provided by healthy marine and coastal eco-systems and the economic losses/damages resulting from losing these environmental and social services.

The goal is to set-up a methodological framework that also allows to transfer elements of economic valuations to the GCLME context identified in this study.

The document gives guidance to the economic valuation of GCLME ecosystem services that will be carried out in the framework of developing the National Action Plans. The outcome of the valuation gives important information to be used for decision-making on the measures to be identified in the NAPs. An additional document will provide for a list of Information and data on the quality and quantity of marine and natural resources needed for assessing the economic value of ecosystems

services. These information and data will then be collected by the GCLME national experts with guidance by the International consultant.
In a second step a report will be produced that estimates the economic benefits of environmental and social services provided by healthy ecosystems in the GCLME and the economic damages from using these services.
At the later phase of this project in 2010, we will prepare a list of appropriate economic instruments for

a) the management of critical zone resources
b) pollution reduction/abatement.

1.2 The role of economic valuation of ecosystem services in LME conservation

This chapter describes the paradigm shift from sectoral to ecosystem oriented management approach, milestones in LME-conservation efforts, which includes both a state-of-the-art review of the most important approaches to LME-conservation as well as an outline of the main international conventions in this field.
If we do not adopt the right policies, the current decline in biodiversity and the related loss of ecosystem services will continue and in some cases even accelerate – some ecosystems are likely to be damaged/degraded beyond repair.
From an economic perspective, marine and coastal ecosystems should be treated, counted and invested in as elements of development infrastructure — as a stock of facilities, services and equipment which are needed for the economy to grow and society to develop and function properly. In order to ensure their productivity and continued support to human development, they need to be maintained and improved to meet both today's needs and those of intensifying demands and pressures in the future — just like any other component of infrastructure.

In contrast, a failure to value ecosystems when choices are made about allocating land and marine resources and investment funds can incur far-reaching economic costs. In the past ecosystem values have been almost ignored in decision-making. One of the reasons for that ignorance is the failure of markets that often do not to assign economic value to the public benefits of ecosystem services, but attribute value to the private goods and services, which production may lead to ecosystem damage (Sukhdev, 2008). Economic valuation can help to provide evidence for public benefits that are not reflected in private goods and services.
Ecosystem services are benefit specific, on the one hand this means that the use of one ecosystem services (e.g. sewage treatment) could prevent the other (e.g. fish nursery) (EFTEC, 2006). On the other it is important to distinguish between the function of the ecosystem and the service that is resulting from the function. The function of water purification of a wetland for example produces the service "clean water" that in the end is the benefit for the society. (Boyd, Banzhaf, 2006) Public priorities and willingness to make tradeoffs to protect and restore key natural resources are cornerstones in the set-up of effective natural resource protection. The overlap between areas producing ecosystem services and areas of high biodiversity are not generally in concordance. Thus economic valuation can help to identify the highly productive areas with a good economic revenue that are not necessarily located in biodiversity hotspots. The result of an economic valuation can thus be a powerful argument for the protection of these less productive areas of high biodiversity and help in zoning conservation efforts (Sherman, 2009).

Economic valuation can help to address, mitigate and calibrate the following issues:

- Human well-being and ecosystem services
- Quantify trade-offs between ecosystem services, conservation and other priorities
- Address non-linear and abrupt changes
- Expand the scope of probabilistic analyses
    - Environmental decision making is often based on estimates, scenarios and incomplete knowledge due to the complexity of natural processes. In this context economic valuation is an additional factor in the attempt to gain the most complete picture for possible future developments.

- Evaluate Interactions of Ecosystem Services with Other Determinants of Human Well-Being.
- Gaps in understanding regarding Human Well-being

(Emerton, 2006 and 2004)

The Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA) (refer to Box 1) has elaborated an ecosystem base approach to the conservation of the marine environment. It fosters the paradigm shift from sectoral management to a marine governance that tackles the current challenges of our oceans at the global scale. To this end the Programme identified 64 large marine ecosystems (LME) that provide for a congruence of ecologically defined space, that is, the geographic areas encompassed by the extent of natural ecosystems and politically defined space, the geographical area coming under the legal jurisdiction of particular political authorities. (Tallis, 2009)

The Handbook on Governance and Socio-economics of Large Marine Ecosystems (Olsen et al., 2006) stresses that the management of ecosystems and their services is intrinsically linked with the management of human behaviour and the initiation of practices that take into account the operation of the natural world.

Therefore the socio-economic importance of LME-related activities and economic and socio-cultural value of key uses of LME resources needs to be identified. In this regard the following issues are important:

- What are the drivers of change in marine and coastal ecosystems?
- Why should we care about the loss or degradation of marine and coastal ecosystems and their services?
- How can the loss of marine and coastal ecosystems and their services be slowed down? Or how could it be even reversed?
- Can valuation of marine ecosystems help in identifying appropriate measures to solve or mitigate the problems?

The Millennium Ecosystem Assessment report on marine and coastal ecosystems (Brown et al., 2006) is the first report that has systematically explored these questions at the global scale. The report states that the provision of the services provided by marine and coastal ecosystems is threatened by the worldwide degradation of marine and coastal ecosystems including a severe decline of global fisheries. There are still major gaps in our knowledge of marine and coastal ecosystems and in methodology to assess and manage them, including inadequate understanding of the marine nitrogen and other nutrient cycles and of the El Nino/Southern Oscillation (ENSO). The MEA report highlights that anthropogenic causes are the major drivers of change, degradation, or loss of marine and coastal ecosystems and services. To the direct drivers of change in marine and coastal ecosystems belong:

- land use change;
- development of aquaculture;
- overfishing and destructive fishing methods;
- invasive species;
- pollution and nutrient loading (eutrophication); and
- climate change.

And the major indirect drivers of change in marine and coastal ecosystems are:

- shifting food preferences and markets;
- subsidies;
- illegal fishing;
- population growth;
- technology change; and
- globalisation.

Terrestrial drivers also impact upon marine and coastal ecosystems. (Brown et al., 2006)

First options for responding to these challenges have been identified by the MEA report. The report distinguishes between operational responses related to policy options and specific responses related to sectors.

The operational response options include the following:

- stakeholder participation in decision-making from global to local levels;
- development of stakeholder capacity;
- communication, education, and public awareness, and the empowerment of communities;
- generating alternative incomes;
- monitoring of biophysical and socioeconomic effects of responses, addressing of uncertainties, such as basic knowledge of biodiversity and ecosystem processes; and
- addressing trade-offs among uses of ecosystem services.

The specific response options include the following:

- international and regional mechanism that may focus on biodiversity, fisheries, habitat loss, or wider aspects of sustainable development;
- successful implementation of international agreements;
- integrated coastal management requiring a holistic view including land-based and freshwater influences;
- marine protected areas;
- coastal protection against storms and floods through provision of natural barriers;
- management of nutrient pollution and waste at source point;
- geo-engineering for CO sequestration;
- economic interventions such as financial incentives, taxes, and subsidies;
- fisheries management; and
- aquaculture management.

(source: ibid)

Economic valuation can play a very important role in the identification of concrete measures and development strategies. In the past much enthusiasm has been spread out about win-win situations of conservation and development planning. In reality the today's resources are very much under pressure and trade-offs between different uses are more likely to occur. In this context economic valuation is very important, because it often reveals hidden trade-offs for the first time. Making these tradeoffs explicit is a core function of ecosystem assessments. Economic analysis is often used to quantify tradeoffs. (Carpentera et al., 2009)
The economic analysis of natural hazards such as the 2004 Indian Ocean Tsunami helps to identify the extend to the protective role that coastal ecosystems play for the protection of humans from natural disasters. An assessment of the devastation caused by the 2004 tsunami in Sri Lanka and Thailand revealed that healthy coastal ecosystems, especially mangroves, had, in fact, provided a level of protection that saved the property and lives of thousands (Kallesøe, 2008).

2 The main ecosystem services and relevant uses in the GCLME

2.1 The overall socio-economic situation in the GCLME region

The GCLME is a multi-cultural, multi-lingual and economically diverse region that is generally gifted with abundant resources. Despite this richness the region is marked by poverty, very low levels of human development and social welfare and massive social conflicts. A large proportion of the population in the GCLME region lives below the poverty line. Poor people are very much dependent on the direct use of ecosystems for the provision of food, fuel wood, water, building materials etc. Their economies, that is often based on subsistence is therefore very vulnerable to environmental degradation, especially in coastal areas where about 24% of the population lives. The poor mainly depend on artisanal fishing and subsistence agriculture. Major economic sectors consist of fisheries (large and small scale), industries, tourism, agriculture, oil and gas extraction, salt production and sand extraction.
The Transboundary Diagnostic Analysis for the GCLME identified major problems experienced in region:

- decline in GCLME fish stocks and unsustainable harvesting of living resources (fish trawlers landings manifest the degrading status of the stocks as landings are dominated by juveniles of the most common species, while certain highly valued/prized species have virtually disappeared);
- uncertainty regarding ecosystem status, integrity (changes in community composition, vulnerable species and biodiversity, introduction of alien species) and yields in a highly variable environment, including effects of global climate change;
- deterioration in water quality (chronic and catastrophic) from land and sea-based activities, eutrophication and harmful algal blooms;
- habitat destruction and alteration including inter-alia modification of seabed and coastal zone, degradation of coasts capes, and coastline erosion.

The core institution that will coordinate the transboundary co-operation in the GCLME is the Guinea Current Commission. In autumn 2009 the commission had still an interim status, but the set-up of a permanent commission is soon to be expected.

Contracting parties to the Interim Guinea Current Commission are the Republic of Angola, the Republic of Benin, the Republic of Cameroon , the Republic of Congo, the Republic of Cote d'Ivoire, the Democratic Republic of Congo, the Republic of Equatorial Guinea, the Republic of Gabon, the Republic of Ghana, the Republic of Guinea , the Republic of Guinea Bissau, the Republic of Liberia, the Federal Republic of Nigeria, the Democratic Republic of Sao Tome and Principe, the Republic of Sierra Leone, the Republic of Togo. (GCLME Regional Coordination Unit, 2006; Interim Guinea Current Commission (IGCC) Executive Secretariat, 2008)

2.2 Identifying the main ecosystem services and relevant uses based on former work

2.2.1 Overall studies for assessing ecosystem services in LME: short overview

Chapter 18 '*Marine Systems'* of the Millennium Ecosystem Assessment Report provides for an overview on the current status, major threats and development opportunities of the world's marine fisheries systems.

The Global Environment Facility in collaboration with other international organisations (IUCN; five UN agencies, the US National Oceanic and Atmospheric Administration's (NOAA) and the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA Coordination Office) developed Perspectives on Regional Seas and the Large Marine Ecosystem Approach, that includes five steps:

1. Identify principal uses of LME resources
2. Identify LME resource users and their activities
3. Identify governance mechanisms influencing LME resource use
4. Assess the level of LME-related activities
5. Assess the interactions between LME-related activities and LME resources

Under the auspices of this project several reports have been published that address LME in general and in specific economic terms.

The Regional Seas Programme of the United Nations Environment Programme, (UNEP/RSP) has published a report called *'Accounting for Marine Economic Activities in Large Marine Ecosystems and Regional Seas'*.

IUCN hast published a report called *'Sustaining the World's Large Marine Ecosystems'*, that includes a chapter on indicators of changing states of large marine ecosystems (Sherman, 2009)

The GEF capacity building internet platform GEF IW:LEARN provides for a training manual on LME and socio-economics.

In addition there are several in depth studies executed in other LMEs, specifically, the Benguela Current LME, the Yellow Sea, the Caspian Sea, the Western Indian Ocean Region etc. (refer to chapter 4)

Main references for this chapter: Hoagland, (2005); Hennessey (2005); Olsen (2006); Sherman (2007); Sherman (2009); Sutinen (2000).

2.2.2 Specific studies done for the GCLME: short overview

Main studies on the GCLME include the reports prepared in the framework of the GCLME project these are:

- Ukwe, Chika (Project Manager) (2007): Combating Living Resources Depletion and Coastal Area Degradation in the Guinea Current Large Marine Ecosystem through Ecosystem Based Regional Actions: Technical report: Preliminary Report on Economic Valuation of Ecosystem Services and TDA, Prepared for the United Nations Industrial Development Organization, Vienna, not published, http://earthmind.net/marine/docs/gclme-draft-valuation-report.pdf, visited on 23. March 2010.
- Interim Guinea Current Commission (IGCC) Executive Secretariat (2008): Strategic Action Programme – Guinea Current Large Marine Ecosystem – a Programme of the Governments of the GCLME Countries, with the assistance of GEF/UNIDO/UNDP/UNEP/US-NOAA/NEPAD/FAO and IMO; Accra, Ghana
- GCLME Regional Coordination Unit (2006): Transboundary Diagnostic Analysis – a Programme of the Governments of the GCLME Countries, with the assistance of GEF/UNIDO/UNDP/UNEP/US-NOAA/NEPAD/FAO and IMO; Accra, Ghana
- Sherman, K. and Hempel, G. (Editors) (2009):The UNEP Large Marine Ecosystems Report :A Perspective on Changing Conditions in LMES of the World's Regional Seas. UNEP Regional Seas Report and Studies No. 182. United Nations Environement Programme. Nairobi, Kenya. 2nd printing

  This report addresses several LMEs, but an extensive chapter is dedicated to the GCLME.

Especially the Preliminary Report on Economic Valuation of Ukwe (2007) provides a good starting point for the further elaboration of a methodology for the economic valuation of ecosystem services in the GCLME. The report gives a first overview of the main uses of ecosystems and economic activities in the GCLME region. Especially the analysis of the fisheries sector includes valuable differentiations and data sources. A critical point however is the inclusion of economic benefits that derive from the extraction on non-renewable resources in particular mining and oil production. The revenue of these activities to our opinion can not be regarded as an ecosystem service or good, because the existence of these resources is not dependent on the existence of an ecosystem. On the contrary: mining and oil production in general must be regarded as activities with negative impacts to ecosystems and their functions. Thus mining and oil production should only be considered in regard to their environmental impact or in other words how much of the value of the ecosystems these activities would deteriorate. The discussion of the costs and benefits of different economic activities, potential impacts to LME conservation goals and trade-offs with other social and economic objectives is a step that should follow the valuation exercise of ecosystem services, while integrating its results. Therefore, we will exclude mining and oil production from the approach to economic valuation presented with this report. The inclusion of non-use values on the other side appears to be a bit vague in the valuation approach suggested by Ukwe. Especially the non-use values constitute a major share of the benefits provided by ecosystems and require a much more thorough analysis. In addition the valuation techniques proposed by Ukwe would consume much time and many resources. Considering the scale of the GCLME and the urgency to achieve a first but also validated estimate of the ecosystems goods and services requires a much easier – even if a bit "rough" and non-academic - methodology that considers the situation in the GCLME at stake.

2.2.3 The ecosystem services we will look at

The ecosystem approach is the fundamental basis for the achievement of the goals set under the Convention on Biological Diversity (CBD). Also the Millennium Ecosystem Assessment (MEA) uses this conceptual framework for analysing and acting on the linkages between people and their environment. The CBD defines the ecosystem approach as follows:

> "The Ecosystem Approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. Thus, the

application of the ecosystem approach will help to reach a balance of the three objectives of the Convention: conservation; sustainable use; and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. An ecosystem approach is based on the application of appropriate scientific methodologies focused on levels of biological organization, which encompass the essential structure, processes, functions and interactions among organisms and their environment. It recognizes that humans, with their cultural diversity, are an integral component of many ecosystems." (CDB, cited in MEA 2003)

The cited functions of ecosystems play the pivotal role in defining ecosystem services. The different functions provide for the goods and services. We understand ecosystem functions as follows:

Ecosystem functions are 'the capacity of natural processes and components to provide goods and services that satisfy human needs, directly or indirectly' (de Groot, 2002).

These functions can be grouped into the following four primary categories: ***regulation, habitat, production, information.*** These functions provide for distinctive services and goods, also referred to as 'ecosystem services'. As we understand ecosystem services as goods and services provided by a living system we will not consider uses of non-renewable resources such as oil mining and sand extraction.
The analytical framework of the Millennium Ecosystem Assessment divides the services of ecosystems in four sub-categories: provisioning, regulating, cultural and supporting services.

Figure 1: Functions of Ecosystem Services

Provisioning Services	**Regulating Services**	**Cultural Services**
Products obtained from ecosystems	***Benefits obtained from regulation of ecosystem services***	***Non material benefits obtained from ecosystems***
• Food • Fresh water • Fuelwood • Fiber • Biochemicals • Genetic resources	• Climate regulation • Disease regulation • Water regulation • Water purification • Pollination	• Spiritual and religious • Recreation and ecotourism • Aesthetic • Inspriorational • Educational • Sense of Place • Cultural heritage
Supporting Services ***Services necessary for the production of all other ecosystem services***		
• Soil formation	• Nutrient cycling	• Primary production

Source: MEA (2003)

Considering the geographic scale of the GCLME it is difficult to list and analyse every single ecosystem good or service. We thus propose to select those goods and services that contribute to the resolution of the major problems identified by the TDA or whose use aggravates these problems. To gain an initial understanding on the importance of the ecosystem services , a description of the potential threats and benefits deriving from the use of these services for LME conservation and the expected socio-economic impacts, especially for the poor population of the GCLME region are summarised below. Here again we focus on the uses of ecosystem services, not the threats and benefits of any economic activity. In regard to the threats mining and oil exploration are of course part of the problem, but these options should be included at a later stage of decision making. As explained in section 1.1 these activities are not part of an ecosystem services valuation..

Table 1: Ecosystems and their services relevant for the GCLME region

Ecosystem	Function	Ecosystem service relevant to LME conservation	Threats to the ecosystem caused by the use of the service	Contribution to LME conservation (in regard to Problems identified by TDA)	Socio-economic impact (poverty alleviation)
Wetlands habitats Mangrove forests and swamps			• Deforestation • Pollution deriving from private households, agriculture and industry	Maintenance of habitats,	• Loss of livelihood • Diseases, deterioration of health
	Regulative function				
	Disturbance prevention	Flood control			Safety of housing
	Water supply	Sewage treatment Drinking water		Pollution control	Diseases, deterioration of health
	Climate regulation	Maintenance of a favourable climate			Health, well-being
	Soil retention	Erosion controll			Safety of housing
	Habitat function				
	Nursery ground for fish and shellfish	Fishery	Depletion of fish stock (overfishing)	Recreation of fish stock	Generation/Loss of income
	Refugium for migratory birds	Tourism	Disturbance of the specie	Biodiversity conservation	Generation/Loss of income/employment
		Maintenance of biodiversity			
	Production function				
	Raw material	Timber and non-timber products	Overuse of the resource may lead to the destruction of the habitat		Generation/Loss of income/employment
	Information functions				
	Recreation	Tourism			Generation/Loss of

Ecosystem	Function	Ecosystem service relevant to LME conservation	Threats to the ecosystem caused by the use of the service	Contribution to LME conservation (in regard to Problems identified by TDA)	Socio-economic impact (poverty alleviation)
					income/employment
	Cultural and artistic Variety in natural features with cultural and etc.	artistic value folklore, national symbols, architect., advertising,			
	Spiritual and historic Variety in natural features with spiritual and	Use of nature for religious or historic purposes (i.e. heritage value of natural ecosystems and features).			
	Science and education	Use of natural systems for school excursions, use of nature for scientific research			
Coastal lagoons			• Pollution deriving from private households and industry • Erosion	Maintenance of habitats	• Safety of housing • Diseases, deterioration of health
	Regulative function				
	Disturbance prevention	Tempest protection			Safety of housing
		Erosion control			
	Habitat function				
	Nursery ground for fish	Fishery	Depletion of fish stock (overfishing)	Recreation of fish stock	Generation/Loss of income/employment
	Refugium for aquatic species	Tourism		Biodiversity conservation	Generation/Loss of income/employment
		Maintenance of			

Ecosystem	Function	Ecosystem service relevant to LME conservation	Threats to the ecosystem caused by the use of the service	Contribution to LME conservation (in regard to Problems identified by TDA)	Socio-economic impact (poverty alleviation)
		biodiversity			
	Information				
	Cultural and artistic Variety in natural features with cultural and etc.	artistic value folklore, national symbols, architect., advertising,			
	Spiritual and historic Variety in natural features with spiritual and	Use of nature for religious or historic purposes (i.e. heritage value of natural ecosystems and features).			
	Science and education	Use of natural systems for school excursions, use of nature for scientific research			
Sea-grass beds			• Pollution deriving from private households and industry • Erosion	Maintenance of habitats	
	Regulative function				
	Disturbance prevention	Tempest protection			Safety of housing
	Habitat function				
	Nursery ground for fish	Fishery	Depletion of fish stock (overfishing)	Recreation of fish stock	Generation/Loss of income/employment
	Refugium for aquatic species	Tourism		Biodiversity conservation	Generation/Loss of income/employment
		Maintenance of			

Ecosystem	Function	Ecosystem service relevant to LME conservation	Threats to the ecosystem caused by the use of the service	Contribution to LME conservation (in regard to Problems identified by TDA)	Socio-economic impact (poverty alleviation)
		biodiversity			
	Information				
	Cultural and artistic Variety in natural features with cultural and etc.	artistic value folklore, national symbols, architect., advertising,			
	Spiritual and historic Variety in natural features with spiritual and	Use of nature for religious or historic purposes (i.e. heritage value of natural ecosystems and features).			
	Science and education	Use of natural systems for school excursions, use of nature for scientific research			
Sandy beaches			• Housing and infrastructure development • Pollution deriving from private households, agriculture and industry		
	Habitat function				
	Nursery ground for turtles	Tourism	Disturbance of the specie	Biodiversity conservation	
		Maintenance of biodiversity			

Ecosystem	Function	Ecosystem service relevant to LME conservation	Threats to the ecosystem caused by the use of the service	Contribution to LME conservation (in regard to Problems identified by TDA)	Socio-economic impact (poverty alleviation)
	Refugium for birds and other species	Tourism	Disturbance of the specie	Biodiversity conservation	Generation/Loss of income/employment
		Maintenance of biodiversity			
	Information				
	Cultural and artistic Variety in natural features with cultural and etc.	artistic value folklore, national symbols, architect., advertising,			
	Spiritual and historic Variety in natural features with spiritual and	Use of nature for religious or historic purposes (i.e. heritage value of natural ecosystems and features).			
	Science and education	Use of natural systems for school excursions, use of nature for scientific research			
Marine ecosystems			• Pollution deriving from private households, agriculture and industry and ships • Algal blooms • Habitat degradation due to destructive		

Ecosystem	Function	Ecosystem service relevant to LME conservation	Threats to the ecosystem caused by the use of the service	Contribution to LME conservation (in regard to Problems identified by TDA)	Socio-economic impact (poverty alleviation)
			fishing techniques		
	Habitat function				
	Nursery ground for fish	Fishery	Depletion of fish stock (overfishing)	Recreation of fish stock	Generation/Loss of income/employment
		Maintenance of biodiversity			
	Refugium for marine species	Fishery	Depletion of fish stock (overfishing)	Recreation of fish stock	Generation/Loss of income/employment
		Tourism	Disturbance of the specie	Biodiversity conservation	Generation/Loss of income/employment
		Maintenance of biodiversity			
	Information				
	Cultural and artistic Variety in natural features with cultural and etc.	artistic value folklore, national symbols, architect., advertising,			
	Spiritual and historic Variety in natural features with spiritual and	Use of nature for religious or historic purposes (i.e. heritage value of natural ecosystems and features).			
	Science and education	Use of natural systems for school excursions, use of nature for scientific research			

3 The methodology for valuating the ecosystem services in the GCLME

3.1 Existing approaches/methodologies

Many international organisations have worked on the economic valuation of ecosystem services. Among the most important in the context of marine protection and transboundary water management are without doubt IUCN, WWF, the Ramsar Secretariat and the UN agencies. While each organisation has put a special focus on its work, all of them rely more or less on similar basic concepts/tools that have been used by the Millennium Ecosystem Assessment on the global scale.
The MEA framework for the assessment of ecosystems is still is in process of further development. This chapter gives an overview on the state-of-the-art of valuation methods of ecosystem services as a follow-up of the MEA.

IUCN
IUCN has issued a tool book (Emerton; Bos, 2004) that aims at streamlining economic valuation into the cycle of water resource management. Their concept is based on the idea of the total economic value that includes the different values represented by direct values, indirect values, option values and existence values. An important part of the book is the section that is dedicated to the embedding of the valuation into decision making and to the translation of values into management decisions.

WWF
The WWF co-operates with all major international organisations in the field of environmental economics. They have published a book reviewing the economic values of the world's wetlands (Schuyt et al., 2004) in which they analyse the functions and values provided by wetlands on the global scale and adding a overview on the current status of global wetland conservation with special regard to the requirements of the Ramsar Convention. Even if this publication does not provide for practical guidance it is a good reference for cross-checking the scope and contents of other wetlands valuations.

Ramsar Convention Secretariat
Already in 1996 the COP of the Ramsar Convention included the concept of economic valuation into their Strategic Action Plan. To support this, the 1997 book "Economic valuation of wetlands: A guide for policy makers and planners" was published by the Ramsar Secretariat (Barbier et al. 1997). Since scientific developments have made fast advances a new guidance was published in 2006 in cooperation with the Secretariat of the Convention on Biological Diversity (Ramsar Technical Report No. 3; CBD Technical Series No. 27; De Groot et al., 2006). The guidance focuses on the application of economic valuation for wetlands establishing a strong link to the objectives of the Ramsar Convention. Even if this focus does only include a small share of ecosystems that need to be considered in LMEs, the book provides for many tools and techniques that can be extrapolated to the larger contexts of marine ecosystems.

UN Agencies
Rather than publishing guidance books, the UN agencies UNEP and UNDP in cooperation with the World Bank support the IW:LEARN Learning Exchange and Resource Network financed by the Global Environment Facility's (GEF) International Waters. This Network aims to strengthen International Waters Management (IWM) by facilitating structured learning and information sharing among stakeholders. Several training workshops have been conducted for high-level water managers on economic valuation. The most relevant among these is the workshop on economic valuation for large marine ecosystems held in Cape Town, South Africa in July 2007 that was co-organised with IUCN Global Marine Programme.

3.1.1 The general approach to economic valuation of ecosystem services

It is important that economic valuation is part of the management cycle of LME conservation efforts, it does not take place in isolation, the initial impulse is always a particular management or policy issue that needs to be addressed, or a particular decision that needs to be made about the use of funds, land or other resources. (Emerton, 2004; also refer to Springate-Baginski et al., 2009) Thus the first exercise is to understand the context of management and which needs and issues are to be addressed. After that the scale and the boundaries of the valuation study needs to be identified including a definition of who and what will be comprised in the study and which level of detail will be used. (ibid.)

After that the economic valuation consists of two steps: first, the ecosystem services needs to be identified.
For the identification of the relevant ecosystem services it is useful to look first at the ecosystem functions. '*Ecosystem functions are 'the capacity of natural processes and components to provide goods and services that satisfy human needs, directly or indirectly'*.(de Groot, 2002)

These functions can be grouped into the following four primary categories: Regulation, habitat, production, information. These functions provide for distinctive services and goods of the ecosystems. De Groot (2002) has provided a framework for the classification of ecosystem services.

Second, the value is appraised in monetary units. The concept of Total Economic Value is a framework widely used to distinguish the different kind of values of ecosystems and break it up into smaller components of which the figure below gives an overview:

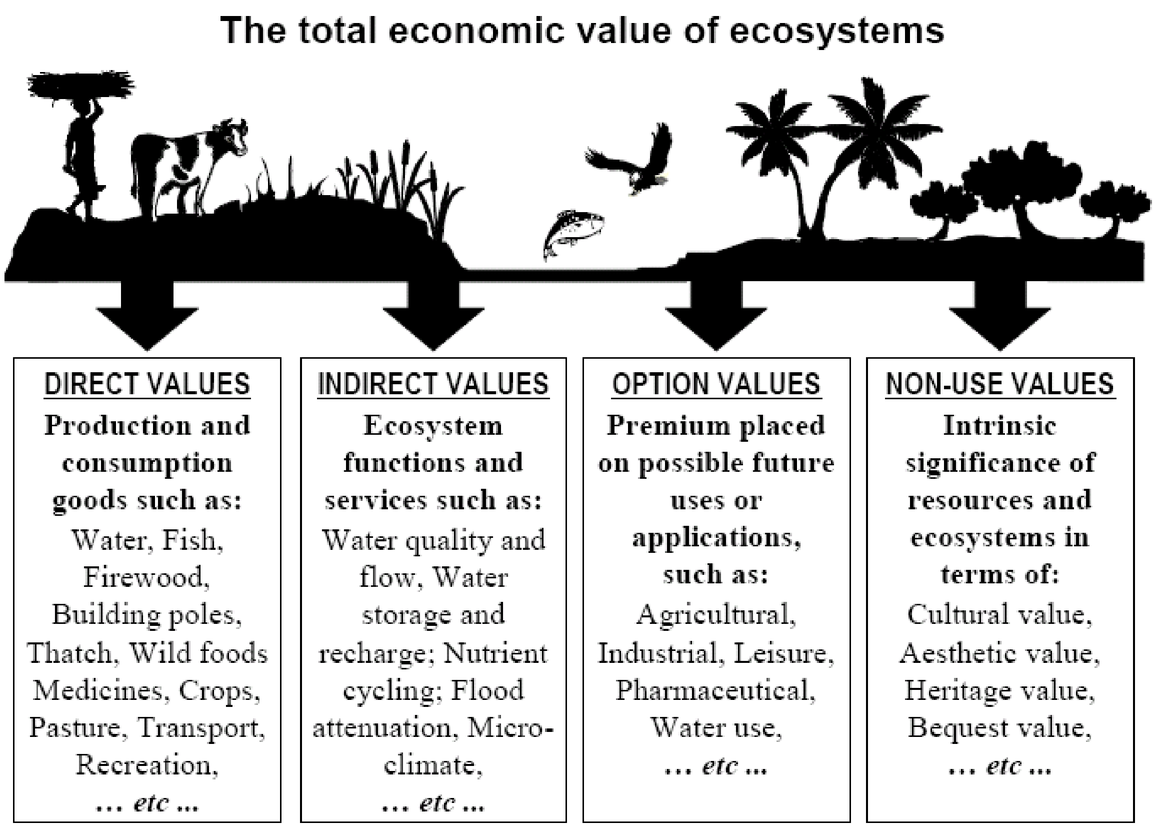

Figure 2: The total economic value of ecosystems (source: Emerton, 2005)

3.1.2 Total Economic Value

The concept of the total economic value is a method of creating a single monetary metric that combines all activities within an LME and to express the levels of each activity in units of a common monetary measure, such as US dollars. (Hoagland et al., 2006)

Before the concept of the total economic value was introduced, economic values have quite narrowly been defined as benefits. Values of ecosystems have been attributed only to raw materials and physical products that ecosystems generate for human production and consumption. These direct uses however represent only a small proportion of the total value of ecosystems, which generate economic benefits far in excess of just physical or marketed products. Instead of focusing only on direct commercial values the concept of Total Economic Value (TEV) also encompasses the subsistence and non-market values, ecological functions and non-use benefits. Broadly defined, the concept of total economic value ecosystems includes:

Use Value:
Direct use value: Individuals make use of a resource in either a consumptive way (e.g. the fishing industry and agriculture) or a non-consumptive way (e.g. rambling).
Indirect use value: Individuals benefit from ecosystem services supported by a resource rather than actually using it (e.g. watershed protection for flood mitigation, cycling processes for agriculture or carbon sequestration).

Non-use value
is associated with benefits derived simply from the knowledge that the natural environment is maintained. By definition, non-use value is not associated with any use of the resource or tangible benefit derived from it, although users of a resource might also attribute non-use value to it.
Non-use value can be split into three basic components:

Altruistic value: Derived from knowing that contemporaries can enjoy the goods and services the natural environment provides.
Bequest value: Associated with the knowledge that the natural environment will be passed on to future generations.
Existence value: Derived simply from the satisfaction of knowing that ecosystems continue to exist, regardless of use made of them by oneself or others now or in future (also associated with 'intrinsic value').

3.1.3 How to assess the value of ecosystem services?

There is a vast range of methods that can be used for the valuation of ecosystem services. Here the following methodologies are briefly described. Main sources of reference to this section are Boyd (2006); EFTEC (2006); Emerton (2004); Hoagland (2005); Hoagland (2006); Kallesøe (2008); Kramer (2005); Pagiola (2004); Smith (1997); Sherman (2009); Springate-Baginski (2009); Tallis (2009).

- Market price
- Production function
- Hedonic pricing
- Travel cost method
- Contingent valuation
- Choice experiment
- Replacement Costs

The figure below illustrates how these methods are aggregated in the valuation process.

Figure 3:Categories of commonly-used ecosystem valuation methods (Source: adapted from Emerton, 2004)

Revealed Preference Approaches			**Cost-based Approaches**	**Stated Preference Approaches**
Market Prices	Production Function Approaches	Surrogate Market Approaches		
Market Prices	Effect on Production	Market Prices	Replacement Costs	Contingent Valuation
		Hedonic Pricing	Mitigative or Avertive Expenditures	Choice Experiments
			Damage Cost Avoided	
			Travel Cost	

Market Price Method
The market price method is applicable to **direct use values**. The value is an estimate from the price in commercial markets. Constraints in this method belong to market imperfections (subsidies, lack of transparency) and policy, which distort the market.

Effect on Production Method
The effect on production method is applicable for **specific ecosystem goods and services** (e.g. water, soils, micro-climate etc.) It estimates the economic values for ecosystem products or services that contribute to the production of commercially marketed goods. The methodology is straightforward and data requirements are limited but the method only works for some goods or services. Data on change in service and the consequent impact on production are often lacking.

Hedonic Pricing Method
The hedonic pricing method covers **some aspects of indirect use**, future use and non-use values. This method is used when ecosystem values influence the price of marketed goods. Clean air, large surface of water or aesthetic views will increase the price of houses or land.
This method only captures people's willingness to pay for perceived benefits. If people are not aware of the link between the environment attribute and the benefits to themselves, the value will not be reflected in the price. This method is very data intensive and very sensitive to specification.

Damage cost avoided, replacement cost or mitigative or avertive expenditures method
It is applicable to indirect use values (e.g. coastal protection, erosion and pollution control, water retention etc.). The value can be estimated by calculating the costs that would occur for building necessary infrastructures to replace the service (eg. treatment plants) or by calculating the estimated damage of a hazardous event (storm).
A main constraint of this method consists in the assumption that the cost of avoided damage or substitutes match the original benefit. But many external circumstances may change the value of the original expected benefit and the method may therefore lead to under- or overestimates. Because of its Tendency to over- or underestimate the actual value; the method should be used with extreme caution.

Travel Cost Method
The travel cost method is applicable to recreation and tourism. The value is estimated from the amount of money that people spend for visiting the area. This method only gives an estimate. Overestimates are easily made as the site may not be the only reason for travelling to that area, thus hard to use when trips are to multiple destinations.

Contingent Valuation Method
The contingent valuation method is applicable to Tourism and Non-Use values
This method asks people directly how much they would be willing to pay for specific environmental services. It is often the only way to estimate the non-use values. It is also referred to as a "stated preference method". There are various sources of possible bias in the interview techniques. There is also controversy over whether people would actually pay the amounts stated in the interviews. It is the most controversial of the non-market valuation methods but is one of the only ways to assign monetary values to non-use values of ecosystems that do not involve market purchases.

Choice Experiment Method
The choice experiment method is applicable for all ecosystem goods and services. It estimates values based on asking people to make tradeoffs among sets of ecosystem or environmental services. It does not directly ask for willingness to pay as this is inferred from tradeoffs that include cost attribute. This is a very good method to help decision makers to rank policy options.

3.1.4 Deliberative and Participatory Valuation Methods

The valuation methods described above often require huge data sets that are very labour intensive to collect and sometimes also very difficult to analyse. Sometimes deliberative and participatory methods that provide for less accurate numbers but better reflect people's preferences and choices especially within largely subsistence-based economies could be an easier opportunity for reaching a first estimate of a given situation. Available methods in this context consist of:

- Survey approaches
- Focus groups
- Citizens' juries
- Livelihood assessment tools

Survey approaches
Survey approaches are generally interview based techniques that often use participatory methods such as mapping, group models, time lines etc. A key interest in questionnaire research is often the ability to analyse correlations between demographic and attitudinal factors. In theory, any concept of value can be captured via questionnaires and interviews, from general statements of ethical principles through to choices between specific conflicting options. Questions can cover monetary values, including stated monetary values, values as revealed through (stated) behaviour, or verbal expressions of value.
One major constraint of this technique is that it is also very time consuming if it is not limited to a very small number of questions. (EFTEC, 2006)

Focus groups
Focus groups involve small groups that have a structured discussion on a particular topic led by a facilitator. Focus group discussions reveal how they aim to discover the positions of participants regarding, and/or explore how participants interact when discussing, a pre-defined issue or set of related issues. Rather than defining monetary valuations of an environmental good or service group discussions will focus on how to choose between conflicting objectives, or on what decision should be made in a particular circumstance, or on the reasons underlying particular behaviours or responses to policy.
Focus groups are generally limited in the number of participants (effective discussions are only feasible with about 15-20 participants). Thus representation is a very important constraint if a discussion should be held with representatives of different stakeholder groups. (Ibid.)

Citizens' juries
Citizens' juries are made of selected citizens that are requested to hold group discussions considering information provided by experts and other stakeholder. Rather than representing individual interest they are asked to reflect opinions that factor in or express a public interest. When the context is specific the jurors may be selected as key stakeholders/representatives of different points of view,

rather than randomly. Generally the emphasis is on citizen values rather than private values, although values are not expressed quantitatively or directly. One constraint of this method is that it is very labour intensive and requires a lot of facilitation. (Ibid.)

3.2 The boundaries of economic valuation

The value of goods is always bound to certain rules and games set by state and the society: Property rules and property rights, Environmental Policies and legal framework, Uncertainties (environmental, political, social, economic), Standards for environmental regulations, environmental policy in an international setting, transboundary externalities, international co-operative agreements. This chapter gives and overview on the role of international institutions esp. conventions, in regard to the boundaries that are given by international law in regard to the economic use of LME. It further depicts the most important socio-economic, legal and policy frameworks at national level one has to bear in mind when conducting a valuation exercise:

- Major Governance Mechanisms and Tools
- The role of markets and the risk of market failures
- Government failures and their mitigation
- The role of civil society

Major Governance Mechanisms and Tools

The international regime on the protection of marine resources and ecosystems provides for an overall framework for marine ecosystem management that give guidance for decision making but that also obliges the contracting parties to meet the targets set by the conventions and protocols. In this context the management of socio-economic information is an important interface between the contracting parties and the convention goals. While conventions define the objectives on the long- and the short-term and provide for the framework to shape future initiatives. The convention's organisation is also dependent on reliable information on the situation in-situ. In this regard economic valuation of LME can contribute to a better negotiation and implementation of international and regional agreements and to integrate the economic aspects into international marine law.

The results of economic valuation contribute to a better understanding of the socio-economic situation of the given area and which opportunities are at stake for future developments. Often this information can feed into global databases that help to better understand processes at the global scale. In addition there is a strong need for access to worldwide information on the socio-economic boundaries of ecosystems. The conventions organisations then can ensure that relevant studies and initiatives are widely known and accessible to those involved in the decision-making process. In this mutual process of information exchange the COP may endorse parameters and criteria for assessments that are supported by well-founded expert advice, this guidance often carries a higher level of authority than the normal efforts of scientists and other experts to adopt data standards and follow accepted methods. The use of this authority can promote data quality and comparability and stimulate additional data collection. (Kimball, 2003)

Box 1: The international regime for the regulation of marine activities and the protection of marine ecosystems

The international law provides for several conventions and protocols on the regulation of marine activities and the protection of marine ecosystems. The most important and comprehensive in this context is the United Nations Convention on the Law of the Sea (UNCLOS).
The Convention on the Law of the Sea comprising a total of 436 articles is the most important multilateral treaty on oceans and seas. This international law regulates almost all spheres of the sea. It entered into force on 16 November 1994, replacing the four Geneva Conventions on the Law of the Sea of 1958. The Convention has been supplemented by two implementing agreements supplement this convention: The 1994 Agreement Relating to the Implementation of Part XI, that clarifies and replaces many of the Convention's deep seabed mining provisions adopted in 1982 and prevails over the Convention in the event of any inconsistency. The 1995 Agreement Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (Fish Stocks Agreement or FSA) supplements and elaborates the LOS Convention's fishery provisions, providing further guidance on implementation.
There are three other conventions that are important in regard to the pollution prevention of seas. These are the International Convention for the Prevention of Pollution of Ships, 1973 (MARPOL 73/78) and the London Convention and Protocol on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (1972 and 1996 Protocol Thereto). And the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (1989),
The "Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972", the "London Convention" for short, is one of the first global conventions to protect the marine environment from human activities and has been in force since 1975. Its objective is to promote the effective control of all sources of marine pollution and to take all practicable steps to prevent pollution of the sea by dumping of wastes and other matter.
In 1996, the "London Protocol" was agreed to further modernise the Convention and, eventually, replace it. Under the Protocol all dumping is prohibited, except for possibly acceptable wastes on the so-called "reverse list". The Protocol entered into force on 24 March 2006.
Important to the GCLME is also the Bamako Convention on the Ban of the Import into Africa and the Control of Transboundary Movement of Hazardous Wastes within Africa (1991) that further elaborated the provisions set under the 1989 Basel Convention.
Further to name is the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities: 1995 (UNEP-GPA).
Among other measures GPA is implemented through the "Combating Living Resources Depletion and Coastal Area Degradation in the Guinea Current LME through Ecosystem-based Regional Actions" (GCLME) project.
In addition to these very marine specific conventions that are aiming at regulating the use of marine resources and their pollution prevention an extensive international legal regime for protecting marine species and habitat and ecological function exists. The most important convention and treaties in this regard are:

- Global Protected Species Conventions
    - Convention on International Trade in Endangered Species
    - Convention on Migratory Species (CMS)
- The Convention on Biological Diversity
- The Global Protected Areas Conventions
    - Wetlands Convention (Ramsar)
    - World Heritage Convention
- Man and the Biosphere Programme (MAB)

The Role of Markets and the Risk of Market Failure

Today in the most world's economies, economic interaction is market driven. Thus price regulation and the designation of the value of goods and services follow the rules of markets. Never the less many public goods and services are lacking markets (e.g. absence of "markets" for species conservation or for most of the regulating and supporting services of ecosystems). Furthermore, there is potential for market-based instruments to produce results that are socially unacceptable. (Sukhdev, 2008)

The Risk of Government Failures
Policy failures arise due to incentives encouraging harmful action. Tax incentives and subsidies can lead to the market working for the destruction of natural capital, even where natural assets offer a sustainable flow of services to the economy and to society. Environmentally harmful subsidies discriminate against sound environmental practices while encouraging other, less desirable activities.
Policy failures also arise when the system of incentives fails to reward those who work to improve the environment, or fails to penalize those who damage it. Many agricultural practices can support high-value biodiversity. (ibid)

The role of civil society
Today it is widely recognised that the management of natural resources is no longer under the responsibility of top-down approaches driven by high-level government decision making, but that the civil society has to play a crucial role in environmental decision making in order to prevent that environmental protection policies are not at risk to fail their objectives from the beginning on. This demand is reflected in major environmental treaties. The most explicit in this context is the 1998 Aarhus Convention[1].

Beside these regulative forces there are also other factors that need to be considered in shaping suitable methods for ecosystem economics, such as

- risks and uncertainty
- ethical issues
- intergenerational equity
- social welfare context
- biodiversity losses
- the non linearity natural variability and cumulative effects of the services provided by ecosystems

The concept of economic valuation should incorporate the above mentioned issues, since it has been elaborated explicitly because conservative valuation techniques have not reflected uncertainty margins and non-use values. Since these aspects however are still very difficult to assess, the outcome of a valuation should always be examined in the regard that still a lot of these aspects are not reflected in the achieved total economic value of a valuation exercise.
One important issue in regard to economic valuation is the significant knowledge gap in regard to the carrying capacity of ecosystems. The most extreme case is that it is almost unknown when the point of ecosystem collapse will be reached. The Stern Review has formulated this incidence as follows: how to assess a roll of the dice, when one of the outcomes is the end of civilization as we know it? As a result we always need to bear in mind that an excessive use of an ecosystem could result in its extinction even if a margin of its area is put under conservation.
Regarding social issues the enumeration of economic values can hide substantial injustice. Even if the economic valuation has resulted in great values for one ecosystem service it could be that this would have severe consequences for parts of the population, that lack of a strong economic lobby or for future generations. Also ethical issues need to be reflected in economic valuations. Societies may give preference to choices that do not represent a manifested specific economic value, only because it touches specific ethical values.
Also the cost of biodiversity loss is not possible to fully assess. One important reason is that we do not fully know when and which species will disappear next and which value these species really represent to our or future generations.
Also the complexity of ecosystems poses us significant difficulties for any assessment. The benefits of ecosystems greatly vary from year to year or season to season due to the non linearity natural

---

[1] The UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters was adopted on 25th June 1998 in the Danish city of Aarhus at the Fourth Ministerial Conference in the 'Environment for Europe' process.

variability and cumulative effects of the services provided. Timelines can help to provide for more or less reliable averages over the years or decades.

Practical difficulties while doing an ecosystem valuation may arise with:

- Marginality
  - It is important to know what is the value of lost ecosystem services as, for example, parts of the stock of tropical forests in certain locations are degraded or destroyed.
- Double counting
  - many ecosystem services are not complementary, the provision of one (say recreation in a wetland) is precluded by others (for example, using the same wetland for effluent treatment and storage).
- Typological issues
  - It is important to differentiate between valuations of the in situ ecosystem stock and estimates of the value of the flow of goods and services from a given stock.
- Spatial and temporal data transfer
- Distribution of benefits and costs
- Methods need to Integrate when, how and by whom the assessment is carried out
- Integration of the economic valuation into the management cycle of LME conservation planning

3.3 The methodology to use for this report

The valuation of ecosystem services should be based on the current status of the ecosystem. In the given frame of this report it won't be possible to make recommendations on the desired protection level, but the valuation will give an input for later decisions in this regard. In addition, as already stated in chapter 2.3, the assessment excludes values created in the area that do not depend on the well-functioning of the ecosystem or that represent a use of a non-renewable resource (e.g. oil extraction).

The objective of the valuation exercise in the framework of this study report is to get a first idea about the costs and benefits deriving from LME conservation at the large scale of the GCLME. Thus the aim is to avoid labour intensive and time consuming surveys and data generation. Nevertheless there is a need especially to assess "values of items that often are considered to be priceless", e.g. maintenance of biodiversity. In a later stage of the project it might be very advisable to put efforts on more detailed economic valuations.

While the predecessor report on economic valuation (Ukwe, 2007) pointed into the direction of a vast variety of time and labour intensive surveys (even if those were not actually done), the current approach is aiming at quantifications that are easy at hand. In this context we propose to collect more metric numbers (such as number of species endangered or extinct). We will then cross-check these numbers with valuations done in other projects of ecosystem services valuation, creating the basis for our economic valuation. A future task could be to use the NAP meetings for discussing the values with relevant stakeholders using participatory approaches. This however would be an additional step that is not foreseen in this phase of the project.

The benefit of the utilisation of data of existing valuation and "transfer" them to our case overweighs the inaccuracy of this approach. As already stated the goal is a first rough estimate.

The application of benefit transfer is quite controversially discussed in academic fields, even if sufficient resources are available for its application. Benefit transfer is not an approach that guarantees for incontestable numbers and figures. It includes a vast variety of uncertainties. These uncertainties even increase if the area under consideration expands on a large territory such as the GCLME area. As a result benefit transfer may not always find the approval from an academic point of view that aims at accuracy of data. But considering the urgency of initiating a more sustainable management practice in LME conservation in the Guinea Current LME, benefit transfer appears to be the best solution at hand that can help to start a development that directs into a sustainable future of the region.

At a later stage decision makers and stakeholders involved into the process of policy and decision making need to be aware of that the result of this valuation has its weaknesses. The results of this first ecosystem services valuation will not be sufficient to start with detailed management plan for the

GCLME, but it will provide for important insights how valuable the existing ecosystem services are for the GCLME region and which benefits will be lost if a preference will be given to uses that further damage or destroy the ecosystems.

National GCLME experts will collect information that will be relevant for the valuation. In this context it will be useful to get time series data, that helps to find the current average value (e.g. harvest of one year can be better or worse than average). It should however be considered that it is not advisable to go too far back to a time when the ecosystem was in a different/better status, because these data could bring in values that already have been lost for human consumption in the past and that thus would distort the represented values. A list of the needed information will be provided in a separate document.
The results of all these efforts will be combined in 2010, in order to reach a rough overall estimate.

4 Using the results of other economic valuations that have been conducted

One part of this study is the review of existing case studies on marine ecosystem valuation that provides for values that are transferable to the situation in the GCLME.
The Benefit Transfer Method is useful in cases where a "real" valuation of the site is too complicated in terms of data availability, time and financial resources. Benefit transfer includes different steps. In the beginning existing data of other studies needs to be identified. Then the transferability of this data has to be checked. This includes an analysis if the services to be compared have the same features and qualities. In addition the quality of the study providing for the values needs to be assessed.
After this the data of the source study needs to be adjusted to the site under consideration. This involves a calibration with existing data of the site to be valuated. Finally the calculation of the value of the ecosystem service has to be done.
The most fundamental problem for value transfers is in assessing whether a given transfer is correct or not when the 'true' value of the policy site is a-priori unknown.

Principally there are two different approaches to transfer benefit values from study sites to a policy site: unit value transfer and benefit function transfer.
The unit value transfer approach directly transfers the (mean) benefit estimate (e.g. mean WTP/household/year) from the study site to the policy site. The benefit function transfer approach transfers the entire benefit function instead of transferring benefit estimates (i.e. values). Benefit function transfers entail the use of a model that statistically relates benefit measures with study factors such as characteristics of the user population and the resource being evaluated. The transfer process requires to adapt the function to the characteristics and conditions of the policy site, forecasting a tailored benefit measure based on this adaptation of the function, and use of the forecast measure for evaluating the policy site.

The unit value transfer approach is most appropriate if the characteristics of the study sites and the policy sites are relatively similar. The benefit function transfer on the contrary offers the opportunity to transfer value functions if the study and policy sites are less similar and differences between the sites need to be incorporated into the calculation. Since the elimination of differences between study sites and policy sites is a rather complex task we aim at the identification of studies that are similar to the situation in the GCLME region. Thus we will base our approach to benefit transfer on the unit value transfer, because the incorporation of differences inherent in the value function approach may generate higher degrees of error than the simple transfer of mean values between those relatively homogeneous sites.

Some significant constraints of the Benefit Transfer Method exist:

- The risk of inaccuracy due to the fact that situations are never identical in two different sites;
- The quality of the transfer is directly dependent on the quality of the transfer study;
- The studies available may not have the sufficient detail to allow for a sufficient analysis of comparability and
- unit value estimates can quickly become outdated.
- Differences between the study site(s) and policy sites that are not specified in the valuation model or in the procedure used to adjust the unit value. To these belong:
    - Differences in the socio-economic characteristics of the relevant populations;
    - Differences in the physical characteristics of the study and policy site;
    - Difference in the proposed change in provision between the sites;
    - Differences in the market conditions applying to the sites (for example variation in the availability of substitutes).

Even so, the transfer of values we will apply will not be fully academic, but more practically oriented in order to offer rough estimations, to be refined in the future.

In the present analysis we will try to minimise these constraints and the following steps will be included into our benefits transfer approach:

- Identification of existing studies or values that can be used for the transfer.
- Decide whether the existing values are transferable. Important criteria in this context are:
    - Comparability of the valued service regarding the similarity of the sites (type, quality, availability of substitutes).
- Evaluation of the quality of studies to be transferred.
- The final step is to adjust the existing values to better reflect the values for the site under consideration, by cross-checking the data of the transfer with available data in the GCLME, provided by the national experts.

4.1 Overview on values of ecosystem services to be considered for the valuation

As already stated above it won't be possible to consider every ecosystem service that provides or could provide for beneficial use in the GCLME at present and in the future. Therefore we need to select those ecosystem services that are of the greatest importance and for which it is possible to generate an estimate. The table below provides for an overview on those values for which it is possible to calculate a first estimate. A critical point is the estimation of the value of the biodiversity of the marine ecosystem. Beside the fish species that are relevant for the fisheries industry the value of marine biodiversity is rather intrinsic for the GCLME at least nothing else was stated in the GCLME TDA and SAP documents. The value of marine mammals that might attract tourism are already included in the beaches and coastal ecosystems, the places where tourists could observe these species. The remaining biodiversity of the marine ecosystem appears to neither provide for specific use values for the population of the GCLME region, nor can a specific non-use value be registered at present. Nevertheless it is scientifically undoubted that marine biodiversity has an immense value for human mankind, the only problem is that at present it is not possible to provide for any estimate in this regard. Therefore the aspect of biodiversity is put into parenthesis for the non-use values of the marine ecosystem, as such it will not be included into the calculation of the total economic value in practice, but it will be a reminder that there is a significant uncertainty that has to be considered in decision making.

Ecosystems	Total Economic Value (TEV)				
	Use Value		Non-use Value		
	Direct Use Value Resources used directly Provisioning services	Indirect Use Value Resources used indirectly Regulating services	Option Value Our future possible use	Bequest Value Future generation possible use	Existence Value Right of existence
Marine ecosystem	Fisheries: Artisanal (with hooks) Artisanal (with nets) Semi-Industrial Trawling companies		(Biodiversity)	(Biodiversity)	(Biodiversity)
Mangroves	Timber Non-timber products	Flood control Sewage treatment Drinking water Maintenance of a favourable climate Erosion control	Biodiversity	Biodiversity	Biodiversity Spiritual and religious Aesthetic Inspirational Educational Sense of Place Cultural heritage
Beaches	Tourism		Biodiversity	Biodiversity	Biodiversity Spiritual and religious Aesthetic Inspirational

					Educational Sense of Place Cultural heritage
Coastal ecosystems (lagoons and seaweed meadows)	Tourism	Flood control Erosion control	Biodiversity	Biodiversity	Biodiversity Spiritual and religious Aesthetic Inspirational Educational Sense of Place Cultural heritage

5 Conclusion and additional recommendations

This report provides for a review of methods on economic valuation of ecosystem services that can be used for the assessment of large marine ecosystems. For the GCLME, a simplified approach is proposed that allows for a first assessment of the economic value of the GCLME at present, which will be the next step to elaborate under this project in 2010..

Decision makers and stakeholders involved into the process of policy and decision making need to be aware of that the result of this valuation has its weaknesses. The results of this first ecosystem services valuation will not be sufficient to start with detailed management plans for the GCLME, but it will provide for important insights how valuable the existing ecosystem services are for the GCLME region and which benefits will be lost if a preference will be given to uses that further damage or destroy the ecosystems. As a consequence based on these results it won't be possible to make detailed decisions how the GCLME region needs to be developed in order to reach to environmentally sustainable management plans. But it will be possible to understand which ecosystems have been underestimated in the past in regard to their social and economic benefits on the one hand and on the other hand to understand that activities, which at a first glance appear to be economically profitable, provoke not only environmental damage but that they also cause significant economic loss. Therefore this first valuation exercise will help to identify explicit and also hidden trade-offs in the use of ecosystem services and other (economic) activities.

For the future work on the conservation of the GCLME however it will be advisable to reconsider other valuation techniques that provide for much more detail and that will be useful for in-depth decision making

6 References

BA, Cheikh Oumar Joshua BISHOP, Moustapha DEME, Hamet Diaw DIADHIOU, Alioune B. DIENG, Omar DIOP, Pedro Andres GARZON, Bara GUEYE, Moustapha KEBE, Oumou K. LY, Vaque NDIAYE, Cheikh Mbacké NDIONE, Astou SENE, Djiby THIAM and Ibrahima A. WADE. (2006): The Economic Value of Wild Resources in Senegal: A preliminary evaluation of non-timber forest products, game and freshwater fisheries. IUCN, Gland, Switzerland and Cambridge, UK, download at http://cmsdata.iucn.org/downloads/ba_et_al_2006_english.pdf, visited on 31. December 2009.

Barbier, Edward B et al. (2008): Coastal Ecosystem-Based Management with Nonlinear Ecological Functions and Values, Science 319, 321 (2008)

Barbier, Edward B; Acreman, Mike and Duncan Knowler (1997) Economic Valuation of Wetlands a Guide for Policy Makers and Planners, Ramsar Convention Bureau; IUCN-The World Conservation Union; download at http://topshare.wur.nl/publicfiles/71372_13_economic%20valuation%20of%20wetlands%20-%20a%20guide%20for%20policy%20makers%20and%20planners.pdf.

Boyd, James and Banzhaf, Spencer (2006) What Are Ecosystem Services? The Need for Standardized Environmental Accounting Unites, Publisher: Resources for the Future , download at http://www.biodiversityeconomics.org/document.rm?id=1073, visited on 31. December 2009.

Brown, C., Corcoran, E., Herkenrath, P. & Thonell, J. (eds). (2006): Marine and coastal ecosystems and human wellbeing: A synthesis report based on the findings of the Millennium Ecosystem Assessment, UNEP DEWA & UNEP-WCMC, Cambridge, UK download at http://www.unep-wcmc.org/resources/PDFs/Completev6.pdf , visited on 31. December 2009.

Carpentera, Stephen R. et al. (2009): Science for managing ecosystem services: Beyond the Millennium Ecosystem Assessment, Proceedings of the National Academy of Sciences 106: 1305-1312 (2009)

De Groot, R.S., Stuip, M.A.M., Finlayson, C.M. & Davidson, N. (2006): Valuing wetlands: guidance for valuing the benefits derived from wetland ecosystem services, Ramsar Technical Report No. 3/CBD Technical Series No. 27. Ramsar Convention Secretariat, Gland, Switzerland & Secretariat of the Convention on Biological Diversity, Montreal, Canada. ISBN 2-940073-31-7.

EFTEC (2006): Valuing Our Natural Environment, Institution: DEFRA, download at http://www.biodiversityeconomics.org/document.rm?id=893, visited on 31. December 2009.

Emerton, L. (ed), 2005, Values and Rewards: Counting and Capturing Ecosystem Water Services for Sustainable Development. IUCN Water, Nature and Economics Technical Paper No. 1, IUCN — The World Conservation Union, Ecosystems and Livelihoods Group Asia [several case study in different countries of Africa and south asia, but related to inland waters]

Emerton, Lucy (1999): Economic Tools for the Management of Marine Protected Areas in Eastern Africa, download at http://data.iucn.org/dbtw-wpd/edocs/1999-044.pdf , visited on 31. December 2009.

Emerton, Lucy ; Bos, Elroy (2004): Value : counting ecosystems as water infrastructure, IUCN, download at http://data.iucn.org/dbtw-wpd/commande/downpdf.aspx?id=10582&url=http://www.iucn.org/dbtw-wpd/edocs/2004-046.pdf , visited on 31. December 2009.

Emerton, Lucy, ed. ; Chong, Joanne (2005): Valuing the role of aquatic resources in livelihoods : economic aspects of community wetland management in Stoeng Treng Ramsar site, Cambodia, IUCN [case study on the Mekong River/ Cambodia] , download at http://cmsdata.iucn.org/downloads/2005_047.pdf, visited on 31. December 2009.

GCLME Regional Coordination Unit (2006): Transboundray Diagnostic Analysis – a Programme of the Governments of the GCLME Countries, with the assistance of GEF/UNIDO/UNDP/UNEP/US-NOAA/NEPAD/FAO and IMO; Accra, Ghana, download at http://igcc.gclme.org/downloads/TDA_book.pdf, visited on 31. December 2009.

Hoagland, Jin, Thunberg and Steinback (2005): Economic Activity Associated with the Northeast Shelf Large Marine Ecosystem: Application of an Input-Output Approach (Chapter 7 in

Sustaining Large Marine Ecosystems: The Human Dimension, T. Hennessey and J. Sutinen, Eds. Elsevier, 2005), download at http://www.iwlearn.net/publications/misc/econ-neshelf-lme, visited on 31. December 2009.

Hoagland, Porter; Jin, Di (2006): Accounting for Marine Economic Activities in Large Marine Ecosystems and Regional Seas, United Nations Environment Programme, Regional Seas Programme (UNEP/RSP), Project No. CP/6000-04-71-2108, FINAL REPORT, April 2006 [Case Study: Benguela Current Large Marine Ecosystem and Case Study: Yellow Sea Large Marine Ecosystem], download at http://www.iwlearn.net/publications/misc/marineecon-whoi, visited on 31. December 2009.

Interim Guinea Current Commission (IGCC) Executive Secretariat (2008): Strategic Action Programme – Guinea Current Large Marine Ecosystem – a Programme of the Governments of the GCLME Countries, with the assistance of GEF/UNIDO/UNDP/UNEP/US-NOAA/NEPAD/FAO and IMO; Accra, Ghana, download at http://igcc.gclme.org/downloads/GCLME_SAP.pdf , visited on 31. December 2009.

Kallesøe, Mikkel Franklin ; Bambaradeniya, Channa ; Iftikhar, Usman Ali ; Ranasinghe, Thushara ; Miththapala, Sriyanie (2008): Linking coastal ecosystems and human well-being : learning from conceptual frameworks and empirical results, IUCN, Ecosystems and Livelihoods Group Asia ; Spain, Ministerio de Medio Ambiente Colombo, LK : Ecosystems and Livelihoods Group, Asia, 2008. viii, 49p. [case studies on tsunami affected Sri Lanka and Thailand] , download at http://data.iucn.org/dbtw-wpd/commande/downpdf.aspx?id=11312&url=http://www.iucn.org/dbtw-wpd/edocs/2008-021.pdf , visited on 31. December 2009.

Kimball, Lee A (2003): .International ocean governance : using international law and organizations to manage marine resources sustainably, IUCN, download at http://data.iucn.org/dbtw-wpd/commande/downpdf.aspx?id=10270&url=http://www.iucn.org/dbtw-wpd/edocs/2001-053-2ed.pdf , visited on 31. December 2009.

Koch, Evamaria W et al. (2009): Non-linearity in ecosystem services: temporal and spatial variability in coastal protection, Front Ecol Environ 2009

Kramer, Randall A. (2005) Economic Tools for Valuing Freshwater and Estuarine Ecosystem Services, download at http://www.iwlearn.net/abt_iwlearn/events/ouagadougou/readingfiles/dukeuniversity-valuing-freshwater-estuarine-services.pdf , visited on 31. December 2009.

Krchnak, Karin M. (2007): Watershed Valuation as a Tool for Biodiversity Conservation, Publisher: The Nature Conservancy [six case studies in Latin America and Indonesa] , download at http://www.biodiversityeconomics.org/document.rm?id=1077, visited on 31. December 2009.

López Ornat, Arturo ; Jiménez-Caballero, Sira (2006): Sustainable financing sources for protected areas in the Mediterranean, IUCN, Centre for Mediterranean Cooperation ; Azahar Programme ; Biodiversity Foundation ; Spain, Ministerio de Medio Ambiente, Malaga, ES : IUCN Centre for Mediterranean Cooperation, 2006. 141p. : ill., maps. , download at http://data.iucn.org/dbtw-wpd/commande/downpdf.aspx?id=11001&url=http://www.iucn.org/dbtw-wpd/edocs/2006-040.pdf , visited on 31. December 2009.

Millennium Ecosystem Assessment (2003): Ecosystems and Human Well-Being - A Framework For Assessment, Island Press. , download at http://www.millenniumassessment.org/documents/document.271.aspx.pdf , visited on 31. December 2009.

Naidoo, Robin A. Balmford, R. Costanza, B. Fisher, R.E. Green, B, Lehner, T.R. Malcolm and and T.H. Ricketts (2008): Global Mapping of Ecosystem Services and Conservation Priorities, Journal PNAS Volume 105, Publisher: National Academy of the Sciences of the USA, download at http://www.biodiversityeconomics.org/document.rm?id=1150, visited on 31. December 2009.

Olsen, Stephen B.; Sutinen, Jon G.; Juda, Lawrence; Hennessey, Timothy M.; Grigalunas; Thomas A. (2006): A Handbook on Governance and Socioeconomics of Large Marine Ecosystems, University of Rhode Island, download at http://www.iwlearn.net/abt_iwlearn/pns/learning/lme-gov-handbook.pdf , visited on 31. December 2009.

Pagiola, Stefano; Ritter, Konrad von and Bishop, Josh (2004): How much is an ecosystem worth? Assessing the economic value of conservation, Publisher: IBRD/The World Bank, download at http://www.biodiversityeconomics.org/document.rm?id=710, visited on 31. December 2009.

Redhouse, David; Roberts, Paul and Tukai, Rehems (2004): Everyone's a winner? Economic valuation of water projects, Institution WaterAid [scarce case study on India and Tansania] , download at http://www.biodiversityeconomics.org/document.rm?id=749, visited on 31. December 2009.

Rönnbäck, Patrik et al. (2008): Ecosystem Goods and Services from Swedish Coastal Habitats: Identification, Valuation, and Implications of Ecosystem Shifts, Ambio, Vol. 36, No. 7, November 2007 (2008)

Schuyt, Kirsten; Brander, Luke (2004): Economic Values of the World's Wetlands, download at, http://assets.panda.org/downloads/wetlandsbrochurefinal.pdf.

Sherman, K. and Hempel, G. (Editors) (2009):The Unep Large Marine Ecosystems Report :A Perspective on Changing Conditions in LMES of the World's Regional Seas. UNEP Regional Seas Report and Studies No. 182. United Nations Environement Programme. Nairobi, Kenya. 2nd printing, download at http://www.lme.noaa.gov/LMEWeb/Downloads/unep_lme_report.zip , visited on 31. December 2009.

Sherman, K., Aquarone, M.C. and Adams, S. (Editors) 2009. Sustaining the World's Large Marine Ecosystems. Gland, Switzerland: IUCN. viii+142p , download at http://www.lme.noaa.gov/LMEWeb/Downloads/book_sustain.pdf , visited on 31. December 2009.

Sherman, Kenneth; Aquarone, Marie-Christine; Adams (2007): Sally Global Applications of the Large Marine Ecosystem Concept 2007 – 2010 , download at http://www.lme.noaa.gov/LMEWeb/Publications/tm208.pdf , visited on 31. December 2009.

Smith, V. Kerry (1996): Pricing What is Priceless: A Status Report on Non-Market Valuation of Environmental Resources, download at http://www.biodiversityeconomics.org/document.rm?id=327, visited on 31. December 2009.

Söderqvist, Tore; Eggert, Håkan; Olsson, Björn and Soutukorva, Åsa (2005): Economic Valuation for Sustainable Development in the Swedish Coastal Zone, AMBIO: A Journal of the Human Environment, Volume 34, Issue 2 (March 2005) pp. 169–175

Springate-Baginski, Oliver, ed. ; Allen, David, ed. ; Darwall, William, ed (2009): .An integrated wetland assessment toolkit : a guide to good practice, , download at http://data.iucn.org/dbtw-wpd/commande/downpdf.aspx?id=11444&url=http://www.iucn.org/dbtw-wpd/edocs/2009-015.pdf , visited on 31. December 2009.

Sukhdev, Pavan; Leader, Study (2008): The Economics of Ecosystems and Biodiversity (TEEB), Remote document, Publisher: European Communities, Institution European Commission, download at http://www.teebweb.org/LinkClick.aspx?fileticket=5y_qRGJPOao%3d&tabid=1018&language=en-US , visited on 31. December 2009.

Sumaila, Ussif Rashid; Munro, Gordon and Keith, Heather (2005): Benguela Current Commission (BCC) Economic Study, , download at http://earthmind.net/marine/docs/bcc-economic-study.pdf , visited on 31. December 2009.

Sutinen, Jon G. Editor (2000): A Framework for Monitoring and Assessing Socioeconomics and Governance of Large Marine Ecosystems, download at http://www.iwlearn.net/publications/misc/econ-neshelf-lme , visited on 31. December 2009.

Tallis, Heather; Polasky, Stephen (2009) Mapping and Valuing Ecosystem Services as an Approach for Conservation and Natural-Resource Management, The Year in Ecology and Conservation Biology, 2009: Ann. N.Y. Acad. Sci. 1162: 265–283 (2009).

Turner, R. K. J. Pavavola, P. Cooper, S. Farber, V. Jessamy and S. Georgiou (2003): Valuing nature: lessons learned and future research, Journal Ecological Economics, Volume 46: 493-510, download at http://www.biodiversityeconomics.org/document.rm?id=951, visited on 31. December 2009.

Turpie, Jane ; Ngaga, Yonika M. ; Karanja, Francis K. (2005): Catchment ecosystems and downstream water : the value of water resources in the Pangani basin, Tanzania, IUCN, Water and Nature

Initiative ; IUCN, Ecosystems and Livelihoods Group Asia ; IUCN, Regional Office for Eastern Africa, Series: IUCN Water, Nature and Economics Technical Paper ; no.7, Colombo : IUCN Ecosystems and Livelihoods Group Asia, 2005. 99p. : ill., maps. , download at http://data.iucn.org/dbtw-wpd/commande/downpdf.aspx?id=10978&url=http://www.iucn.org/dbtw-wpd/edocs/2005-103.pdf , visited on 31. December 2009.

Ukwe, Chika (Project Manager) (2007): Combating Living Resources Depletion and Coastal Area Degradation in the Guinea Current Large Marine Ecosystem through Ecosystem Based Regional Actions: Technical report: Preliminary Report on Economic Valuation of Ecosystem Services and TDA, Prepared for the United Nations Industrial Development Organization, Vienna, not published, http://earthmind.net/marine/docs/gclme-draft-valuation-report.pdf, visited on 23. March 2010.

Wang, Chongyun; Meer, Peter van der; Peng, Mingchun; Wim Douven, Rudi Hessel, and Chenlin Dang (2009): Ecosystem Services Assessment of Two Watersheds of Lancang River in Yunnan, China with a Decision Tree Approach, AMBIO: A Journal of the Human Environment, Volume 38, Issue 1 (February 2009) pp. 47–54

UNIDO PROJECT/PROGRAMME
GPRAF04004 BL 1186

Combating living resources depletion and coastal area degradation in the Guinea Current Large Marine Ecosystem through Ecosystem-based regional actions

Subcomponent: Economic Valuation

Report on estimating/quantifying economic benefits of environmental and social services provided by healthy ecosystems in the GCLME/economic damage from using these services

FINAL REPORT

Author: Eduard Interwies (InterSus – Sustainability Services)
Report prepared for the United Nations Industrial Development Organization (UNIDO)
August 2010

Table of contents

1 Background and rationale of this report

The project "Combating Living Resources Depletion and Coastal Area Degradation in the Guinea Current LME through Ecosystem-based Regional Actions" has a primary focus on the priority problems and issues identified by the 16 GCLME countries that have led to unsustainable fisheries and use of other marine resources, as well as the degradation of marine and coastal ecosystems by human activities. The long-term development goals for the project are: 1) recover and sustain depleted fisheries; 2) restore degraded habitats; and 3) reduce land and ship-based pollution by establishing a regional management framework for sustainable use of living and non-living resources in the GCLME.

To stop and reverse the further degradation of ecosystems important for human well-being and biodiversity protection, it is crucial to develop strategies and policy instruments especially suited to overcome the challenge. In the context of designing such instruments, and in weighting different goals, it is important to estimate and understand the total economic value of the ecosystem’s contribution to the society. This contribution does not only comprise the immediate economic gains deriving from the use of raw materials, food, clean water etc. (use value), but also the benefits of non-use environmental services to which it is very difficult to attribute a certain value in monetary terms, such as landscape beauty, cultural nature sites, optional use for future generations etc. Economic valuation helps to demonstrate and quantify the economic value of ecosystems in terms of raw materials, protection of natural and human systems, and maintenance of options for future economic production and growth, as well as the costs associated with the loss of these beneficial values through resource degradation.

Ecosystems are systems consisting of biotic and abiotic factors. Ecosystems are dynamic. Thus an ecosystem is not a static composition of elements, but it consists of the interaction of animals, plants, micro-organisms, mineral resources, climatic and other factors. An ecosystem is somehow comparable with a living organism, not with dead material. Thus the service of an ecosystem is the result of this specific interaction, the product of the output of ecosystem elements and their interaction. The task of ecosystem service valuation is to assess the economic value of this output. If we look at the extraction of crude oil, sand, gravel or other mineral resources, we can state that the extraction produces a value. But this value does not derive from the ecosystem but just happens to share the same origin area as the one of the ecosystem. Mineral resources and fossil fuels are inert substances. Even more fossil fuels like crude oil seldom have any influence on the functioning of ecosystems. They consist just of a layer deep in the earth, without any effect on living resource. As a result, the revenue from the extraction of non-renewable resources such as crude oil can in this context not be regarded as a service provided by the ecosystem. The economic valuation of ecosystem services provides for a value that derives directly from the existence of the considered ecosystem.

Economic valuation of ecosystem services is not about summing up every economic activity in the area of investigation but to valuate those goods and services that directly derive from the existence of an ecosystem and its functioning.

In this context it needs to be noted that the economic valuation of ecosystem services is only one aspect that policy makers need to take into consideration when taking decisions. The value of oil extraction and other mining activities should not be ignored by decision making. But the assessment of this value is not part of an ecosystem service valuation.

As stated and detailed in the Methodology Report, this part of the project study will present the estimations of the economic values of environmental and social services provided by healthy ecosystems in the GCLME and the economic damages from losing these services. To achieve this goal, the methodological framework developed and outlined in the Methodology Report is used (see Chapter 2), integrating the information provided by the national experts, as well as several international studies listed in the relevant sections that are used mainly to derive values for the GCLME context through a Value Unit Benefit Transfer. Additionally, for the valuation of certain ecosystem services, secondary valuation methods that better reflect the characteristics of these services and functions – such as the Replacement Cost Method - are being utilized as well (see Chapter 3 and 4).

Following the evaluation, the document gives guidance to the economic valuation of GCLME ecosystem services that will be carried out in the framework of developing the National Action Plans. The outcome of the valuation gives important information to be used for decision-making on the measures to be identified in the NAPs (Chapter 5).

The report closes by giving recommendations as how to improve on data quality and quantity, and thus on improving future economic valuation attempts, and hints to open research fields (Chapter 6).

2 The valuation approach for the GCLME

One part of this study is the review of existing case studies on marine ecosystem valuation that provides for values that are transferable to the situation in the GCLME. In general Benefit Transfer is an approach that is applicable to both use values and non-use values. If possible, we will include existing data on ecosystem services value in the GCLME, and other valuation methodologies. As a result, the valuation exercise for the GCLME area will be a combined estimate deriving from existing data and the benefits transfer approach, plus additional methodologies wherever necessary.
The Benefit Transfer Method is useful in cases where a “real” valuation of the site is too complicated in terms of data availability, time and financial resources. Benefit Transfer includes different steps. In the beginning existing data of other studies needs to be identified. Then the transferability of this data has to be checked. This includes an analysis if the services to be compared have the same features and qualities. In addition the quality of the study providing for the values needs to be assessed.
After this, the data of the source study needs to be adjusted to the site under consideration. This involves a calibration with existing data of the site to be valuated. Finally, the calculation of the value of the ecosystem service has to be done.
The most fundamental problem for value transfers is in assessing whether a given transfer is correct or not when the ‘true’ value of the policy site is a-priori unknown.

Principally there are two different approaches to transfer benefit values from study sites to a policy site that are Unit Value transfer and benefit function transfer.
The Unit Value transfer approach directly transfers the (mean) benefit estimate (e.g. mean WTP/household/year) from the study site to the policy site. The benefit function transfer approach transfers the entire benefit function instead of transferring benefit estimates (i.e. values). Benefit function transfers entail the use of a model that statistically relates benefit measures with study factors such as characteristics of the user population and the resource being evaluated. The transfer process requires adapting the function to the characteristics and conditions of the policy site, forecasting a tailored benefit measure based on this adaptation of the function, and use of the forecast measure for evaluating the policy site.

The Unit Value transfer approach is most appropriate if the characteristics of the study sites and the policy sites are relatively similar. The benefit function transfer on the contrary offers the opportunity to transfer value functions if the study and policy sites are less similar and differences between the sites need to be incorporated into the calculation. Since the elimination of differences between study sites and policy sites is a rather complex task we aim at the identification of studies that are similar to the situation in the GCLME region. Thus we will base our approach to Benefit Transfer on the Unit Value transfer, because the incorporation of differences inherent in the value function approach may generate higher degrees of error than the simple transfer of mean values between those relatively homogeneous sites.

Some significant constraints of the Benefit Transfer Method exist:

- The risk of inaccuracy due to the fact that situations are never identical in two different sites;
- The quality of the transfer is directly dependent on the quality of the original study;

- The studies available may not have the sufficient detail to allow for a sufficient analysis of comparability and
- Unit Value estimates can quickly become outdated.
- Differences between the study site(s) and policy sites that are not specified in the valuation model or in the procedure used to adjust the unit value. To these belong:
    - Differences in the socio-economic characteristics of the relevant populations;
    - Differences in the physical characteristics of the study and policy site;
    - Difference in the proposed change in provision between the sites;
    - Differences in the market conditions applying to the sites (for example variation in the availability of substitutes).

Even so, the transfer of values we will apply will not be fully academic, but more practically oriented in order to offer rough estimations, to be refined in the future.

In the present analysis we will try to minimise these constraints and the following steps will be included into our benefits transfer approach:

- Identification of existing studies or values that can be used for the transfer.
- Decide whether the existing values are transferable. Important criteria in this context are:
    - Comparability of the valued service regarding the similarity of the sites (type, quality, availability of substitutes).
    - Evaluation of the quality of studies to be transferred.
- The final step is to adjust the existing values to better reflect the values for the site under consideration, by cross-checking the data of the transfer with available data in the GCLME, provided by the national experts.

We will furthermore supplement the estimations derived by the Unit Value transfer by providing results gained from the Replacement Cost method. This methodology is applicable to indirect use values (e.g. coastal protection, erosion and pollution control, water retention etc.). The value of the ecosystem service to be valuated can be estimated by calculating the costs that would occur for building necessary infrastructures to replace the service (e. g. treatment plants, dikes) or by calculating the estimated damage of a hazardous event (storm).
A main constraint of this method consists in the assumption that the cost of the substitutes matches the original benefit. But many external circumstances may change the value of the original expected benefit and the method may therefore lead to under- or overestimates. Because of its tendency to over- or underestimate the actual value, the measurement has to be regarded with a certain degree of caution. To flank the Benefit Transfer and to provide additional information, however, it is perfectly applicable.

3 How to calculate the value of ecosystem services in the GCLME based on Benefit Transfer approach?

The Methodology Report explained in detail the role of economic valuation of ecosystem services in LME conservation, and identified the main ecosystem services and relevant uses. It furthermore gave insights into the assessment of ecosystem services, and the methodology used to evaluate them (see also Chapter 2). The report also stated that it will not be possible to consider every ecosystem service that provides or could provide for beneficial use in the GCLME at present and in the future. Therefore, we need to select those ecosystem services that are of the greatest importance and for which it is possible to generate an estimate. The modified table[1] below provides for an overview on those values for which it is possible to calculate a first estimate.

The sections that follow this table provide for details on the practical approach to the first valuation of the ecosystem services in the GCLME. It is a combination of existing data of the GCLME region and other methodologies, mainly Benefit Transfers from case studies of other marine ecosystems and/or ecosystems that are similar to those that can be found in the GCLME region, and Replacement Cost assessments.

As outlined in the Methodology report, the calculation of the value of ecosystem services in the GCLME will assess use values and set a strong emphasis on non-use values, as far as possible.

[1] In this version of the table, the ecosystems of the GCLME are subdivided into "marine ecosystems" and "coastal ecosystems", the latter including mangrove forests and swamps as well as lagoons, seaweed meadows and beaches. For further simplification, "flood protection" and "erosion control" are merged as well, as they derive from the same ecosystem function (Disturbance Prevention) (cf. Methodology Report).

Table 3.1: Overview on values of ecosystem services to be considered for the valuation

Ecosystems	Total Economic Value (TEV)			
	Use Value		Non-use Value	
	Direct Use Value Resources used directly Provisioning services	Indirect Use Value Resources used indirectly Regulating services	Bequest Value Future generation possible use	Existence Value Right of existence
Marine ecosystem	Fisheries Artisanal (with hooks) Artisanal (with nets) Semi-Industrial Trawling companies		Biodiversity	Biodiversity
Coastal ecosystems -Mangroves (swamps/forests) -Coastal lagoons -Seaweed meadows/seagrass beds -Others (e.g. beaches)	Timber Non-timber products Tourism	Flood/Erosion control Sewage treatment Drinking water Maintenance of a favourable climate Fish nursery Carbon Sequestration		Biodiversity Spiritual and religious Aesthetic Inspirational Educational Sense of Place Cultural heritage

3.1 Practical considerations regarding the methodological approach to the valuation of the different ecosystems

In this section, the methodology for evaluating the different ecosystem services will be explained. First, an overview of methodological details and simplifications undertaken by the author in order to cope with the varying quality of available data as well as to provide a comprehensive report is given. This overview applies to both use and non-use values. Then, the various use values are described, structured according to their belonging to either marine or coastal ecosystems. Finally, the non-use values are described, although, divergent from the structure given in the section on use values, they are not classified by ecosystem, but by differentiating between biodiversity and other non-use values, reflecting the gaps in separate data sets for the non-use values of marine ecosystems on the one hand, and coastal ecosystems on the other hand.

1) The ecosystem types seagrass beds, mangrove swamps and forests, coastal lagoons and sandy beaches have been merged into a single category named "coastal ecosystems".
2) This category, however, needs to be clarified regarding its actual content:
   - "Seaweed meadows/seagrass beds" are not very well developed in the region (cf. GCLME Transboundary Diagnostic Analysis 2006: 13f). It is assumed that these ecosystems do not play a significant part in the GCLME region, and they are accordingly not included in the category "coastal ecosystems".
   - The ecosystem type "sandy beaches" is considered an important nesting ground for sea turtles and birds, and is particularly common on the Angolan coast. Unfortunately, there is no data available regarding the distribution of those nesting grounds in the region generally or on the Angolan coast specifically. The sandy beaches are, however, not completely excluded from the economic analysis, as their worth to tourism is considered in the relevant section (see below).
   - The data available on the size and area of the relevant ecosystems is sufficient only for mangroves, but is not differentiated between mangrove forests or swamps, or between different conditions of mangrove ecosystems.
   - Furthermore, the ecosystem types "mangrove forests/swamps" and "coastal lagoons" are considered to be congruent, as the data actually does not differentiate selectively between those two ecosystem types, since most of the shorelines of lagoons are covered by mangroves anyway. In fact, the only spatial data available on coastal lagoons (cf. GCLME Transboundary Diagnostic Analysis 2006) includes the water surface of those water bodies, hence enlarges the area of by multiple factors. Moreover, the two ecosystems provide for similar ecosystems services, and using the proposed methodology prevents us from significantly overestimating the area of relevant ecosystems and thus rendering the report noncredible.
   - Therefore, only mangroves and coastal lagoons are included in the category "Coastal Ecosystems" and only these are considered for the economic valuation of use values of terrestrial ecosystems in this report, because:
     - Lack of data and relative importance of other terrestrial ecosystems, as described above.

- Mangroves and coastal lagoons provide for the broadest range of ecosystem services in the region, and are well studied in other sites of the world.

- Mangrove ecosystems often have very unique features that can't be found in other regions of the world. Therefore the regional ecological specifics of the mangroves need to be kept in mind and the result of the Benefit Transfer cannot be the basis for local decision making, but for a global trade-off analysis for the whole GCLME region.

3) It is recognized by the author of this report that a portion of the fishing output summarized under marine ecosystems will definitively take place in the coastal ecosystems. As it was impossible to distinguish between those two areas with regard to fishing output, the direct use value "fishing" is now integrated into marine ecosystems. The important share of the coastal ecosystems of the total fishery output is accounted for, however, by allocating those ecosystems the indirect use value "fish nursery", a value that will be calculated on the basis of the total fishery output (see below). That value will then be subtracted from the total fishery output to calculate the final figure, to avoid double counting.

4) The use values are independent of each other and include no risk of double counting of values. Thus the values can be calculated in a simple addition. The values will be estimated on the basis of US$/ha of mangroves (see above). As far as possible the valuation on the basis of benefits transfer will provide estimates for the single ecosystem services listed above. In addition an estimate on the total economic value (TEV) of mangroves will be provided.

3.2 Use Values

3.2.1 Marine Ecosystems

The use values of marine ecosystems consist mainly of the income generated by fishing, including:

- Artisanal Fishing (with hooks)
- Artisanal Fishing (with nets)
- Semi-Industrial Fishing
- Trawling companies.

As mentioned in the Methodology Report, the revenue resulting from extraction of mineral resources cannot be regarded as an ecosystem service or good, because the existence of these resources is not dependent on the existence of an ecosystem (cf. Methodology Report). On the contrary: mining and oil production in general must be regarded as activities with negative impacts to ecosystems and their functions. Thus mining and oil production should only be considered in regard to their environmental impact or in other words how much of the value of the ecosystems these activities would deteriorate. The discussion of the costs and benefits of different economic activities, potential impacts to LME conservation goals and trade-offs with other social and economic objectives is a step that should follow the valuation exercise of ecosystem services, while integrating its results. Therefore, we will exclude mining and oil production from the approach to economic valuation presented with this report (cf. Methodology Report).

During the analysis of the extensive documents and statistics provided by the national experts (see ANNEX), it was not possible to acquire data differentiating between the various methods of artisanal and industrial fishing. The economic valuation therefore follows the methodology of the Ukwe report (BDCP 2007) and provides an overall figure for the economic value of fishing in the GCLME.

This figure, however, needs furthermore to be viewed in the light of the question whether the current methods are still in the stage of being sustainable or not, meaning that the fishing practice already leads to a depletion of fish stock (cf. World Bank/FAO 2009). The author of this report assumes that the current fishing practices exceed the reproduction rate of fish stock, therefore also the value of a fishing practice needs to be calculated that respects the reproduction rate. Some problems have to be considered in this respect. First, the reproduction rate of fish is dependent on various factors, such as nursery ground, water pollution etc. An improvement of the preconditions for reproduction would yield in larger fish stock. Secondly, fish trawlers are not only coming from GCLME countries but also from other states, which often includes illegal, unreported and unregulated fishing (IUU). The fish landed by trawlers coming from outside of the GCLME in ports outside the GCLME would also need to be considered if calculating landings of a sustainable fishing practice.

Unfortunately, the data requirements to calculate the number ("Tons of fish-landing that would respect the reproduction rate of fish stock") could not be provided by the national experts. To cope with that, in this report a global estimation of a necessary 20% reduction in fishing area and output to guarantee sustained fish stocks is adopted (Sukhdev/Kumar 2009). A similar number was estimated for the Nigerian waters (Tobor 1990). Thus, the figures provided by Ukwe (BDCP 2007) are used as a basis, and adapted by applying a 20%-reduction to reflect a sustainable level of fishery output.

As mentioned above, to get the final result, this figure will then be reduced by the value determined for the indirect use value "fish nursery" of coastal ecosystems, to avoid double counting.

3.2.2 Coastal ecosystems

Coastal ecosystems include mangrove forests and swamps, coastal lagoons, seagrass beds and sandy beaches (see above; cf. GCLME Transboundary Diagnostic Analysis 2006). These ecosystems provide for a broad range of ecosystems services, including the following direct use values:

- Timber
- Non-timber products
- Tourism

The role of natural resources in livelihoods is typically significant (especially among poorer households) — although is rarely recorded in formal statistics or indicators of economic output and growth, or factored into the investment appraisals or cost benefit analyses informing development activities in coastal areas. Mangrove forests have been shown to sustain more than 70 direct human activities, ranging – beside fishery - from fuelwood collection to the gathering of medicinal herbs and raw materials for constructing housings or manufacturing traded goods (Dixon 1989).

To depict the economic gains generated by using the forestry products of mangroves – labelled as "timber" and "non-timber forestry products" (NTFP) - a twofold approach is chosen. First, a Unit Value transfer is conducted, using studies from south Asian mangrove regions as study sites. Second, the value for NTFP in eight GCLME countries generated by

Ukwe (BDCP 2007), using shadow prices, is adapted to all sixteen members, and broken down to a per ha figure, to allow for better comparison.

The coastal ecosystems of the GCLME, including mangroves, lagoons and sandy beaches, are very important resources for the regional tourism industry. Unfortunately, in most GCLME countries, there are few data available on tourism at all, let alone data differentiated by coast/inland or by a certain ecosystem. Furthermore, it is not possible to transfer tourism data from other world regions to the GCLME because tourism is highly dependent on access and standards of infrastructure. Therefore, a Benefit Transfer exercise is not possible in this case.

Thus, we chose an alternative way of generating figures depicting the importance of the ecosystems for the tourism industries of some GCLME countries. First, we collected all information available via the national experts, national tourism statistics and the World Tourism Organization (WTO), especially regarding

a) the relative importance of tourism for the economy of a certain country (% share of GDP), and
b) the relative importance of the coastal region for the tourism industry of a certain country (% share of guest nights at coast, or similar data).

Second, we calculated a ratio between the tourism on the coast and in other parts of the country, based on the available data and utilizable in countries without having the exact information as well. Third, this ratio is then used as a percentage of the value of the tourism industry embodied by the % share of GDP, displayed per coastal km.

It is assumed that in GCLME countries without available data on the GDP-share of the tourism industry, the tourism sector is negligible.

In this way, the direct use value “tourism” is calculated for the whole coast, not for a single ecosystem, with the advantage of being able to include ecosystems for which actually no data is available, like sandy beaches, into the account.

Regarding tourism, we will tolerate the data inaccuracy that derives from the inclusion of tourism that is not related to visits of ecosystems (recreation, scientific and educational purposes).

The coastal ecosystems furthermore provide for a broad range of ecosystems services, including the following indirect use values

- Flood control /Erosion control
- Sewage treatment/nutrient reduction
- Drinking water
- Maintenance of a favourable climate
- Fish nursery
- Carbon Sequestration

The value of coastal ecosystems for storm protection and preventing land erosion is generally difficult to estimate. A possibility to close this gap is the usage of the Replacement Cost method, although in itself not undisputed (cf. Barbier 2007). We identified two projects of planned or existing coastal protection works in damaged coastal areas in the GCLME, and will use them as a basis for the calculation, in which the cost of the erosion control measure can be regarded as the Replacement Cost of coastal ecosystems that are not yet damaged.

The respective width of mangroves necessary to offer the same degree of coastal protection is assumed to be 100m, according to relevant literature (cf. Barbier 2007 and 2008).
In addition to this, we performed a Unit Value Benefit Transfer (cf. Methodology Report) using several south Asian studies on the economic value of mangroves as study sites.

Mangroves, especially mangrove swamps, have a very important ecological function in filtering water and degrading and decomposing organic materials, thus serving as a biological purification plant. Thus, the indirect use values "sewage treatment" and "drinking water" could be calculated in a similar way as above, by using costs of treatment plants to reflect the value of ecosystem services that provide surrounding populations with clean or potable water. As it was impossible to obtain data from the region regarding such projects, we will display the value of these use values by carrying out a Unit Value Benefit Transfer, again using several south Asian mangrove studies.

The ecological function of coastal ecosystems in maintaining a favourable climate, through cooling the air and at the same time reducing wind speeds and offering shade is well respected and important. Nevertheless, it was neither possible to get data on this ecosystem service through the national sources, nor through international literature that could have been that basis for a Benefit Transfer. Accordingly, this indirect use value has to be excluded from further analysis.

Mangroves and coastal ecosystem provide a further extremely crucial service to the surrounding societies, namely the restocking of fisheries by constituting fish nurseries and breeding grounds (Rönnbäck 1999). To exactly calculate the reproduction rate of fish species in mangrove areas, or the losses in catch inflicted by the destruction of mangrove ecosystems, it would be important to get scientific information in the linkages between mangrove forests and fishery production (cf. Rönnbäck 1999; Barbier 1994). However, data on those linkages is unavailable for the GCLME region. But international studies were facing the same task, and some hints can be taken from those.
In a 1996 World Bank study, it is estimated that the fishery and mangrove linkage is that one ha of mangrove forest provides rearing habitat for 0.7 tonnes of capture fisheries yield. That is, a loss of 100 ha of mangroves would cause fish harvest to fall by 70 tonnes (World Bank 1996). Rönnbäck (1999) recommends a quota of 30 – 80% of the total annual value of near-shore fisheries to be credited to mangrove services, while Emerton/Kekulandala (2003) assume a 10% relation between fishery value and nursery/breeding ground service provided by mangroves.
In this report, first we calculate according to the World Bank assumption, meaning that we will be able to attribute a concrete number to each ha of mangrove ecosystems, by using per tonnes values derived from Ukwe (BDCP 2007). Secondly, we use the conservative 10% figure of Emerton/Kekulandala (2003), to get a comparison and a sensitivity analysis on the scope of the contribution of coastal ecosystems to total fishery.
As detailed above, these results are to be subtracted from the total fishery output, to avoid double counting.

Tropical forests, including mangroves, have an important role in regulating carbon dioxide in the global atmosphere through the processes of respiration and photosynthesis, whereby plants absorb CO_2 and store it in their biomass. Therefore, another major ecological function of mangroves is to serve as carbon sink. The general approach in estimating the potential of

a forest in sequestrating carbon involves calculating the total biomass per hectare (biomass density), and then applying appropriate conversion factors to get the carbon equivalents. In estimating a monetary value of the carbon sequestered by the forest, an international price per unit amount of carbon reduced is usually applied.
In this report, we will identify reliable international studies evaluating the value of carbon stored, but we will limit the selection to mangrove studies exclusively. These identified studies will then be used as study sites to perform a Unit Value transfer.

3.3 Non-use Values

As mentioned in the Methodology Report, it won't be possible to provide for concrete figures, but in the following section we will try to give some indications on the dimension of non-use values. Non-use values are:

- Bequest Value - Future generation possible use
- Existence Value - Right of existence

The valuation of non-use values is a difficult topic, and still subject to a great extent of uncertainty. Although many studies have been performed covering non-use values (cf. DEFRA 2007), the methods employed suffer from empirical as well as statistical problems (cf. Hutchinson et al. 2008). Without going into details, challenges include the measurement of non-use values (cf. Mullan/Kontoleon 2008; Baumgärtner 2006) and statistical problems in interpreting the results of valuation studies ("embedding effect": cf. Bateman/Turner 1993; Kahnemann/Knetsch 2002).
Considering these difficulties, applying study results through a Benefit Transfer seems to be a difficult exercise (cf. Woodward/Wui 2001; Thiele/Wronka 2002). However, some insights can be drawn from a comparison with global estimates on non-use values as well as single case studies in this respect.

3.3.1 Biodiversity

The GCLME is one of the world's most productive marine areas and a globally important region of marine biological diversity. The coastal ecosystems like mangroves and shallow lagoons, as well as the terrestrial ecosystems not covered by this report, like the tropical West African rainforest, have to be recognized as hotspots of biodiversity.
Under the auspices of the Convention of Biodiversity all GCLME countries have prepared National Biodiversity Strategies and Action Plans. These documents provide for estimates on species diversity (numbers of species) and their threats. For Cameroon for example it is stated that:

> *There are 9000 species of flora, 156 of which are endemic and 74 which are classified as threatened; 297 species of mammals; 849 species of birds, 373 species of reptiles and amphibians, including 19 endemics; 451 species of fish with 35 of those classified as threatened.*

Unfortunately, such data is rarely comparable between countries, due to difficulties in data provision. Furthermore, such data is quite impossible to use directly because of a lack of instruments to *measure* biodiversity for the purpose of evaluating it (cf. Mullan/Kontoleon 2008).
Biodiversity has specific use value components (e. g. fishery, timber and non-timber products etc.) to which it is easier to attribute concrete values (and which are already evaluated in the above sections). Indeed, most studies on valuing biodiversity focus on the use-value, although a significant share of the value of biodiversity is related to non-use values. The loss

of biodiversity is one of the most important global challenges. It is still not possible to estimate what consequences the accelerated loss of biodiversity will have for the survival of human mankind in the future.

First attempts for quantifying the losses of terrestrial biodiversity have been made on the global scale. One example is the report on the Cost of Policy Inaction (COPI) (Braat/ten Brink 2008). The COPI report estimated an approximate loss of about 20% of biodiversity for the GCLME region for the period between 2000 and 2050, if no measures for biodiversity conservation will be taken. The African biodiversity losses will result in welfare losses of 17% of projected African GDP in 2050. Welfare losses do not only include the economic value in monetary terms but include anything related to human welfare.

As the COPI report includes the use-values of biodiversity, but at the same time excludes marine ecosystems, the COPI figures cannot be used as a measure for the non-use value of biodiversity in the whole GCLME region.

The figures for biodiversity losses, however, contain the direct and indirect use values already listed in the respective sections. Ergo, the COPI figure *includes* the non-use values of biodiversity, but all other values as well – to use some of the COPI results as a measure for the non-use values, the task would be to extract the non-use value, done in the COPI report only to a very limited extent and in a general way, by providing numbers for “Cultural diversity & Identity & Heritage & Recreation & Ecotourism”, amounting to 2.1% of total losses. Due to the impossibility of extracting exact ratios out of this mixture of use and non-use values, we assume an equal share between “Ecotourism & Recreation”, “Existence Value of Biodiversity” and “Other non-use values” (meaning cultural diversity/identity/heritage etc.). Therefore, we will assume the existence value of biodiversity and the other non-use values each having an equal share of the TEV of ecosystems of about 0.7%.

We will double-check this figure with available valuation studies which list extractable numbers (see Chapter 4), meaning that the studies available have to provide a very clear distinction between the non-use value biodiversity and cultural/education/aesthetic values. This figure is then applied to the use-values identified in this report for the GCLME region, to calculate the final values.

Valuing marine biodiversity suffers the added complication that the marine environment is extremely diverse. In addition the marine environment is difficult to sample and monitor. This complexity results in significant limitations in current scientific knowledge of the effects of marine biodiversity on ecosystem functioning. As a result, valuation studies have tended to focus on the terrestrial environment, as the above mentioned COPI report. Nevertheless, we will derive the non-use value of marine ecosystems in the same way as for terrestrial ecosystems, thus applying the 0.7 percentage to the marine use values (i. e. fisheries) as well. We are aware of the relatively low per hectare values resulting in this approach. We argue, however, that the relative density of species is much lower in marine ecosystems, and a lower per hectare value therefore justified. Furthermore, in using conservative estimations leading to lower boundary values, we strengthen the credibility of this report.

The terrestrial studies tried to estimate the non-use value of biodiversity by conducting economic valuation studies, mostly using the contingent valuation method (CVM). They are, however, not suitable for conducting a Benefit Transfer, as they first of all differ very much in methodology and initial situation, thus rendering them not transferable to the GCLME region. Second, the results of these studies directly depend on the socio-economic situation of the persons requested to express their willingness to pay or willingness to accept compensation and thus vary widely, the results often encompassing several orders of magnitude.

There are, however, several meta-analyses on economic valuation specifically of wetlands, namely Brouwer (1999), Woodward/Wui (2002), Schuyt/Brander (2004) and Brander (2006). Those studies include values for the non-use value of biodiversity, and cover a broad range of studies and study sites. Therefore, the results are certainly not tailor-fitted to the GCLME. Nevertheless, they give quite a good overview on minimum and maximum values for terrestrial biodiversity, and are used in this evaluation exercise to provide a comparative figure to the results derived through the methodology outlined above.
Summing up the methodology for the evaluation of the existence value of biodiversity in this report, we will use a three-step approach, consisting first of the results listed in the COPI report, providing numbers that describe the overall importance of biodiversity conservation. Second, the 0.7 percentage of TEV will be used on the basis of the identified use values in the GCLME, double-checked thirdly by the results of the most recent meta-analysis.

3.3.2 Other Non-use Values

Besides the non-use values of biodiversity, other non-use values consist of:

- Spiritual and religious value
- Aesthetic value
- Inspirational value
- Educational value
- Sense of Place
- Cultural heritage

As mentioned in the methodology report and outlined above, the evaluation of non-use values is a difficult exercise. Similar to the non-use value of biodiversity, cultural and scientific uses are also highly related to the specific context of region and/or situation. Each culture in the world attaches specific non-use values to ecosystems, and these preferences will greatly vary in terms of what has a value and what not. As a result, a numeric Benefit Transfer is fairly possible (Beaumont et al. 2008; Turpie et al. 2003).
In this report, we took the following alternative approach, closely related to the approach explained for the existence value of biodiversity: examining different valuation studies, we used the percentage of non-use values excluding biodiversity in regard to the TEV, creating an average percentage of non-use values excluding biodiversity of the TEV of different case studies of mangrove or wetland ecosystems, and to calculate this percentage with the TEV identified in the GCLME. This result we will compare with the relative numbers given in the COPI report, to double check the calculated percentage.
Through this methodology, we will as well evade the problems regarding the availability of studies covering the marine ecosystems, as we calculate the value of non-use values as a share of the overall TEV. The result provides a figure that represents an approximation to the ratio between use values and non-use values.

The following table summarizes the methodological approach to each ecosystem type and its use and non-use values:

Table 3.2: Methodologies

<table>
<tr><th rowspan="3">Ecosystems</th><th></th><th colspan="5">Total Economy Value</th></tr>
<tr><th></th><th colspan="2">Use Value</th><th colspan="3">Non-use Value</th></tr>
<tr><th></th><th>Direct Use Value</th><th>Indirect Use Value</th><th colspan="2">Bequest Value</th><th>Existence Value</th></tr>
<tr><td>Marine Ecosystems</td><td></td><td>Fisheries, including:
- Artisanal (hooks/nets)
- Industrial/Trawling
Methodology: adjusted data from Ukwe (BDCP 2007)</td><td></td><td colspan="2" rowspan="3">Biodiversity
Methodology: COPI estimations, plus analysis of meta-analyses</td><td rowspan="2">Biodiversity
Methodology: COPI estimations, plus analysis of meta-analyses</td></tr>
<tr><td rowspan="4">Coastal Ecosystems</td><td>Mangrove Swamps/ Forests</td><td rowspan="2">Timber
Non-timber products
Methodology: Unit Value Benefit Transfer
Tourism
Methodology: national statistics/GDP share</td><td rowspan="2">Flood Control/ Erosion Control
Methodology: Replacement Cost Method and Unit Value BT
Sewage treatment
Drinking water
Methodology: Unit Value Benefit Transfer
Fish nursery
Methodology: Unit Value Benefit Transfer
Carbon Sequestration
Methodology: Unit Value Benefit Transfer</td></tr>
<tr><td>Coastal Lagoons</td><td>Biodiversity
Spiritual/Religious Value
Aesthetic Value
Inspirational Value
Educational Value
Sense of Place
Cultural heritage
Methodology: international studies</td></tr>
<tr><td>Seaweed Meadows/ Seagrass beds</td><td>not included</td><td>not included</td><td>not included</td><td>not included</td><td>not included</td></tr>
<tr><td>Sandy Beaches</td><td>not included</td><td>not included</td><td>not included</td><td>not included</td><td>not included</td></tr>
</table>

4 Economic Valuation: Results

The following section contains the results of the economic valuation of the various ecosystem services, according to the methodologies outlined in both the Methodology Report, as well as above in Chapter 3.

For the later calculations of spatial values, at first a table containing the relevant sizes of ecosystems in the GCLME, as far as data was available, is provided:

Table 4.1: Size and area of ecosystems in the GCLME

State	Marine Area (ha)	Mangroves w/o coastal lagoons (ha)	Mangroves and Coastal Lagoons (ha)	Seeweed/Seagrass Meadows	Sandy beaches
Angola	-	33,300	-	fairly relevant	no data
Benin	790,000	6,600	22,300	fairly relevant	-
Cameroon	450,000	195,700	195,700	fairly relevant	-
Republic of Congo	-	1,700	-	fairly relevant	-
Cote d´ Ivoire	3,050,000	9,900	131,900	fairly relevant	-
DRC	-	20,100	-	fairly relevant	-
Guinea Ecuatorial	8,260,000	25,800	25,800	fairly relevant	-
Gabon	6,230,000	160,600	363,800	fairly relevant	-
Ghana	6,360,000	13,700	50,860	fairly relevant	-
Guinea	-	203,900	-	fairly relevant	-
Guinea Bissau	-	299,900	-	fairly relevant	-
Liberia	-	11,000	-	fairly relevant	-
Nigeria	6,150,000	738,600	763,300	fairly relevant	-
Sao Tome and Principe	60,000	140	140	fairly relevant	-
Sierra Leone	3,740,000	105,200		fairly relevant	-
Togo	-	1,100	6,860	fairly relevant	-
GCLME	252,797,700	1,827,240	-	fairly relevant	-

Sources: Corcoran 2007(data for mangroves); TDA (data for coastal lagoons and marine areas); Interim Guinea Current Commission (overall figures for GCLME).

4.1 Use Values

4.1.1 Marine Ecosystems

Fisheries (Artisanal/Industrial)

The fisheries resources of the ecosystem includes a diverse assemblage of fishes including small pelagics, (sardinellas shad), large pelagics (tuna and billfish), crustaceans and molluscs (shrimp, lobster, cuttlefish, and demersal species (sparids and croakers) (Ajayi 1994). The rich fishery resources are of both local and transboundary importance with stocks supporting artisanal fisheries and offshore industrial fisheries from many nations. Most of these straddling and migratory stocks have attracted large commercial fishing fleets from around the world, especially from the former Soviet Union, European Union, Eastern Europe, Republic of Korea, and Japan (Ibe/Csizer 1998). This wealth of estuaries, deltas, coastal lagoons and the nutrient-rich upwelling cold waters make a major contribution to the diversity of fish life in the GCLME region with an estimated 239 fish species, including *Sardinella aurita and maderensis*, *Thunnus albacares*, etc. as pelagic species; *Arius sp.*, *Pseudotolothus typus and senegalensis, Dentex sp., Octopus vulgaris, Cynoglossus sp.,* and others as demersal species. Pelagic tuna fishing also constitutes an important industry in the GCLME region (Ajayi 1994).

As detailed above (Chapter 3), the total monetary output of fisheries is calculated using the Ukwe (BDCP 2007) data as basis, adapting those figures by subtracting first a 20%-amount reflecting sustainable levels of fishing, and second the value of coastal ecosystems as fish nursery, to avoid double counting.

In the Ukwe report (BDCP 2007), the total landings of industrial and artisanal fisheries in the GCLME in 2003, including an estimated number for illegal, unregistered or unregulated fishing (IUU), amount to 1 588 514 tonnes, reflecting an economic value of 18.7 bn. (18 795 400 070) US $. To incorporate sustainability quotas into this number, we explained above to subtract 20% of these figures, resulting in a sustainable economic fishing output of 1 270 811 tonnes worth app. 15 bn. (15 036 320 056) US $. The following table summarizes the result and breaks it down to national levels:

Table 4.2: Sustainable fish landings per annum

State	Sustainable fish landings (t)	Sustainable fish landings ($)	Total Value of sustainable fish landings* ($)
Angola	171,039	2,069,571,900	1,862,614,710
Benin	9,597	116,123,700	104,511,330
Cameroon	45,071	545,359,100	490,823,190
Republic of Congo	17,635	213,383,500	192,045,150
Cote d´ Ivoire	45,120	545,952,000	491,356,800
DRC	3,655	44,225,500	39,802,950
Guinea Ecuatorial	2,000	24,200,000	21,780,000
Gabon	25,708	311,066,800	279,960,120
Ghana	277,638	3,359,419,800	3,023,477,820
Guinea	75,572	914,421,200	822,979,080
Guinea Bissau	3,093	37,425,300	33,682,770
Liberia	6,244	75,552,400	67,997,160
Nigeria	216,380	2,618,198,000	2,356,378,200
Sao Tome and Principe	2,722	32,936,200	29,642,580
Sierra Leone	38,560	466,576,000	419,918,400
Togo	14,274	172,715,400	155,443,860
IUU#	293,264	3,548,494,400	3,193,644,960
Total	1,247,572	15,095,621,200	13,586,059,080
GCLME area: 252797700 ha	-	-	53.7 US$/ha

Sources: BDCP (2007), adjusted.
30% IUU quota adapted by BDCP is congruent with international research (cf. EFTEC 2008).
*adapted by subtracting the use value "fish nurseries".

Explanatory notes:

- The data in the above pictured table is derived from FAOSTAT sources (2006), as it provides a coherent methodology and comparative results. There is, however, a number of country-specific data provided by some national experts that is very detailed and reliable, especially because time series are given in many cases. Those data is depicted in ANNEX, to be used with guidance given in Chapter 5, especially regarding the price for a single tonne of fish landings.
- Please refer to Chapter 5 as well for guidance as to how adjust the values to national per hectare values.
- As IUU landings amount to 30% of all fish landings, the table could of course be presented in another way, reducing IUU in the region, and at the same time increasing legal sustainable fish landings.
- As BDCP (2007) and FAOSTAT (2006) do not differentiate between artisanal and industrial fishing, this classification is not depicted here. There is, however, the possibility of calculating those numbers using the data provided by national experts (see ANNEX) or following the general guidelines outlined in Chapter 5.

4.1.2 Coastal Ecosystems

<u>Timber and Non-Timber Products</u>

According to the methodology outlines above, a twofold approach is chosen to depict the economic gains generated by using the forestry products of mangroves. First, a Unit Value transfer is conducted, using studies from south Asian mangrove regions as study sites. Second, the value for NTFP in eight GCLME countries generated by BDCP (2007), using shadow prices, is adapted to all sixteen members, and broken down to a per ha figure, to allow for better comparison.

The studies identified as study sites for the Unit Value transfer are the following:

- Nam Do/Bennett (2005): "An economic valuation of wetlands in Vietnam's Mekong Delta: a case study of direct use values in Camau Province", estimating the value of timber products at 16.9 US $/ha/a (2005 value), using market prices.
- Emerton/Kekulandala (2003): "Assessment of the economic value of Muthurajawela wetland", Sri Lanka. The authors estimate the value of non-timber products at 150 US $/ha (2003 value), using market prices.

As both studies assess ecosystems that resemble the situations in ecosystems in the GCLME – mangroves in the first study, and a coastal wetland with a large share of mangroves in the second – there is no need to adapt the study results, except for adjusting the values to the general economic price level in West Africa (cf. Methodology Report), reflected by the GDP (PPP) per capita:

Table 4.3: GPD (PPP) Ratios between study and policy sites

State/Region	GDP (PPP) per capita (2009)	Ratio West Africa to Country
West Africa	1710	1
Vietnam	2850	0,6
Sri Lanka	4720	0,36

Sources: OECDstats; IMF.

Adapted to national price levels, the results of the Unit Value transfer are as follows:

- Timber products: 10.1 US $/ha/a.
- Non-timber products: 54 US $/ha/a.

In comparison, Ukwe (BDCP 2007) calculates the value of one of the major non-timber forestry products, the *periwinkle* snail, in eight countries of the GCLME (Benin, Cameroon, Cote d´Ivoire, Equatorial Guinea, Gabun, Ghana, Nigeria, Sao Tome) to be at 1.941 bn. US $. As those countries represent a mangrove area of 1 151 040 ha, the value per hectare of periwinkle amounts to 1686 US $/a.

The huge span in the results reflects the difficulties in assessing the correct price for products that are not traded on a real market, but exchanged or consumed locally. In order to use more conservative values, we will use the results gained through the Unit Value transfer, but make mention of the great spans whenever necessary.

<u>Tourism</u>

As outlined above, a Benefit Transfer was not possible in the case of tourism (Chapter 3). Instead, as a first step we collected all information available via the national experts, national tourism statistics and the World Tourism Organization (WTO), especially regarding

a) the relative importance of tourism for the economy of a certain country (% share of GDP), and

b) the relative importance of the coastal region for the tourism industry of a certain country (% share of guest nights at coast, or similar data).

The results are listed in the following table:

Table 4.4: Tourism industries and share of coastal tourism

State	Income tourism ($/year in brackets)	GDP corresponding year	Share of tourism of GDP (%): calculated	Share of tourism of GDP: experts*	Share of coastal tourism
Angola	66 Mio. (2004)	19,7 Mrd.	0,3	-	70%
Benin	106 Mio. (2003)	3,4 Mrd.	3,1	2%	70%
Cameroon	36 Mio. (1995)	8,7 Mrd.	0,4	-	70%
Republic of Congo	20 Mio. (2003)	3,5 Mrd.	0,5	-	70%
Cote d´ Ivoire	76 Mio. (2004)	15,4 Mrd.	0,5	44%	70%
DRC	1 Mio. (2004)	6,5 Mrd.	0,01	-	70%
Guinea Equatorial	5 Mio. (2000)	1,3 Mrd.	0,38	-	70%
Gabon	15 Mio. (2003)	5,6 Mrd.	0,26	0%	70%
Ghana	466 Mio. (2004)	8,8 Mrd.	5,3	-	70%
Guinea	30 Mio. (2004)	4 Mrd.	0,75	-	70%
Guinea Bissau	2 Mio. (2003)	236 Mio.	0,85	-	70%
Liberia	0 Mio.	-	-	0%	0%
Nigeria	21 Mio. (2004)	72,2 Mrd.	0,03	0,20%	70%
Sao Tome and Principe	10 Mio. (2000)	46 Mio.	22	-	70%
Sierra Leone	83 Mio. (2005)	4,9 Mrd.	1,7	8%	70%
Togo	15 Mio. (2003)	1,7 Mrd.	0,9	2%	70%

Sources: World Tourism Organization (Income); World Bank Development Indicators database and World Fact Book (GDP).

*Data provided by the national experts (share of tourism of GDP and share of coastal tourism).

Explanatory notes:

- In case where calculated data and data provided by the national expert is available, the last will always be preferred, except in the case of Cote d´Ivoire and Sierra Leone, as the figures seem too high.
- The share of coastal tourism of the total tourism income is calculated on the basis of the information from Ghana, as it is the only reliable data on this ratio available.

The present total income of the respective tourism industry in coastal areas is than calculated as follows:

(GDP 2009 * share of tourism industry of GDP * 0.7) per km coast

It has to be mentioned that the resulting figure does not reflect the growth of tourism relative to GDP growth during the last years. This is due to the fact that the data available is not sufficient to provide growth numbers. Therefore, the figures presented below have to be understood as a conservative estimation.

Table 4.5: Value of coastal tourism in the GCLME

State	GDP corresponding year Bn. US $	% Share of tourism of GDP	Total tourism income Mio. US $/a	Total coastal tourism income Mio. US $/a	Length of Coast (km)	Value of tourism per coastal km US $/a
Angola	19,7	0,3	59	41,3	1600	25,812
Benin	3,4	2	68	47,6	121	393,388
Cameroon	8,7	0,4	34	23,8	402	59,203
Republic of Congo	3,5	0,5	17	11,9	169	70,414
Cote d´ Ivoire	15,4	0,5	77	53,9	169	318,934
DRC	6,5	0,01	0,65	0,45	37	12,162
Guinea Ecuatorial	1,3	0,38	5	3,5	296	11,824
Gabon	5,6	0,26	14	0	-	-
Ghana	8,8	5,3	466	326,2	700	466,000
Guinea	4	0,75	30	21	320	65,625
Guinea Bissau	0,236	0,85	2	1,4	350	4,000
Liberia	-	0	0	0	(560)	-
Nigeria	72,2	0,2	144	100,8	853	118,171
Sao Tome and Principe	0,046	22	10	7	209	33,492
Sierra Leone	4,9	1,7	83	58,1	402	144,527
Togo	1,7	2	34	23,8	56	425,000
Total	-	-	-	720,8	-	-

It has to be noted, that the value derived here does not represent a laminar, but a linear value; how to break these figures down to laminar information is discussed in Chapter 5.

Flood Control/Erosion Control

The value of coastal ecosystems for storm protection and preventing land erosion will be estimated utilizing on the one hand the Replacement Cost method with two coastal protection projects in the GCLME as basis, and on the other hand deriving values through a Unit Value transfer (see Chapter 3).

The two projects identified in the GCLME region are:

- Keta Sea Defence, constructed in 2002 at the cost of 83 million US$. The project protects around 8.4 km of coastline in the Volta Region of Ghana (Ghanaian Times, 24/06/2006).
- The construction of five stone jetties between Gounoukopé and Aného, Togo. The jetties add to a total length of 450 m, at a cost of 250 million CFA, around 475 000 US$ (Ministry of Technology and Environment, Togo).

Because we calculate with a width of 100 m mangroves necessary to offer the same degree of coastal protection (cf. f. e. Barbier 2007 and 2008), we first calculated the cost of 100 m of coastal protection works:

- Keta Sea Defence/Ghana: 988 095 US$.
- Gounoukopé and Aného/Togo: 105 555 US $.

With an assumed life expectancy of 50 years, the yearly per hectare value of coastal mangroves rates between 2111 US$/ha/a (Togo) and 19761 US$/ha/a.

For comparison, a Unit Value transfer has been performed, using the following studies as study sites:

- Emerton/Kekulandala (2003): "Assessment of the economic value of Muthurajawela wetland", Sri Lanka. The authors estimate the value of "coastal protection" at 1907 US$/ha/a, using the Replacement Cost method.
- Emerton (2005): "Values and Rewards – Counting and Capturing Ecosystem Water Services for sustainable Development", including a case study on the Ream National Parc, Cambodia. The author estimates the value of "storm protection" at 32 US$/ha/a, and of "coastline protection" at 122 US$/ha/a, in both cases utilizing a Benefit Transfer.
- Sathirathai (1998): "Economic Valuation of Mangroves and the Roles of local Communities in the Conservation of natural Resources: Case Study of Surat Thani, south of Thailand". The author assesses the value of mangroves for "coastline protection" using the Replacement Cost method be at 102 US$/ha/a ($ 2010).
- Batagoda (2003), cited in Kathiresan (2007), evaluating mangroves in Sri Lanka, and estimating their value for "storm protection" at 8000 US$/ha/a.
- Tallis et al. (2008): assuming the value of mangroves in Vietnam for "coastal protection" in terms of real annual savings to be at 608 US$/ha/a.

As all studies assess ecosystems that resemble the situations in ecosystems in the GCLME – mangroves and coastal wetlands with a large share of mangroves – there is no need to adapt the study results, except for adjusting the values to the general economic price level in West Africa (cf. Methodology Report), reflected by the GDP (PPP) per capita (see above).

Table 4.6: GPD (PPP) Ratios between study and policy sites

State/Region	GDP (PPP) per capita (2009)	Ratio West Africa to Country
West Africa	1710	1
Vietnam	2850	0,6
Cambodia	2015	0,85
Lao PDR	2210	0,77
Thailand	8060	0,2
Sri Lanka	4720	0,36

Sources: OECDstats; IMF.

Adjusted to national price levels, the results of the Unit Value transfer are as follows:

- Emerton/Kekulandala (2003): 686.5 US$/ha/a.
- Emerton (2005): aggregated value 130.9 US$/ha/a.
- Sathirathai (1998): 2.4 US$/ha/a.

- Batagoda (2003): 2880 US$/ha/a.
- Tallis et al. (2008): 364 US$/ha/a.

As is quite visible, the range of resulting values is quite impressive. To cope with that, and at the same time getting reliable, thus conservative results, we calculated the mean value of the seven datasets, cutting the values >1000 US$/ha/a back to the highest result <1000 US$/ha/a, reflecting the possible overestimation due to the utilization of the Replacement Cost Method (cf. Methodology Report; Barbier 2007). Therefore, the mean value for the ecosystem service “coastal protection/erosion control” has to be set at 465.9 US$/ha/a.

<u>Sewage Treatment</u>
The international studies chosen for the Unit Value Transfer to assess the ecosystems service “sewage treatment” are:

- Emerton, L., Iyango, L., Luwum, P., and Malinga, A., 1999, The Economic Value of Nakivubo Urban Wetland, Uganda. The authors estimate the value of the swamp for “sewage treatment” to be at 181 US$/ha/a, utilizing the Replacement Cost method.
- Gerrard, P. (2004): “Integrating Wetland Ecosystem Values into Urban Planning: The Case of That Luang Marsh, Vientiane, Lao PDR.” The author estimates the value of the swamp for “water purification” to be at 35.5 US$/ha/a, as well utilizing the Replacement Cost method.

Regarding the first value, it has to be kept in mind that the Nakivubo Swamp is situated very close to the Ugandan capital Kampala, with a very high population density of around 4600 people/km² in the greater metropolitan area (Nyakaana et al. 2007). It is suggested, therefore, to adjust the value to a lower level reflecting the mean population density of populated coastal strips in the GCLME of around 500 people/km² (National Experts Togo and Benin), resulting in a value of 19.7 US$/a per hectare. The second study likewise describes a wetland that borders an urbanized area, but there is no data available on population density in that region. Therefore, the only adaptation that can be done is the adjustment of the values to the general economic price level in West Africa (cf. Methodology Report), reflected by the GDP (PPP) per capita (see table 4.6), resulting in an adjusted value of 27.3 US$/ha/a. Calculating the mean value of the two almost congruent results, the value for the ecosystem service “sewage treatment” in the GCLME is assumed to be at 23.5 US$/ha/a.

<u>Drinking Water</u>
Only one international study could be identified for the Unit Value Transfer to assess the ecosystems service “drinking water”, as other reports with similar backgrounds usable as study sites seem unavailable. The chosen study is:

- Emerton/Kekulandala (2003): “Assessment of the economic value of Muthurajawela wetland”, Sri Lanka. The authors estimate the value of “drinking water” at 14.8 US$/ha/a, using the Replacement Cost method.

The study site closely resembles the mangrove/coastal ecosystems assessed in this study. Hence, the only adjustment to be taken is again to adjust the value to West African price levels, use the above stated ratio of 0.36 between West Africa and Sri Lanka. Therefore, the adjusted value of coastal ecosystems in the GCLME for the ecosystem service “drinking water” according to the Unit Value transfer amounts to 5.2 US$/ha/a.

<u>Fish nursery</u>
As detailed above (Chapter 3), we will calculate the important function of coastal ecosystems as fish nursery utilizing a twofold approach: the first uses the World Bank fishery and

mangrove linkage-assumption of 0,7 tonnes fish per hectare mangroves, and calculating monetary values for this function using the per tonnes values derived from Ukwe (BDCP 2007). The second approach uses the 10% quota extracted from Emerton/Kekulandala (2003), to get a comparison and some insights on the scope of the contribution of coastal ecosystems to total fishery.

The adjusted BDCP (2007) data for sustainable fish landings (see above) states an amount of 1 247 572 t, worth around 15 bn. US$, representing a per tonne value of 12 100 US$. Adopting the 0.7 tonne/ha approach of the World Bank, each hectare of mangroves provides nursery grounds for fish worth 8470 US$. Thus, the 1 827 240 ha of mangroves in the GCLME would provide nursery grounds worth 15.4 bn. US$, exceeding the value of sustainable fisheries in the whole GCLME. As this approach is obviously not feasible regarding the GCLME region, the second approach is chosen, defining the value of mangroves for fish nurseries to be 10% of the total catch, resulting in a total value of 1.509 bn. US$/a, and a per hectare value of 828 US$/a.

As mentioned above, this figure is subtracted from the value of sustainable fisheries, to avoid double counting.

<u>Carbon Sequestration</u>

Two international studies on mangroves including values for carbon sequestration have been identified and chosen for performing the Unit Value transfer:

- Batagoda (2003), cited in Kathiresan (2007), evaluated mangroves in Sri Lanka, and estimated their value for "carbon sequestration" to be at 75.5 US$/ha/a.
- Sathirathai (1998): "Economic Valuation of Mangroves and the Roles of local Communities in the Conservation of natural Resources: Case Study of Surat Thani, south of Thailand". The author assesses the value of mangroves for "carbon sequestration" to be at around 82 US$/ha/a ($ 1995), or 158 US$/ha/a ($ 2010). In the study, however, the price for a ton CO2 is assumed to be around 38 US$ ($2010), whereas the momentary prices for carbon range around 17.5 Euro/t CO2 (EU ETS; cf. Point Carbon), or 22.4 US$. The value is therefore reduced by a factor of 0.58, resulting in an adjusted value of 91.6 US$/ha/a.

Calculating the mean value of the two almost congruent results, the value for the mangrove´s ecosystem service "carbon sequestration" in the GCLME is assumed to be at 83.5 US$/ha/a.

Use Values in the GCLME: Overview

The following table provides an overview of the calculated use values of ecosystems in the GCLME:

Table 4.7: Use Values - Overview

Ecosystems	Ecosystem Service	Value (US$/ha/a)
Marine	Fisheries	53,7
Total Marine Ecosystems		53,7
Coastal	Timber	10,1
	Non-Timber Products	54
	Tourism	(total: 720,8/a)*
	Carbon Sequestration	83,5
	Coastal Protection	465,9
	Sewage Treatment	23,5
	Drinking Water	5,2
	Fish Nursery	828
Total Coastal Ecosystems		1470,2 + coastal tourism

*as tourism is calculated in US$/coastal km, the per hectare value is not depicted in this table.

4.2 Non-use Values

Biodiversity

As explained above, the evaluation of the non-use values of biodiversity is not a simple task. In this report, we will use the projected results of the COPI report as a first approximation that underlines the overall importance of biodiversity conservation. Furthermore, we use the share of non-use biodiversity (0.7%) extracted from the COPI report to provide figures for the GCLME, and double-check these with the most recent and most comprehensive meta-analysis.

The COPI report lists the welfare losses incurring in different world regions by 2050, assuming a further destruction of biodiversity. For understanding the COPI assessment, it is important "to appreciate that the COPI costs are actually a mixture of cost types – some are actual costs, some are income foregone (e.g. lost food production), some are stated welfare costs (e.g. building on willingness to pay (WTP) estimation approaches). Some directly translate into money terms that would filter directly into GDP (gross domestic product); some would have an effect indirectly, and others would not be picked up by GDP statistics (which themselves are only economic statistics and not fully representative of welfare or wellbeing1). The combined COPI costs should be seen as welfare costs, and for the sake of ease of comparison are given as % of GDP" (Braat/ten Brink 2008).

For Africa, this will translate into a 17% loss of projected 2050 GDP, or, in numbers, a loss of 3.15 Trillion Euro. Assuming an equal biodiversity covering the whole African continent, the losses in the GCLME states would amount parallel to their share in African GDP of 23% in 2009 (World Development Indicators database 2010) to 724.5 bn. Euro (920 bn. US$), an amount equal to six times the current GDP of the economically most powerful country, Nigeria, or, on an yearly basis, to 12.49 bn. Euros/a (15.86 bn. US$). This number is provided only to underline the overall importance of biodiversity conservation.

The second step in the evaluation of non-use biodiversity is the application of the 0.7% quota on the use values identified in this report. As listed in table 4.7, those values amount to 1470.2 US$/ha/a (terrestrial), respectively 53.7 US$/ha/a (marine), as the numbers for marine and coastal ecosystems are calculated separately. Therefore, the non-use value of biodiversity in the GCLME amounts to:

- 10.3 US$/ha/a for the terrestrial ecosystems and
- 0.4 US$/ha/a for the marine ecosystems.

To double-check the results with international findings, we analyzed several meta-analyses of valuation studies that include a value for biodiversity, namely Brouwer (1999), Woodward/Wui (2002), Schuyt/Brander (2004) and Brander (2006). We analysed the last and most recent and comprehensive one, and extracted the following figures:

- In the 191 studies examined were 5 wetland types considered (21% covering mangroves).
- The ecosystem service "biodiversity" was examined 19 times, with an average value of 17 000 US$ (1995)/ha/a, surpassing all other values considered. The median of 15 US$/ha/a, however, indicates how huge the statistical spread of the data is.

As is quite obvious, to extract reliable numbers out of a mass of studies differing enormously from each other is extremely vague at best. We will, however, use the median value of Brander (2006) converted to 2010 dollars – 28.8 US$/ha/a, resembling the non-use value of terrestrial biodiversity in international studies.

As said before, the COPI report and most other valuation studies cover only the value of terrestrial biodiversity, because of the difficulties connected to the evaluation of marine ecosystems, especially regarding biodiversity (see above, or cf. Beaumont 2008; Delaney/Wilson 2009). Some studies, however, exist, and are described shortly. A brief review of marine valuation studies is provided by Ledoux and Turner (2002), but they are only able to list two studies aimed at marine biodiversity, valuing (respectively) the willingness-to-pay (WTP) for the conversation of seals in Greece and the net present value of a Marine Parc in the Caribbean. Patterson/Cole (1999) attempted to place a value on New Zealand's biodiversity, but omitted a value for the open ocean from their final valuation as marine biodiversity was considered too difficult to value. Pimentel et al. (1997) undertook a study of the economic benefits of biodiversity in the United States, and included no marine examples except fisheries. Beaumont (2008) directly aims to value marine biodiversity, defined as richness and composition at species level. The study specifies an existence value of 0.5 – 1 bn. British pound for the British seas, derived from a CV study identifying the WTP for the conservation of marine mammals around the British coast. All these results, however, are extremely difficult to transfer to the GCLME, due to huge differences in terms of socio-economic (income distribution, knowledge base etc.) and geographical (size and type of concerned area, richness in biodiversity etc.) factors. Therefore, we were unable to provide a comparative figure for the existence value of marine biodiversity through, for example, a Benefit Transfer, and thus unable to double-check the above number.

Contrasting the calculated results for terrestrial ecosystems– 10.3 US$/ha/a - with Brander´s (2006) median value – 28.8 US$/ha/a – it is quite obvious that, although the international result is almost three times higher, the scale is similar, no matter of course regarding the data spread that occurs on a regular basis in biodiversity evaluation. As for the marine value, it has to be stated that, although the value seems to be very low on a per hectare basis, the great worth of marine biodiversity will be reflected when the data is extrapolated to encompass the whole marine area of the GCLME.

<u>Other non-use values</u>

As mentioned in the methodology report and outlined above (see Chapter 3), the evaluation of non-use values is a difficult exercise. Similar to the non-use value of biodiversity, cultural and scientific uses are also highly related to the specific context of region and/or situation. Each culture in the world attaches specific non-use values to ecosystems, and these preferences will greatly vary in terms of what has a value and what not. As a result, a numeric Benefit Transfer is fairly possible (Beaumont et al. 2008; Turpie et al. 2003).

Alternatively, we calculated an average share of non-use values of the TEV, excluding biodiversity. From the COPI report, we extracted an equal share of the non-use value of biodiversity and cultural/heritage/educational values, namely 0.7% of TEV. To compare this number with shares presented in other studies, we analysed international valuation reports on mangrove ecosystems, and found one in which the distinction between the non-use value of biodiversity and cultural/heritage/educational values was possible:

- Emerton/Kekulandala (2003): "Assessment of the economic value of Muthurajawela wetland", Sri Lanka. The share of other non-use values of the TEV is 0.7%, exactly matching the extracted COPI number.

Therefore, the value of non-use values in the GCLME, excluding the existence value of biodiversity, amounts to:

- 10.3 US$/ha/a for the terrestrial ecosystems and
- 0.4 US$/ha/a for the marine ecosystems.

4.3 Use Values and Non-Use Values in the GCLME: Summary

The following table provides an overview of the calculated use values, non-use values and total economic value (TEV) of ecosystems in the GCLME.

Table 4.8: TEV of ecosystems in the GCLME

Ecosystems	Ecosystem Service	Value (US$/ha/a)	Total Area (ha) (Marine/ Mangroves)	Sub-Total	TEV/a
Marine	Fisheries	53.7	252,797,700	13,575,236,490	13,777,474,650
	Biodiversity	0.4		101,119,080	
	Other non-use values	0.4		101,119,080	
TEV Marine Ecosystems/ha		54.5			
Coastal	Timber	10.1	1,827,240	18,455,124	3,444,849,392
	Non-Timber Products	54		98,670,960	
	Tourism	*		720,800,00	
	Carbon Sequestration	83.5		152,574,540	
	Coastal Protection	465.9		851,311,116	
	Sewage Treatment	23.5		42,940,140	
	Drinking Water	5.2		9,501,648	
	Fish Nursery	828		1,512,954,720	
	Biodiversity	10.3		18,820,572	
	Other non-use values	10.3		18,820,572	
TEV Coastal Ecosystems/ha		1,490.8			

*as tourism is calculated in US$/coastal km, the value of 720.8 m. US$/a is added as a whole to the TEV of coastal ecosystems.

In the table above, the non-use value "biodiversity" (which actually in conferring to its existence value exclusively) seems to contribute only a very small fraction to the TEV. It has to be noted, though, that through alternative forms of illustration, the overall value of biodiversity could be depicted more clearly, for example by highlighting the dependencies of almost all use values on a functioning and well-developed system of flora and fauna.
Summarizing the results of this report, it has to be noted that although we applied very conservative assumptions in cases where we needed to choose between lower and higher figures, the overall figure is quite impressing indeed: the Total Economic Values of marine and terrestrial ecosystems in the GCLME amount to 13.7 bn. US$/a respective 3.4 bn. US$/a. Further destruction of these remaining ecosystems would result in severe

degradation of the services provided, and therefore affect human food supply, health and rural income as well as economic growth and stability in the whole region.
To illustrate the economic losses incurring by the destruction of only one hectare of mangrove forest, we calculated the TEV of mangroves for 50 years, applying a discount rate of 3% and 4%, respectively (avoiding methodical questions of principle: cf. Sukhdev/Kumar 2009).

One hectare of destroyed mangrove ecosystem in the GCLME therefore accounts to losses from 32 000 (4% discount rate) to 38 000 US$ (3% discount rate)!

5 Application of Results to the national Level

In the following chapter, we try to provide the national experts with guidance as how to adapt the general data calculated in the previous chapters to the respective national levels. This task will be performed on a value-by-value basis, as each adaptation has to be treated differently.
In general, the adaptation is quite simple: in the sections above, we calculated a per hectare value. If reliable national data on exact sizes of the relevant ecosystems is available, the adaptation is quite simple. If not, we try to give guidance as how to calculate approximate numbers, where possible or necessary.
A second option is the availability of more detailed or reliable data on the national level, compared to the data used in this report. We added the list of selected information provided by national experts in the ANNEX, to be used accordingly. However, the data quality varies enormously, and is not usable in all cases. Therefore, we were not able to use all of the data provided by the national experts in the chapters above. But if better quality national data is available, we will urge the national experts to use those in their NAP, applying the relevant guidance we will outline below.

<u>Sustainable Fisheries:</u>
The calculated total value of sustainable fisheries in the GCLME, adjusted by subtracting the value for “fish nurseries”, amounts to 13.5 bn. US$/a, or 53.7 US$/ha/a. The following notes regarding the data and the possibilities for applying them to national levels have to be taken:

- The data for tons of fish landings are taken from BDCP (2007), who derived them from FAOSTAT (2006). If national data provides other figures, and is reliable, especially when timelines are available, we propose to use those instead.
- It has to be remembered, though, to adjust the calculated values first to sustainable levels (if no more specific data is available) – by applying a flat 20% reduction, and second to exclude the value of the ecosystem service “fish nursery” provided by the coastal ecosystems. This is done through calculating that value first (by simply multiplying the calculated per hectare value with the area of mangroves in the respective country; see below), and then subtracting it from the total value of fisheries.
- When using national statistics of fish landings, we propose to utilize the mean per tonne value listed in the BDCP report of 12 100 US$.
- The data derived from FAOSTAT, furthermore, does not distinguish between artisanal and industrial fisheries. Most national experts, however, were able to acquire data incorporating this distinction (see ANNEX I). In those cases, we suppose to use it directly or calculate the ratio between the types of fishery, wherever necessary. If no distinction is possible, we propose to use a 60% – 40% ratio of artisanal to industrial fisheries (cf. FAO 1997).
- If uncertainties arise regarding the marine area of a given country, please refer to the table listed in ANNEX II for default figures derived from the size of the relevant states´ exclusive economic zones.

Sample calculation: Guinea
According to the data provided by the national expert from Guinea, the yearly fish landings amount to 53 854 tonnes for artisanal and to 39 480 tonnes for industrial fisheries. These

values have to be adjusted to sustainable levels, reducing the figures by 20% each, resulting in 43 083 t respectively 31 584 t. Multiplied by the per tonne value derived from BDCP (12100 US$), the sustainable fish landings per year add up to 521 304 300 US$ (artisanal) and 382 166 400 US$ (industrial), respectively 903 470 700 US$ (combined). Ten percent of this figure has to be assigned to the ecosystem service "fish nursery", reducing the figure to 813 123 630 tonnes. The size of Guinea´s EEZ is roughly 10 945 600 ha, therefore the value of fish landings per hectare sums up to 74.3 US$/a.

<u>Timber and Non-Timber Products</u>

By applying a Unit Value transfer with values adjusted to West African price levels, we calculated the value of timber products to be at 10.1 US$/ha/a, and the value of non-timber products at 54 US$/ha/a. The following notes regarding the data and the possibilities for applying them to national levels have to be taken:

- To calculate the total value of timber/non-timber products in a given country, it is necessary to simply multiply the respective figure with the area (in ha) of mangrove ecosystems.
- If national data is available depicting a concrete value for timber and/or non-timber products, we suppose to use that one directly, if the methodology is deemed to be well-grounded. Here, it is of great interest to get data clarifying the huge gap between the data provided by Ukwe (BDCP 2007) and the results from the Benefit Transfer, as mentioned above.
- Furthermore, it is possible to get a more accurate figure by applying a GDP-ratio using a country value (GDP [PPP] per capita), instead of the figure for the whole of West Africa. The respective data is available at the statistical service of international monetary organizations, like the World Bank´s "World Development Indicators database" (cf. http://data.worldbank.org/data-catalog).

<u>Tourism</u>

The values for coastal tourism listed above already incorporate a separate figure for each country of the GCLME. The data, however, is provided on a "per coastal kilometer" instead of the usual per hectare basis. This is due to lack of data, as outlined in the relevant chapters (Chapters 3 and 4). Nevertheless, we will try to give hints as how to get from linear to laminar values.

- We would recommend to count a one-kilometer wide strip of coastal areas to be relevant for the coastal tourism industry, therefore dividing the per kilometer value by 100 to get a per hectare result. This methodology, however, is based on assumptions and experience, rather than reliable data. The resulting figures, therefore, have to be seen with great caution. It should be remembered, as well, that the value for tourism does not necessarily means a sustainable usage of natural resources.
- As mentioned above, the data used to calculate the value of tourism was very difficult to acquire. Therefore, a mixture of sources and baseline years is being utilized, neglecting GDP growth, or the relative growth of tourism in relation to GDP. We urge the national experts, therefore, to acquire actual national data on tourism, especially coastal tourism.
- The ratio coastal tourism – inland tourism of 70% - 30% is derived from a single data source, which is Ghana. If it is possible to get concrete rations for another country, we recommend sharing these figures with other national experts, to maybe being able to improve the overall data quality.

Sample calculation: Guinea-Bissau and Togo
To demonstrate the conversion to ha values, as well as the great variety in the provided data, we use Guinea-Bissau and Togo as calculation examples. In Guinea-Bissau, the generated per km value of coastal tourism is 4000 US$, in Togo 425 000. Divided by 100, we get to per hectare values of 40 US$ (Guinea-.Bissau) respectively 4250 US$ (Togo). Although it is quite possible that the income generated by tourism differs greatly between states with a more developed tourism industry and others, the huge difference in the resulting figure hints at the data gaps necessary to be filled.

<u>Flood Control/Erosion Control</u>
The value of coastal/mangrove ecosystems for coastal protection have been calculated to rate at 465.9 US$/ha/a, reflecting West African price levels. Some notes have to be taken:

- To calculate the total value of mangroves providing coastal protection in a given country, it is necessary to simply multiply the respective figure with the area (in ha) of mangrove ecosystems.
- To calculate a more concrete value of the ecosystem service “coastal protection” in a given country, it would be necessary to identify coastal protection works, and analyze the quantity structure as well as the monetary costs, to apply the Replacement Cost method (cf. UNEP 2000 for further guidance). We calculated assuming the life expectancy of coastal protection works to be 50 years.
- Furthermore, it is possible to get a more accurate figure by applying a GDP-ratio using a country value (GDP [PPP] per capita), instead of the figure for the whole of West Africa. The respective data is available at the statistical service of international monetary organizations, like the World Bank´s “World Development Indicators database” (cf. http://data.worldbank.org/data-catalog). In the case of “coastal protection”, however, the calculated figure is derived from several international studies, each representing a different price level. Thus, to adjust the values to national levels, is would be necessary to generate the specific numbers using the original, not-adjusted results from the evaluation studies (see above), and adjust those to the national level, using country-specific GDP per capita values. To exclude the highest figures (for methodological difficulties applying the Replacement Cost method, see Barbier 2006), we recommend to exclude the outliers (>1000 US$/ha/a), and afterwards calculate the statistical mean to get the final figure.

Sample calculation: Cameroon
To adjust the values generated using a general West African GDP per capita to national values using national GDP figures, at first the GDP ratio in relation to the country of the study site has to be calculated. Cameroons GDP (PPP) per capita in 2009 amounted to 2147 international Dollars. The ratio is calculated by dividing this number by the GDP (PPP) of the study site:
→Cameroon 2147 : 2850 (Vietnam) = 0.75.
This ratio has then to be applied to the result from the original study, in the case of Erosion Control/Vietnam the study of Tallis et al., with a final figure of 608 US$/ha/a. Multiplied by the Cameroon – Vietnam GDP ratio of 0.75, the result would be 456 US$/ha/a. This procedure has then to be repeated for all studies incorporated, to be able to calculate the new mean value in the end.

Sewage Treatment and Drinking Water

As Sewage Treatment and Drinking Water were calculated using a similar methodology, we give recommendations for adjusting those values to national levels together. The remarks have to be made

- To calculate the total value of mangroves providing sewage treatment and/or drinking water in a given country, it is necessary to simply multiply the respective figure with the area (in ha) of mangrove ecosystems.
- Furthermore, an adjustment via the country-specific GDP per capita is possible in these cases as well, to get a more accurate data for each country. We propose following the above outlined methodologies.
- As the values are generated using a relative low number of international studies as study sites, it would be of great value to get information on sewage treatment/water purification projects featuring both quantity structures and monetary costs, to conduct a separate calculation using the Replacement Cost method (cf. UNEP 2000 for further guidance).

Sample calculation: see "Flood Control/Erosion Control" above.

Fish nursery

As described above, applying the World Bank fishery and mangrove linkage-assumption of 0.7 tonnes fish per hectare mangroves was not feasible in the case of the GCLME. Thus, we utilized the 10% quota extracted from Emerton/Kekulandala (2003). To adjust the derived values to national levels, the following steps could be taken:

- First, the 10% quota has to be applied to the adjusted levels of national sustainable fish landings, in case this adjustment was done (at the same time, the figure for national sustainable fish landings has to be reduced).
- Second, if there is more accurate national data on the fishery and mangrove linkage available, both in terms of absolute or relative (i. e. percentages) contribution, we recommend using these figures instead of the flat 10% quota utilized in this report.

Sample calculation: see "Fisheries" above.

Carbon Sequestration

The value of mangrove ecosystems in terms of carbon sequestration have been calculated to be at 83.5 US$/ha/a. For applying this number to national levels, the following guidelines should be followed:

- To calculate the total value of mangroves providing carbon sequestration in a given country, it is necessary to simply multiply the respective figure with the area (in ha) of mangrove ecosystems.
- If there is accurate national data on the amount of carbon capture of domestic mangrove forests is available, we suppose using this data instead of the general figures provided by this report.
- To adjust the value to current carbon prices, it has to be kept in mind that the price level for carbon utilized in this report is 22.4 US$/t CO2, where applicable (i. e. in the second study site).

Biodiversity and other non-use values

As outlined in the relevant chapters and the Methodology Report, the evaluation of both (the existence value of) biodiversity and other non-use values faces several difficulties and restrictions. The values calculated in this report are derived from the total value of use values.

- Therefore, to adjust the non-use values to national levels, it is necessary to apply the 0.7% quota to the adjusted total value of use values, if such an adjustment was performed.

Sample calculation: Guinea

As demonstrated above, the value for sustainable fish landings in Guinea amount to 74.3 US$/ha/a, instead of 53.7 in the whole GCLME. To recalculate the value of biodiversity or other non-use values, this new figure has to be included in generating the TEV of Guinea´s ecosystems (in this case, marine ecosystems) before applying the 0.7% quota.

There are, however, great gaps in research and data availability regarding the evaluation of biodiversity (see Chapter 6). This includes a formula as how to actually use the available data on biodiversity, for example number of species etc. We recommend staying with the results listed in this report, until more specific valuation results are available, at best through first-hand studies conducted in the GCLME itself. This is especially true for studies treating marine biodiversity, as research has yet to deliver applicable evaluation studies.

- A further challenge would be to adjust the values presented in this report, implying an even distribution of biodiversity across ecosystems and countries (see Chapter 3), to the actual biodiversity value of coastal regions in comparison to other ecosystems.

6 Summary and Outlook

In this report, we tried to demonstrate the value of the GCLMEs ecosystems for human wellbeing, social welfare and economic growth. We expressed this value in monetary units, and although we used conservative estimations throughout the report, the resulting figures are quite impressive: the GCLME ecosystems generate a yearly TEV of around 16.5 bn. US$, excluding tourism, which has a high potential for welfare generation in the area, and excluding mineral extraction as well. Furthermore, the destruction of one hectare of mangrove ecosystems today amounts to an economic loss of at least 32 000 US$, considering the next 50 years!

The result of this first valuation exercise for the GCLME region, however, provides only for a rough estimate of the value of the most important ecosystems present in the region. Decision makers and stakeholders involved in the process of policy and decision making need to be aware of the fact that the results of this valuation have their weaknesses.

First, the results of the values derived via Benefit Transfer might need some additional considerations: Mangrove ecosystems often have very unique features that can't be found in other regions of the world. Therefore the regional ecological specifics of the mangroves need to be kept in mind and the result of the Benefit Transfer cannot be the basis for local decision making, but for a global trade-off analysis for the whole GCLME region. For the future work on the conservation of the GCLME it will be advisable to consider exercising tailor-fitted evaluation studies *in the region* that provide for much more detail and that will be useful for in-depth decision making.

Second, the availability and quality of data was sometimes inadequate to perform the evaluation exercises devised beforehand. It is therefore recommended to improve on data quantity and quality regarding ecosystem services in the GCLME. We regard especially the following study areas as information gaps with a high priority to close:

- Ecosystem Type: Sandy beaches, especially regarding the Angolan coast (quantitative and qualitative values unknown).
- Ecosystem Type: Seagrass beds (quantitative and qualitative values unknown).
- Ecosystem Type: Coastal Lagoons (quantitative and qualitative values unknown, for example in regard to the relation of water area – land area).
- Ecosystem Service: Sustainable Fishing (quantitative data lacking).
- Ecosystem Service: Fish Nursery ("fishery and mangrove linkage-assumption" of World Bank to be specified).
- Ecosystem Service: Tourism (quantitative and qualitative data lacking).

Third, the general limitations and statistical errors occurring in economic evaluations in general, and by using a Benefit Transfer specifically, have to be kept in mind. These are, among others, the general problem of valuating dynamic systems using a static approach, or the difficulty in excluding any double-counting of ecosystem services (for example, the biomass accounted for the storage of carbon is the same biomass that is contributed with coastal protection). For further information, it is referred to the Methodology Report, and the respective literature.

Fourth, there are specific limitations regarding the results of this particular evaluation exercise. These exist at the one hand due to a lack of data (see above for data gaps), at the other hand because of the design of this study:

- For simplicity, in this report it is assumed that every hectare of a certain ecosystem equals all other hectares, neglecting social and ecologic region-specific factors that would certainly influence the values of ecosystem services; as such, the study has to be understood as a first and general approach of valuating ecosystem services in the GCLME region.

- The ecosystem services “Sewage Treatment and Drinking Water” and “Flood Control/Erosion Control” are evaluated based on a Benefit Transfer using South Asian mangrove studies. Of course it would have been much more accurate to use study sites on the African continent, as they would much better reflect the specific circumstances of the region.
- Regarding the results for non-use values, it has to be stated that those are based on our assumption of an equal share between “Ecotourism & Recreation”, “Existence Value of Biodiversity” and “Other non-use values” depicted in COPI report. Of course this is a qualified assumption, but nevertheless based on our experience and knowledge, not on concrete data. We propose to carry out a West African study based on the Contingent Valuation Method to clarify this topic.

And, last not least, there are the great gaps in research and data availability regarding the evaluation of biodiversity, and the evaluation of marine ecosystems in general. In these two areas, the international scientific progress in devising and performing new studies has to be observed. Alternatively, and even better, are studies giving insights into feasible proceedings regarding the valuation of these two methodologically difficult topics, carried out in the GCLME region itself.

To sum up, the present report gives a first estimation of the value of ecosystem services in the GCLME. It is recognized, however, that due to a lack of both qualitative and quantitative in some study areas, the estimations presented here need to be improved through either specific studies covering ecosystem services in the GCLME region itself, or the advance of scientific methodologies to evaluate non-use values. Nevertheless, the resulting figures are quite impressive, especially regarding that we used conservative figures: the GCLME ecosystems generate a yearly TEV of around 17.2 bn. US$, and each lost hectare of mangroves costs at least 32 000 US$!

7 ANNEX

ANNEX I: Data on fisheries provided by the national experts.

ANNEX II: Exclusive Economic Zones in the GCLME.

ANNEX III: Sources.

ANNEX I: Data on fisheries provided by the national experts

Country	Timelines	Fish Landings Artisanal Fisheries	Fish Landings Industrial/Semi-Industrial Fisheries	Total Landings per year (tons)
Angola	no data	no data	no data	no data
Benin	11 years (1996-2006)	98 710 tons per year: 8973 tons	6999 tons per year: 636 tons	appr. 9600
Cameroon	6 years (1995-2000)	per year: 45 000 tons	per year: appr. 9000 tons	54 000
Republic of Congo	Artisanal: 8 years (2000-2007) Industrial: 10 years (2000-2009)	110 398 tons per year: 13 800 tons	110 629 tons per year: 11 000 tons	24 400
Cote d´ Ivoire	not available	per year: 35 000 tons	per year: 19 000 tons	54 000
Democratic Republic of Congo	no data	no data	no data	no data
Guinea Ecuatorial	not available	per year: appr. 600 tons	no data	(600)
Gabon	not available	no data	no data	15 000
Ghana	no data	no data	no data	no data
Guinea	14 years (1995-2008)	753 960 tons per year: 53 854 tons	552 720 tons per year: 39 480 tons	appr. 93 000
Guinea Bissau	Industrial: 11 years (1993-2003) Artisanal: not available	per year: 20 118 tons (in 2009)	per year: 32 100 tons	appr. 52 000
Liberia	no data	no data	no data	no data
Nigeria	4 years (2002-2005)	per year: 240 000 tons	per year: 31 747 tons	appr. 270 000
Sao Tome and Principe	not available	per year: 4000 tons	per year: 300 tons	4300
Sierra Leone	18 years (1991-2007)	per year: 63 800 tons	per year: 20 612 tons	84 412
Togo	Artisanal: 10 years (2000-2009)	244 190 tons per year: 24 000 tons	no data	(24 000)

Sources: National Experts.

ANNEX II: Exclusive Economic Zones in the GCLME

State	EEZ (km²)	EEZ (ha)
Angola	501 050	50 105 000
Benin	30 024	3 002 400
Cameroon	14 693	1 469 300
Republic of Congo	40 499	4 049 900
Cote d´ Ivoire	174 545	17 454 500
DRC	1 072	107 200
Guinea Ecuatorial	308 337	30 833 700
Gabon	193 627	19 362 700
Ghana	224 908	22 490 800
Guinea	109 456	10 945 600
Guinea Bissau	106 117	10 611 700
Liberia	246 152	24 615 200
Nigeria	216 789	21 678 900
Sao Tome and Principe	165 364	16 536 400
Sierra Leone	159 744	15 974 400
Togo	15 357	1 535 700

Source: Sea Around Us (2010).

ANNEX III: Sources

Ajayi, T. O. 1994: The Status of Marine Fishery Resources of the Gulf of Guinea: Proceedings of 10th Session FAO CECAF, Accra, Ghana, 1994. CECAF/RE/94/2.

Barbier, E. B. 1994: Valuing Environmental Functions: Tropical Wetlands. Land Economics 70(2), pages 155-173.

Barbier, E. B. 2007:Valuing Ecosystem Services as productive Inputs. Economic Policy 2007, pages 177-229.

Barbier, E. B. 2008: Coastal Ecosystem-based Management with nonlinear Ecological Functions and Values. Science 319,321.

Bateman, I. J./Turner, P. K. 1993: Valuation of the Environment, Methods and Techniques: The Contingent Valuation Method. Belhaven.

Baumgärtner, S. 2006: Measuring the diversity of what? And for what purpose? A conceptual comparison of ecological and economic biodiversity indices.

Beaumont, N. J. et al. 2008: Economic valuation for the conservation of marine biodiversity. Marine Pollution Bulletin 56, pages 386–396.

BDCP 2007: Combating Living Resources Depletion and Coastal Area Degradation in the Guinea Current Large Marine Ecosystem through Ecosystem-based Regional Actions. Vienna.

Braat, L./ten Brink, P. 2008: The Cost of Policy Inaction (COPI): The case of not meeting the 2010 biodiversity target.

Brander, L. M: et al. 2006: The Empirics of Wetland Valuation: A Comprehensive Summary and a Meta-Analysis of the Literature. Environmental & Resource Economics 33: 223–250.
Brouwer, R. et al. 1999: A meta-analysis of wetland contingent valuation studies.

Christie et al. 2004: A valuation of biodiversity in the UK using choice experiments and contingent valuation. Applied Environmental Economics Conference 2004, 26 March. The Royal Society.

Central Intelligence Agency: The World Factbook (https://www.cia.gov/library/publications/the-world-factbook/)

Chukwuone, N. A. et al. 2009: Valuing the Guinea current large marine ecosystem: Estimates of direct output impact of relevant marine activities. Ocean & Coastal Management 52, pages 189–196.

Corcoran, E. 2007: Mangroves of Western and Central Africa.

DEFRA 2007: An introductory guide to valuing ecosystem services (http://www.defra.gov.uk/environment/policy/natural-environ/documents/eco-valuing.pdf).

Delaney, A./Wilson, D. C. 2008: Socio-cultural Valuation of Marine Biodiversity. A Working Paper in Methods. IFM-AAU Working Paper.

Dixon, J. A. 1989: Valuation of Mangroves.Tropical Coastal Area Management.

EFTEC 2008: Costs of Illegal, Unreported and Unregulated (IUU) Fishing in EU Fisheries.

Emerton, L. 2005: Values and Rewards – Counting and Capturing Ecosystem Water Services for sustainable Development.

Emerton, L./Iyango, L./Luwum, P./Malinga, A. 1999: The Economic Value of Nakivubo Urban Wetland, Uganda, Uganda National Wetlands Programme, Kampala and IUCN — The World Conservation Union, Eastern Africa Regional Office, Nairobi.

Emerton, L./Kekulandala, L. D. C. B. 2003: Assessment of the economic value of Muthurajawela wetland. Occasional Papers of IUCN Sri Lanka.

FAO (Food and Agriculture Organization) 1997: Review of the state of world fishery resources: marine fisheries. FAO Fisheries Circular No. 920 FIRM/C920. FAO Rome.

FAO 2009: The relevance of mangrove forests to African fisheries, wildlife and water Resources.

GCLME Regional Cooperation Unit 2006: Transboundary Diagnostic Analysis. Accra.

Gerrard, P. 2004: Integrating Wetland Ecosystem Values into Urban Planning: The Case of That Luang Marsh, Vientiane, Lao PDR, IUCN – The World Conservation Union Asia Regional Environmental Economics Programme and WWF Lao Country Office, Vientiane.

Gunawardena, M. 2005: Economic Valuation of a Mangrove Ecosystem Threatened by Shrimp Aquaculture in Sri Lanka. Environmental Management, Volume 36, Number 4, pages 535-550.

Heip, C./Hummel, H. et al. 2009: Marine Biodiversity and Ecosystem Functioning. Printbase, Dublin, Ireland.

Hutchinson, G. W./Chilton S. M./Davis, J. 2008: Measuring Non-Use Value of Environmental Goods using the Contingent Valuation Method: Problems of Information and Cognition and the Application of Cognitive Questionnaire Design Methods.

Ibe, A. C./Csizer, Z. 1998: The Gulf of Guinea as a Large Marine Ecosystem. UNESCO Nature and Resources 1998; 34(3):30-39.

Interim Guinea Current Commission 2008: Strategic Action Plan.

International Monetary Fund – World Economic Outlook Database 2010 (http://www.imf.org/external/pubs/ft/weo/2010/01/weodata/index.aspx).

Kahneman, D./Knetsch J. L. 1992: Contingent valuation and the value of public goods. Journal of Environmental Economics and Management 22, no. 1: 90–94.

Kathiresan, K. 2007: Importance of Mangrove Ecosystems. Centre of Advanced Study in Marine Biology.

Koch, E. W./Barbier, E. B. 2009: Non-linearity in ecosystem services: temporal and spatial variability in coastal protection. Front Ecol Environ 7(1), pages 29–37.

Lal, P. 2003: Economic valuation of mangroves and decision-making in the Pacific. Ocean & Coastal Management Volume 46, Issues 9-10, Pages 823-844.

Ledoux, L./Turner, R. K. 2002: Valuing ocean and coastal resources: a review of practical examples and issues for further action. Ocean & Coastal Management 45, pages 583–616.

Mullan, K./Kontoleon, A. 2008: Benefits and Costs of Forest Biodiversity: Economic Theory and Case Study Evidence.

Nam Do, T./Bennett, J. 2005: An economic valuation of wetlands in Vietnam's Mekong Delta: a case study of direct use values in Camau Province. Asia Pacific School of Economics and Government. Canberra.

OECD Stat Extracts 2010 (http://stats.oecd.org/Index.aspx).

Patterson, M./Cole, A. 1999: Assessing the Value of New Zealand's Biodiversity. School of Resource and Environmental Planning, Massey University.

Pimentel et al. 1997: Economic and environmental benefits of biodiversity. Bioscience 47, 747–757.

Rönnbäck, P. 1999: The ecological basis for economic value of seafood production supported by mangrove ecosystems. Ecological Economics Volume 29, Issue 2, Pages 235-252.

Sathirathai, S. 1998: Economic Valuation of Mangroves and the Roles of local Communities in the Conservation of natural Resources: Case Study of Surat Thani, south of Thailand.

Schuyt, K./Brander, L. (2004): Living waters conserving the source of life: the economic values of the worlds wetlands. WWF, Gland.

Sea Around Us Project – Fisheries, Ecoystems & Biodiversity 2010 (http://www.seaaroundus.org/).

Spaninks, F./van Beukering, P. 1997: Economic valuation of mangrove ecosystems: potential and limitations. CREED Working Paper No 14.

Sukhdev, P./Kumar, P. 2009: The Economics of Ecosystems and Biodiversity.

Tallis, H. et al. 2008: An ecosystem services framework to support both practical conservation and economic development.

Ten Brink, P. et al. 2009: TEEB – The Economics of Ecosystems and Biodiversity for National and International Policy Makers – Summary: Responding to the Value of Nature.

Thiele, H. D./Wronka T. C. 2002: Umweltgüter und ihre Bewertung: Möglichkeiten und Grenzen des Benefit Transfers. Zeitschrift für Umweltpolitik und Umweltrecht 25, no. 3: 383–404.

Tobor, J. G. 1990: The fishing industry in Nigeria-Status and potential for self-sufficiency in fish production.

Turpie, J. K. et al. 2003: Economic value of terrestrial and marine biodiversity in the Cape Floristic Region: implications for defining effective and socially optimal conservation strategies. Biological Conservation 112, pages 233–251.

UNEP 2000: The Valuation of Biological Diversity for National Biodiversity Action Plans and Strategies: A Guide for Trainers.

UNEP 2009: The UNEP´s Large Marine Ecosystems Report.

Woodward, R. T./Wui Y. S. 2001: The economic value of wetland services: a meta-analysis. Ecological Economics 37, no. 2: 257–270.

World Bank, 1996. 'Environmental and social review of the buffer zone component', Report no. E-239, Coastal Wetlands Protection and Development Project, the World Bank. (http://www-ds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2000/02/03/000178830_9811170353564/Rendered/PDF/multi_page.pdf).

World Bank 2004: How Much is an Ecosystem Worth? Assessing the Economic Value of Conservation. Washington DC.

World Bank Development Indicators database 2010 (http://data.worldbank.org/data-catalog).

World Bank/FAO 2009: Sunken Billions – The Economic Justification for Fisheries Reform. Agriculture and Rural Development. Washington (http://go.worldbank.org/EKE38PW3O0).

World Tourism Organization 2010: Facts and Figures (http://www.unwto.org/facts/menu.html).

UNIDO PROJECT/PROGRAMME
GPRAF04004 BL 1186

Combating living resources depletion and coastal area degradation in the Guinea Current Large Marine Ecosystem through Ecosystem-based regional actions

Subcomponent: Economic Valuation

Report on generic list of economic instruments for the management of critical zone resources and pollution reduction/abatement in the Guinea Current Large Marine Ecosystem Area

Author: Eduard Interwies (InterSus – Sustainability Services)
Report prepared for the United Nations Industrial Development Organization (UNIDO)
June 2010

Table of Contents

List of case studies

List of Figures

List of tables

1 Introduction – Background and rationale of this report

The GCLME project has a primary focus on the priority problems and issues identified by the 16 GCLME countries that have led to unsustainable fisheries and unsustainable use of other marine resources, as well as the degradation of marine and coastal ecosystems by human activities.
The long-term development goals of the project are:
1) recover and sustain depleted fisheries;
2) restore degraded habitats; and
3) reduce land and ship-based pollution
by establishing a regional management framework for sustainable use of living and non-living resources in the GCLME. To strengthen regional cooperation the riparian countries have established the Interim Guinea Current Commission (IGCC). The GCLME project's Regional Coordination Unit (RCU) which is hosted by the Government of Ghana serves as the IGCC's executive secretariat.

Priority action areas include reversing coastal area degradation and living resources depletion, relying heavily on regional capacity building.

The GCLME is one of the world's most productive marine areas that are rich in fishery resources, petroleum production, and an important global region of marine biological diversity supporting the livelihood of many communities, especially those living around the coast.

Despite its resources, the GCLME is facing a lot of challenging problems, namely, population explosion and urbanization, fisheries depletion, water pollution, public health and sanitation, habitat degradation, coastal erosion, loss of biological diversity, and land-use (UNEP, 2005) all of which have been exacerbated by human activities.
It is important to note that a rapidly decreasing fish stock will cause not only a problem in protein supply for the large populations around the coastal communities but the whole West Africa region, even as the livelihoods of commercial fishermen in the areas are threatened. In addition, the physical destruction of natural capital e.g. coastal habitats, including wetlands, causes the loss of spawning and breeding grounds for most living resources and the loss of the rich and varied fauna and flora of the region, including some rare and endangered species.
Decision makers in the GCLME need to be presented a generic set of economic instruments for the sustainable management of critical zone natural resources and pollution reduction/abatement.
This will allow the national socio-economic experts to provide a chapter on economic instruments and the costs/benefits from unsustainable/sustainable use of coastal and marine natural resources to the NAP on economic instruments at national level and to propose the application of best adopted economic instruments given the social, economic, legal and regulatory environment in each GCLME country.
The GCLME project would thus enable the sixteen countries to take the value of environmental and social services provided by healthy ecosystems into consideration and make well informed choices on the use and protection of these ecosystems, which constitutes a precondition to effectively reverse the GCLME wide observed trends in natural resource degradation.
The protection and management of Large Marine Ecosystems is a complex task that needs to provide adequate incentives for needed behavioural changes in order to protect the ecosystem as well as to secure appropriate funds for further protection activities. Economic instruments are powerful tools that help to induce behavioural change reducing harmful behaviour and to overcome shortages in state finances for the protection of the ecosystem. They also can increase the commitment and responsibility of stakeholders involved.

The present report provides for a discussion on generic economic instrument for the wise use of environmental goods and services. It is divided into two sections. The first gives an overview on generic economic instruments for strengthening environmental policies. The second section provides for details on those instruments that could be applicable in the context of the LME conservation. The report will concentrate on the following policy fields:

- Sustainable fisheries
- Pollution prevention and control
    - Water pollution
    - Air pollution
- Financing of protected areas and biodiversity conservation

In the consideration of these policy fields a strong emphasis will be put on both the achievement of environmental objectives and a socio-economic development that is appropriate to mitigate social stress and to improve the situation of poor people.

2 The integration of economic instruments into environmental policies

Economic instruments have to be well integrated into an overall environmental policy that consists of a wise combination of government regulatory instruments in the various sectors and policy fields. Economic instruments can provide for a useful add-on in regard to regulatory command-and-control mechanisms as well as powerful incentives for inducing consumers and producers behavioural change. Policy makers however have to be aware that economic instruments alone cannot solve all environmental challenges. Regulatory measures will always need to be considered in wise environmental management planning. This report will not go into detail on regulatory non-economic instruments, but Table 1 below presents the most important regulatory instruments for environmental protection in order to complete the picture of available management choices.

Table 1: Generic List on major regulatory instruments for environmental management		
Planning instruments		Land-use plans eg. rural development plans, urban spatial planning, infrastructure development plans, water resource management plans
Planning instruments		Environmental Impact Assessment (EIA) EIA of the effects of projects on the environment. The EIA procedure ensures that environmental consequences of projects are identified and assessed before authorisation is given.
Planning instruments		Strategic Environmental Assessment (SEA) The purpose of an SEA is to ensure that environmental consequences of certain plans and programmes are identified and assessed during their preparation and before their adoption
Nature Conservation Management		Management Plans for Protected Areas
Nature Conservation Management		Development of networks of protected areas
Nature Conservation Management		Protection of species and ecosystems by law (e.g. restrictions in wildlife trade (for example as provided by CITES), hunting, collection of wildlife species etc., laws on the protection of specific habitats outside of protected areas)
Nature Conservation Management		Prohibition and/or enforcement of specific land-use practices (e.g. in agriculture, urban development, infrastructure development)
Command and control instruments	Emission control	Emission Ceilings: limiting individual sources but also national totals of atmospheric emissions of pollutants by law (to these pollutants belong: Fine articles, Sulphur dioxide (SO2), Nitrogen dioxide (NO2), Lead (Pb), Carbon monoxide (CO), Benzene, Ozone, Arsenic (As), Cadmium (Cd), Nickel (Ni), Polycyclic Aromatic Hydrocarbons)
Command and control instruments	Emission control	Enforcement of quality standards: · Engines (e.g. catalytic converter) · Fuels (e.g. low carbon fuels)
Command and control instruments	Emission control	Development of a sustainable transport system (e.g. reduction of unnecessary transport)
Command and control instruments	Emission control	Restrictions on the discharge of sewage and wastewater
Command and control instruments	Emission control	Enforcement of sewage treatment (esp. for industries)
Command and control instruments	Restrictions	Restrictions on the use of natural and mineral resources (e.g. timber products, mining, harvest of wildlife species not protected under nature conservation regimes)
Command and control instruments	Restrictions	Fishing quota ceilings and other restrictions on the use of marine natural resources
Command and control instruments	Chemicals	Classification, labelling and packaging of chemical substances and mixtures
Command and control instruments	Chemicals	Chemical Accidents - Prevention, Preparedness and Response Control measures aimed at the prevention of major accidents and control measures aimed at the limitation of consequences of major accidents
Production		Introduction of Eco-friendly technologies
Production		Integrated Product Policy All products cause environmental degradation in some way, whether from their manufacturing, use or disposal. Integrated Product Policy (IPP) seeks to minimise these by looking at all phases of a products' life-cycle and taking action where it is most effective.
Consumption		Green public procurement
Consumption		Waste management (waste prevention, recycling, waste treatment esp. treatment of hazardous waste etc)
Consumption		Energy saving

In general, economic instruments are under state and government control, thus the government sets rules and if necessary provides funds to induce a certain behavioural change or to achieve a certain output. “Newer” instruments however leave greater choices to companies to choose one or the other behaviour. This often leads to greater corporate environmental responsibility of firms. Others are more open to mechanisms of markets and help to overcome market imperfections. Figure 1 gives an overview on the most common economic instruments in environmental management.

Economic instruments for sustainable resource management

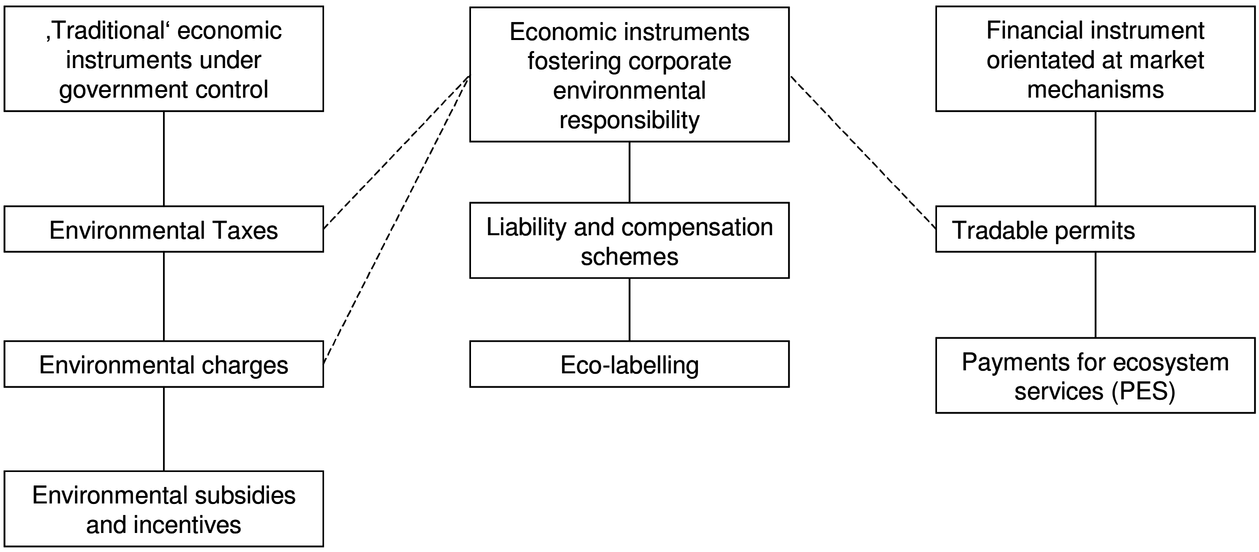

Figure 1: Economic instruments for sustainable resource management

The different instruments presented in this figure will be discussed in more detail in the sections below.

3 Generic economic instruments for strengthening environmental policies

3.1 Environmental Taxes

An environmental tax is a levy on environmentally harmful products or activities. The final end of environmental taxes is to incorporate the costs of environmental damage into market prices. In most cases environmental harmful products or activities create costs on the burden of the society. These costs may include decrease in harvest, necessary repair of buildings and infrastructure, health care services etc. These costs are defined as externalised costs, because they are not covered by the polluter, but they have to be paid by others. If these costs are not included, the consequences are incorrect market signals that encourage environmentally harmful behaviour. (EEA, 2000)
The levy of environmental taxes should lead to cover the costs of environmental damage on the one hand, but on the other - and maybe more importantly - to induce behavioural change of producers and consumers in order to prevent environmental damage before it happens. The OECD provides for a general definition of the principles of environmental taxation: '*A principle of good environmentally related taxation is to tax the behaviour to be influenced as directly as possible, in order to enhance the chance of actually influencing behaviour*'. (OECD, 2001). In addition environmental taxes raise revenue for government expenditures[1].

Use of revenue	Country application
General budget	• Belgium (Flanders) (currently) • Denmark • Estonia (*) • Finland • Netherlands • Norway • Sweden
Fund waste management schemes etc.	• Flanders (at the start, environment and nature fund) • France (at the start, modernisation fund for waste management) • Latvia (distributed between national and municipal environmental funds) • Poland (distributed between environmental funds) • United Kingdom (partly to Entrust fund)
Clean up contaminated sites	• Austria, Finland (**) • Switzerland
Other	• Czech Republic (municipal budget where landfill is located) • France (currently revenue neutral with reduced VAT on collection) • United Kingdom (partly to reduce national insurance contributions)

(*) Revenue becomes part of the central budget but it is earmarked for environmental protection.
(**) Although the revenue becomes part of the general budget, the Ministry of Finance had a 'gentleman's agreement' with the Ministry of the Environment when the tax was introduced, so that more money would be made available to fund contaminated land remediation.

Table 2: Use of waste tax revenues in selected EU Member States (Source: EEA, 2005)

[1] **Fehler! Verweisquelle konnte nicht gefunden werden.**The Table provides for an overview on how tax revenues on waste are allocated to the government budgets in the European Union..

	1990	1997	2002
As % of total tax revenues			
Energy	4.7	5.2	5.0
Transport	1.3	1.3	1.3
Pollution/resources	0.2	0.3	0.2
Total environmental taxes	6.2	6.7	6.5
Labour taxes	49.7	50.8	51.0

Table 3: Shares of taxes on energy, transport and pollution/resources, and on labour 1990, 1997 and 2002 in the European Union (Source: EEA, 2000)

'Traditional' government levies such as taxes on income, employment and investment put pressure on the economy by a distortion of the functioning of the market. An ecological tax reform should also explore the options for a tax shift from taxes on the 'goods' (income, employment and investment) to the 'bads' (environmentally harmful activities and products). The replacement of the revenue could then have the double effect that it reduces pollution through behavioural change on the one hand and on the other that the whole tax structure would have less distortional effects on the market. This effect is called the double-dividend. (EEA, 2000; OECD, 2006B)

A common definition of environmentally related taxes on which the OECD, the International Energy Agency (IEA) and the European Union has agreed is:

> "environmentally related taxes […] [are] any compulsory, *unrequited* payment to general government levied on tax-bases deemed to be of particular environmental relevance. The relevant tax-bases include energy products, motor vehicles, waste, measured or estimated emissions, natural resources, etc. Taxes are unrequited in the sense that benefits provided by government to taxpayers are not normally in proportion to their payments.
>
> Requited compulsory payments to the government that are levied more or less in proportion ot services provided (e.g. the amount of wastes collected and treated) can be labelled as *fees* and *charges*. The term *levy* covers both taxes and fees/charges." (OECD, 2006B)

Environmental taxes can be applied to a large number of items. The most common are energy products, motor vehicles, waste-related taxes, such as waste disposal, hazardous chemicals, fertilisers, tourism and the extraction of natural resources, like sand and gravel. (OECD, 2006B; EEA, 2000; HM Treasury, 2002). In general any product or activity could be taxed and they might be targeted both at consumers and at producers. In all cases they affect both consumers and producers by alternating the relative price of the product or service. The higher price is then the signal for behavioural change: the producer will seek to find solutions to reduce the tax burden by replacing or reducing the input of the environmentally harmful substance or activity. The consumers might reduce consumption and/or will try to find alternatives for the satisfaction of their needs. (EEA, 2000)

In this context however some aspects have to be considered for the design of environmental taxes. The introduction of environmental taxes can face significant barriers.

Some sectors could face considerable disadvantage in (international) competition, which also could impact on employment rates. In the design of an ecological tax reform several aspects need to be considered. First, it needs to be evaluation, if the environmental tax does not have the opposite effect. A loss in competitiveness could lead firms to transfer their production to other countries and/or consumers could choose to buy import products that are not subject to environmental friendly production schemes. (OECD, 2006B)

The question of competition however needs to be reflected at the macro-economic scale. The loss of competitiveness in one sector could result in economic gains in other sectors due to the double-dividend effect and/or the net-benefit of the environmental tax (e.g. through reduced health care costs) could overwhelm the sectoral economic loss. In addition it could

be advisable to gradually introduce an environmental tax. Producers might need time to adapt to the tax, let it be for the search of alternatives, let it be for the adjustment of the production towards more resource efficiency or for changes in consumption patterns. Thus it could be useful to determine an incremental tax rate over a period of time or to issue permanent or temporary tax-exempts for particularly vulnerable firms or sectors.
But not only producers, also consumers might be threatened by an additional economic burden, since it could be that there is neither an alternative to the product or service nor the option for a reduction of the amount of consumption. (EEA, 2000)
While high-income households might be willing to pay higher prices for a better environmental protection, low-income households could face a loss in well-being, if the higher prices cut their budgets. In general distributional effects arise from the direct payment of the tax, from higher prices induced by the tax, the use of the tax revenue by the government and form the benefits of the environmental improvement. Thus environmental taxes can have both positive and negative effects on the different social groups.
In order to prevent social injustice corrective measures of the tax should be applied. One option is to mitigate the effect ex-ante by exempting or reducing the tax rate for special groups. Or the other option is to compensate affected groups ex post, e. g. by reimbursement of the tax. The second option might be advisable if the tax rate structure should not be disturbed. (OECD, 2006B)

3.2 Environmental charges

In the literature environmental charges are often treated in the same context as environmental taxes (compare among others EEA, 2005 and 2006; Stavins, 2001). In deed environmental charges are also government levies like environmental taxes. The difference is that these compulsory levies are requited and more or less raised in proportion to services provided (e.g. amount of waste water treated). Charges are often also referred to as fees. (OECD, 2006B)
Like taxes, charges and fees also permit some flexibility in the way firms or other polluters respond to it in contrast to pure command and control regulations.
The types of charge schemes that are appropriate will depend on the targeted natural resource. Charge schemes can include entrance fees for protected areas, concession payments for tourism, and hunting and fishing fees. In agriculture levies could be raised on pesticides and fertilizer. These can be set up as requiring a charge per unit of product or contained substances.
Other types of environmental charge include levies on the use of a natural resource (such as water abstraction) reflecting the value of the environmental resources used, and provide an incentive for users to change their behaviour, in response to a price change. Thus the objectives of taxes and charges are almost the same in this context. (UNEP, 2004)
Charges can be raised both to reach a correspondence to the cost of the use the natural resource (such as abstraction levies) and to cover costs of service provision. In this case charges and fees are developed to (partly or fully) cover the cost of damage to the environment resulting from use of resources. Pollution charges, a special case of environmental charge, which should break even the financial and economic costs of discharging wastes into the environment. With the charge polluters are encouraged to reduce their polluting behaviour, and are effectively paying for the reduction of the environmental quality. (Stavins, 2001)
The basis of pollution charges on pollutant discharges is the load and/or the concentration, it should (to some extend) correspond to the environmental damage imposed by pollutants.

A desirable pollution charge should:

- Correspond to the environmental costs of wastewater pollution;
- Be proportional to marginal abatement costs and high enough to create an incentive for investments in pollution reduction;
- Provide for sufficient revenue for remediation of the pollution.

Levying charges on diffuse (non-point) pollution, e.g. from farms, is difficult to carry out directly, and tends to be done by proxy (acreage, number of cattle, etc) or product (e.g. tax on fertiliser).
In any case a successful implementation of pollution charges is a well-functioning monitoring and measuring system. (Ibid.)

Box 1: Example for water abstraction charge in the UK

In the UK licence holders are charged for water abstraction in order to fund the costs for effective water resources management. The charges should encourage licence holders to sustainable water use.
The Environment Agency is responsible for the protection and improvement of the quality of rivers, streams, lakes, estuaries, coastal waters and ground waters, the control of pollution and the regulation of discharges and abstractions.
The goal of the charges is cost recovery of the regulation of water abstraction should be reached with three basic types of charge:

Application charge

The application charge is levied for any licence to abstract water, or to vary an existing licence.

Advertising administration charge

Is raised for the costs advertisements in a local newspaper if necessary as part of the application process.

Subsistence charge

The subsistence charge is usually payable by everyone who holds a full licence to abstract water.

Structure of the charges:

The application charge and the advertising administration charge are fixed charges.
The subsistence charge depend on the following factors:

- Volume - annual licensed volume (in '000 cubic metres)
- Source - unsupported, supported or tidal
- Season - summer, winter or all year
- Loss - high, medium, low or very low
- Standard unit charge (SUC) - charge for the region in which the abstraction is authorised to be made
- Environmental Improvement unit charge (EUIC) - charge to recover the costs of compensation payments.

(Source and further details at UK Environment Agency, http://www.environment-agency.gov.uk/business/regulation/38809.aspx)

Deposit-refund schemes

A special case of environmental charges are deposit-refund schemes, which are applied in cases where the clean-up costs for illegal waste disposal (especially for hazardous chemicals) are much higher than a legal and proper disposal. Here a front-end charge (deposit) combined with a refund that is paid at the moment of return of the substance in question for recycling or (proper) disposal. Beside chemicals deposit-refund systems also exist for batteries, vehicles, car tyres, glass containers and wrapping materials. (EEA, 2005 and Stavins, 2001)

3.3 Environmental subsidies and incentives

The definition that is most widely used in the policy context, probably because of its broad scope, is that of the OECD (2005), which defines subsidies as:
‘A result of a government action that confers an advantage on consumers or producers, in order to supplement their income or lower their costs’

3.3.1 The danger of environmentally harmful subsidies

Subsidies are any form of government support that aim at economic development. The OECD provides for a generic and broad definition of subsidies:
"A subsidy is a measure that keeps prices for consumer below market levels, or keeps prices for producers above market levels or that reduces costs for both producers and consumers by giving direct or indirect support." (OECD, 2005)
In regard to environmental protection however subsidies are not always considered to be favourable. On the contrary, subsidies can produce substantial environmental impact. Subsidies are not only direct money transfer, it can also involve many different measures, such as tax reduction and exempts, provision of credits, credits at lower interest rates. Others are provision of free of charge services or charging below cost price. All these measures are targeted at a maintenance of the economy at a level that could not be achieved without this support. In case the economic activity involved provokes environmental damage, then the impact would be lower without the subsidy. The OECD has characterised these kind of subsidies 'environmentally-harmful subsidies' or even 'perverse subsidies'. A definition of environmental harmful subsidies is proposed by the OECD as follows:
'A result of a government action that confers an advantage on consumers or producers, in order to supplement their income or lower their costs, but in doing so, discriminates against sound environmental practices.' (Valsecchi C. et al., 2009)
Even if it is today widely accepted that subsidies can result in substantial environmental impact, it is often not easy to simply eliminate them. Pearce argues that a first an necessary step is to identify those subsidies which are environmentally harmful, what reasons there are that make them harmful or not and also to understand how large subsidies are. Already the last point is often not easy to determine. Because of the complexity of measures of what can be considered a subsidy, it is often difficult to say what the baseline scenario is, so to say what would be the condition without subsidies. Pearce gives the example of international aviation fuel. In comparison to other transport sectors aviation fuel is not taxed, not to levy a tax is not necessarily a subsidy, but it still advantages aviation, therefore some argue that this constitutes a hidden subsidy. Also the trade-offs with other social end economic goals need to be included into the baseline scenario. Many subsidies are allocated with the goal to support socially vulnerable groups and people. It is however advisable to carefully look at the costs and benefits in regard to the achievements of the goal and to counterbalance this with the possible environmental damage, which may additional disadvantage the target group of the subsidy. If looking at subsidies also the nature government support matters. Three general differentiations can be made according to Pearce: market price support, cost-reducing support and payments for explicit (environmental) purposes. Generally it can be said that subsidies encouraging higher production rates, thus those that are related to the production output, create greater environmental damage, than those that are decoupled from production rates and output. And finally also the geographic scale matters if one analysis the consequences of subsidies. A subsidy that protects the production in one area may have adverse effects on production schemes in areas without subsidies and it is likely that there further environmentally harmful effects occur. (Pearce, 2006)

Box 2: Example: The vicious circle of harmful water subsidies in developing countries

Pearce (2006) provides for an illustration of the negative social, environmental and economic impacts of subsidies in the water sector of developing countries. Water subsidies in developing countries amount to about USD 45 billion per annum that roughly equals to the total official foreign aid. Urban supplies for drinking are significantly subsidised, but the very poor often do not have access to piped water instead they need to pay substantial amounts to vendors for bottled water. Cost recovery of capital costs of urban supplies is seldom reached. Irrigation water is often supplied at very low supply costs hardly covering, in addition it has a high opportunity cost (i.e. the value of water in the next best use). Low prices imply low revenues for water companies and agencies, this makes investment in new supplies less likely. As a result potentially valuable agricultural land often is not developed because water infrastructure cannot be upgraded or maintained. In addition subsidised Irrigation infrastructure benefits more larger farmers and not smaller ones who are often less connected to the infrastructure. Finally, these distributional impacts are combined with environmental damage. For example, low prices encourage excess irrigation and this can result in water logging and salinisation of soils, reducing agricultural potential. (Pearce, 2006)

Taking all these considerations into account the necessity of analysing existing subsidies in regard to their harmfulness to the environment, becomes evident. The identification and finally the removal of environmental harmful subsidies is a decisive step towards a subsidies reform targeted at a sustainable management of environmental resource management.
The OECD has developed an analytical framework for the assessment of subsidies in regard to their effects on the environment. This framework consists of three complementary tools for the assessment of circumstances that mitigate, or have rebound effects, on the environmental harmfulness of a subsidy.
These tools are extensively described in three main publications issued by the OECD, therefore they should only briefly be outlined in this report.

Tool 1 - The quick scan (based on OECD, 1998):
The ‘quick scan’ was developed to assess which subsidies are qualified to provide for win-win situations for the environment and the economy, or which subsidies could reach such situations if subjected to appropriate reforms.
This tool a designed to answer the following questions:

- Does the subsidy meets its objective (i.e. does the support lead to benefits within the target group), and if so
- Does any negative impact on the environment occur, due to this support?

The answers to these questions should reflect that the effect of subsidies are not only bound to the scale and design of the subsidy, but also to other preconditions such as environmental regulations and policies, that set specific standards and foresees the application of pollution abatement techniques. It further considers the pollution absorption capacity of the environment.

Tool 2 - the checklist (based on OECD, 2005):
The quick scan approach
the ‘quick scan’ approach was developed further that allows for a more pragmatic handling of the issue. It focuses on circumstances under which the removal of a subsidy could have substantial beneficial effects on the environment and how these subsidies could be prioritised. Figure 2 provides for a flow chart of the several steps that need to be undertaken for the check-list approach.

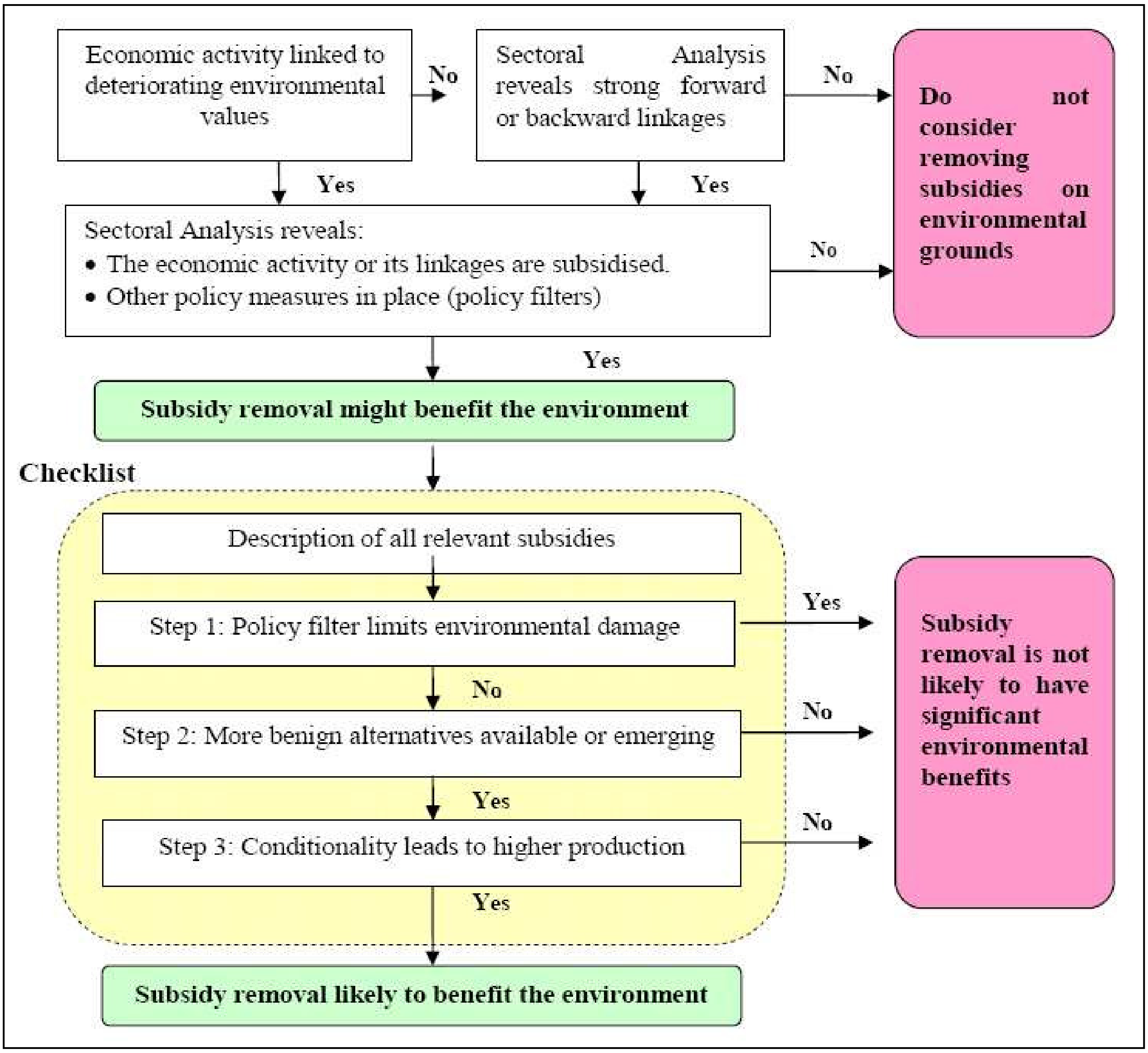

Figure 2: Flowchart of the checklist (Source: OECD, 2005)

Tool 3 - The integrated assessment framework (based on OECD, 2007a)

Tool 1 and 2 were even further developed concluding in the 'integrated assessment framework', which incorporates also a sustainability perspective and an analysis of social and economic trade-offs with environmental concern, because it has been recognised that a separate treatment of these aspects would fail to highlight synergies and to achieve solutions that ingrate both social and environmental concerns.

Thus the integrated assessment focuses on:

The identification of costs and benefits in all spheres associated with environmental, economic and social life, including the relevant trade-offs to be made. Since any reform also needs understanding and support of the broader public the framework also aims at a provision of comprehensive information to be disseminated to relevant stakeholders. The framework is further designed to be applicable to any type of subsidy and it should allow for both ex-ante and ex-post analyses.

The role of Official Development Assistance (ODA)

Official Development Assistance can be regarded as a special form of subsidies or at least it often has similar effects as national subsidies. Therefore principles for detecting environmental harmful subsidies and their removal could be also a viable tool for identifying environmentally harmful ODA.

3.3.2 Environment-friendly subsidies and incentives

As stated above subsidies can create can create environmental and even social harm even if their initial purpose was meant to tackle these problems. As a result the application of subsidies needs to be considered very carefully. However, if correct pricing of environmental goods and services is not to be realised, then financial support for research and development, investment and other activities can be an appropriate tool to foster sustainable development. Some preconditions are however needed in order not to thwart the polluter-pays principle:

- They should not provoke substantial interferences in international trade and investment;
- They should be restricted to sectors and industries that struggle with the compliance of environmental goals;
- They should not go beyond a determined transition period and be tailored to the socio-economic circumstances that constrain the implementation of a country's environmental policy.

This often applies to new technologies that compete with older but cheaper ones, like renewable energies against fossil fuels. The subsidy should be calculated on the basis of the external cost avoided, thus the environmental costs that would need to be paid if the energy were conventionally produced. (EEA, 2006)

Similarly environmental resources such as forests are often exploited depriving the society of their environmental services like climate regulation or storage of water resources. The protection of these resources can encouraged by the provision of subsidies. Box 3 provides for an example of subsidies for forest conservation programmes in Finland, which might not be fully applicable in the GCLME context, but it could however provide for some innovative ideas.

Box 3: Example for environment –friendly-subsidies and incentives

Forest Biodiversity Programme for Southern Finland (METSO, 2002-2007)

The METSO programme encourages the forest owners' willingness to protect forests on a voluntary basis and is managed by the Ministry of Agriculture and Forestry and the Ministry of the Environment. The aim is to restore and manage forest habitats.

Landowners agree to maintain or improve specified biodiversity values of the forest and in return they receive a regular payment from the State as buyer of these natural values.

The environmental authorities invite the landowners to submit tenders on areas to be protected based on conservation of biological criteria and the price at which they are willing to offer their sites for protection. A crucial element is that landowners have to compete for the acceptance in the programme. This forces them to evaluate their forest management practices in regard to forest and biodiversity objectives. Experiences with the METSO programme have shown that landowners change their attitudes towards an improved biodiversity conservation even if they are not excepted to participate in the programme. (OECD, 2006a, for more information refer to the programmes website at http://wwwb.mmm.fi/metso/international/index.html)

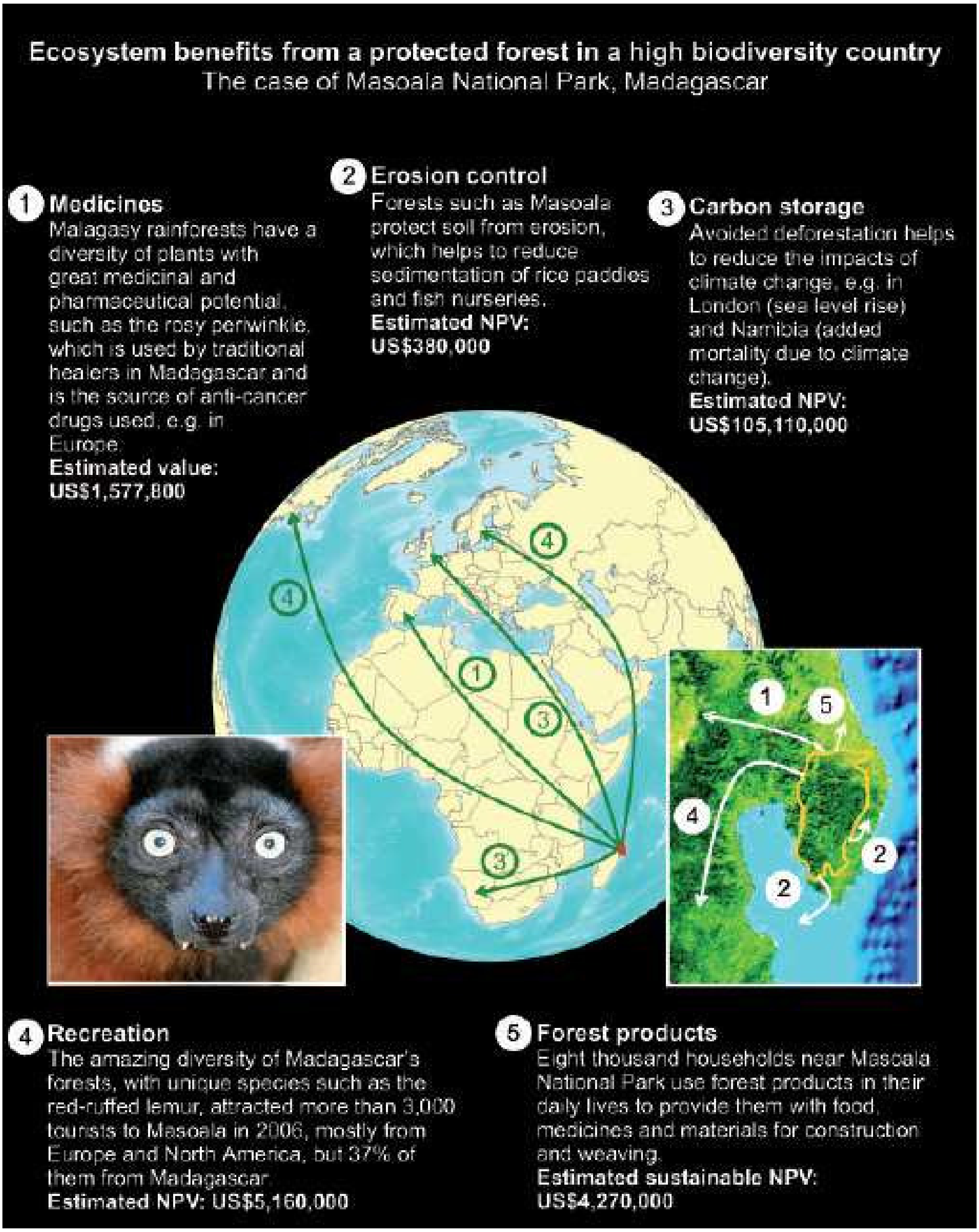

Figure 3: Ecosystem benefits from a protected forest in a high biodiversity country (Source: Sukhdev; TEEB, 2008)

3.4 Tradable permits

Emission trading

An instrument designed to achieve reductions in pollution (the most prominent example is carbon trading) or use of resources (in this context fish quotas) in the most effective way through the provision of market incentives to trade.

Options for emission trading are **cap and trade** or **baseline and credit**. The cap and trade scheme allocates to each company an emission permit at the start of the cap and trade period. Each year the company has to report on the actual emission. If the company has not taped its full allowance potential then it has the right to sell the surplus. If the company exceeds the allowance it must find other parties that are able to sell their surplus. The trade systems is finite, that means that there is an absolute quantity of allowable emissions (cap).
The baseline and credit system has to be calculated each year. For each contracting party a baseline for allowable emissions is determined on the basis of its economic performance. If emissions of the party is below the baseline, then it can sell the achieved credits can be sold to those who could not keep the baseline level. A constraint for this system is that there is no cap, thus the baseline varies with the economic activity. In case of unexpected economic growth this system gives not halt to additional emissions. In addition the cap and trade system is easier to operate once the baseline has been set. (Stern, 2007)

Tradable permit systems however are not only applied to emission trading schemes. Other sectors where experiences with trading schemes were made are the waste, the water and the fishing sector.

Box 4: Example of tradable permits in the waste sector

In Great Britain a packaging recovery notes system was implemented that obligated companies to provide evidence that they had recycled and recovered their packaging waste. The companies could either comply individually, or join one of the 'compliance schemes'. The form of evidence is known as the packaging recovery note (PRN). These are issued by reprocessors when material is actually recycled or recovered, and are sold to firms or compliance schemes.
This system can be considered a trading system since the PRNs are traded. They serve as vouchers for the firms, so they can demonstrate that they have met their recycling obligations. The PRN system has contributed to reducing the weight of packaging, as a means of reducing the tonnage obligation, and has had some effect on encouraging re-usable packaging, and has resulted in low compliance costs. (EEA, 2005)

Box 5: Example of tradable permits in the water sector

An Australian Example: The Hunter River Salinity Trading Scheme
In Australia a cap-and-trade scheme was established to regulate discharges of saline water from coalmines and power stations in the Hunter River catchment.
This scheme aims at the management of saline water discharge for limiting the impacts on irrigation, other water users and on the aquatic ecosystem. The scheme establishes a cap on salinity discharges. The cap orientates at the share that can be safely diluted within a high flow event and is calculated according to the ambient salinity in the river and concentration targets at key points in the river. The implementation of this scheme is controlled by a comprehensive monitoring system that is operated and paid by the permit holders themselves but it is audited by the competent environmental authority.
Initially the scheme was managed through EPA licensing with ‘credits’ allocated to coalmines and power stations in the region and including a reserve held by the EPA. More recently, the pilot has moved to a permanent footing under separate legislation. A number of innovations have accompanied introduction of the permanent scheme, including extending the life of credits to 10 years and allowing third party ownership. In order to maximise the potential benefits from trade and facilitate new entrants, twenty percent of credits expire every two-years and are reallocated via auction. (Whitten, 2003)

Tradable permits in the fisheries sector
A prominent example of trading fish quotas was analysed by Kerr et al. (2002) for the New Zealand Exclusive Economic Zone (EEZ), which will be discussed in more detail in chapter 4.1.

3.5 Liability and compensation schemes

Liability and compensation schemes are adherent to the precautionary principle of preventing environmental damage before it happens. It is an effective means for the implementation of the polluter-pays-principle and decoupling economic development from natural resource degradation. Environmental liability forces producers to incorporate environmental risk management into their production schemes. Therefore operators will be more willing to adopt environmental management schemes and environmental audits that will lead to an integration of environmental concerns in business management.
Liability and compensation however have the potential to produce a number of economic impacts, to these belong:

- fines and non-compliance penalties (e.g. for breach of emissions standards);
- the risk of liability and the need (where applied) for insurance or contingencies to cover eventual liabilities;
- the impact of liabilities on price (e.g. in the sale/privatisation of industries, installations and sites the price can be affected by perceived liabilities for cleaning up contaminated land);
- the costs of addressing liabilities (e.g. clean up of land);
- the costs of compensation (e.g. for oil spills). (EEA, 2005)

Considering the introduction of liability and compensation schemes in the GCLME context decision and policy makers need to carefully consider where to set the standard for liability. Certainly environmental standards need to be adapted to the technical and financial feasibility in the context of the overall situation in the countries. If standards are set too high than the competitiveness of firms will suffer, enforcement and control of the liability laws will be very costly and the danger of illegal pollution and waste disposal will be even higher. Therefore a gradual approach to introducing certain standards will be advisable.
Liability schemes can also combined with reporting requirements of operators about their environmental performance and/or about information on use, storage, and release of hazardous chemicals. Also voluntary commitments such as environmental certification or labelling of environmentally friendly production could be an option for combination in this context. (Stavins, 2001)

3.6 Payments for ecosystem services (PES)

The concept of ecosystem services incorporates different aspects of the above mentioned instruments, but as a whole it can be characterised as an instrument on its own. Therefore a special section is dedicated to PES.
Ecosystem services include, for example, the role of upstream forests and other natural areas in reducing downstream floods. These services today are rarely compensated in land prices or by other mechanisms. Providing incentives by paying stakeholders and managers to maintain environmental services is an innovative way of strengthening environmental security. Therefore, finding ways for internalising the external effects (positive) of open space but also of new green field developments (negative) through taxation is one theoretical way forward.
There is still no clear definition on PES, but in general PES are transactions that bring together the providers and beneficiaries (the water company, the farmer down river, the firm that needs to buy carbon offsets).
Some examples of PES are:

- Carbon sequestration and storage (e.g. a Northern electricity company paying farmers in the tropics for planting and maintaining additional trees) => also refer to the chapter 3.4 on tradable permits;
- Biodiversity protection (e.g. conservation donors paying local people for setting aside or naturally re-storing areas to create a biological corridor);
- Watershed protection (e.g. downstream water users paying upstream farmers for adopting land uses that limit deforestation, soil erosion, flooding risks, etc.);

- Landscape beauty (e.g. a tourism operator paying a local community not to hunt in a forest being used for tourists' wildlife viewing). (ibid.)

Wunder (2005) provides for a rather simple definition of how payments of ecosystem services work. A PES is:

1. a voluntary transaction where
2. a well-defined environmental service (or a land-use likely to secure that service)
3. is being 'bought' by a (minimum one) buyer
4. from a (minimum one) environmental service provider
5. if and only if the provider secures ES provision (conditionality).

PES programs are voluntary and mutually beneficial contracts between consumers of ecosystem services and the suppliers of these services. The party supplying the environmental services holds the property rights over an environmental good that provides a flow of benefits to the demanding party in return for compensation. The beneficiaries of the ecosystem services are willing to pay a price that is lower than their welfare gain due to the services. The providers of the ecosystem services are willing to accept a payment that is greater than the cost of providing the services or the foregone benefit he would receive if the service provision includes to stop some activities. Figure 4 illustrates this process of bargaining between service providers and service buyers. (Smith et al, 2006)

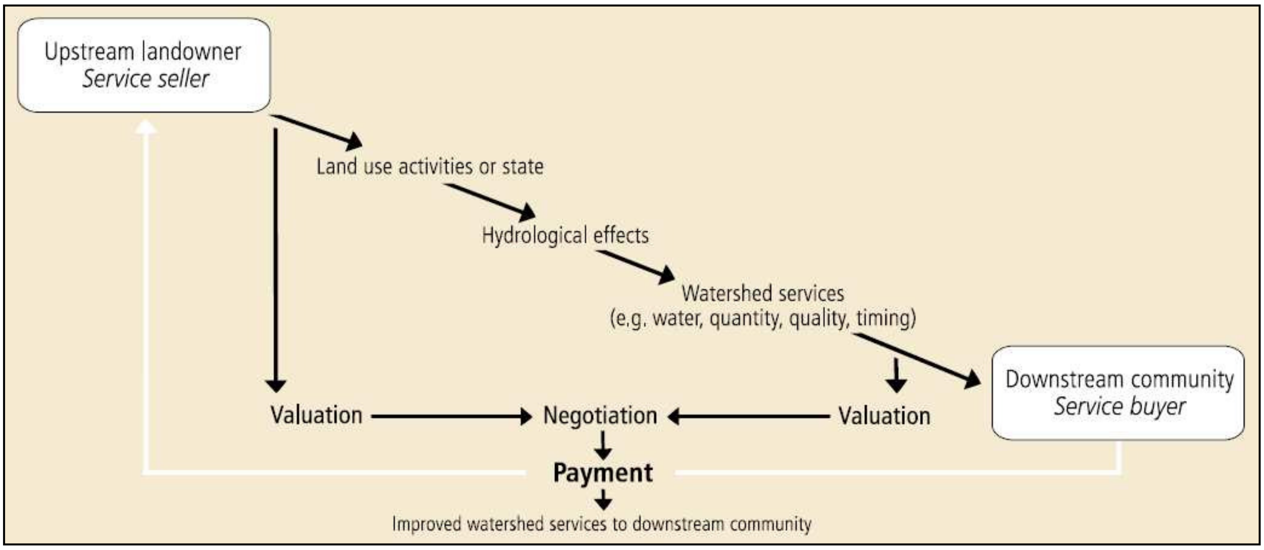

Figure 4: Payments link upstream and downstream stakeholders in watershed services (Source: Smith et al., 2006)

PES require defined property rights over the ownership of the service to facilitate the exchange. A constraint in this regard is that ecosystem services often represent public goods. Since no one can really 'own' clean water in a river, the ownership must more belong to the actual land use or change in land use that in the end provides the service (Hope et al, 2007). In problematic cases it could be advisable to have the public sector as intermediary that could settle conflicts in cases where ownership of ecosystem services would lead to a depletion of a public good. (Duraiappah, 2007)

The conservation of global environmental commons (like atmosphere, the oceans, biodiversity, the arctic, boreal and tropical forests, etc) is an urgent need for the future existence of mankind. Payments of ecosystem services at the global scale could be one solution in this regard. The Global Environmental Facility (GEF) engages in the support developing countries' provision of global commons and promotes the concept of PES at the global scale (GEF, 2008). But practical experiences with international markets for ecosystem services are so far limited to carbon sequestration, biodiversity private trade in bioprospecting. (WWF, 2003)

4 Economic instruments in the context of LME conservation and management

4.1 Economic instruments for sustainable fisheries

The occurrence of over fishing is often described as a vicious circle. The reported global marine fisheries landings have declined by about 0.7 million tonnes per year since the late 1980s with at least 28% of the world's fish stocks overexploited or depleted, and 52% fully exploited by 2008. (Mora et al., 2009) Figure 7 shows how fish stocks have been declining in the past decades. The decline of fish stocks in the past decade (Figure 5 provides for an overview on the state of exploitation of global fishery resources and Figure 6 and Figure 8 give an overview on global fishlandings. Figure 9 provides for a list of fishstocks in the Eastern Middle Atlantic that includes the GCLME) did not correspond in a diminishing of the global fisheries fleet. In the opposite, today most countries involved in the fishing industry have a large fleet overcapacity that leads to a decreasing economic viability of the fishing sector.

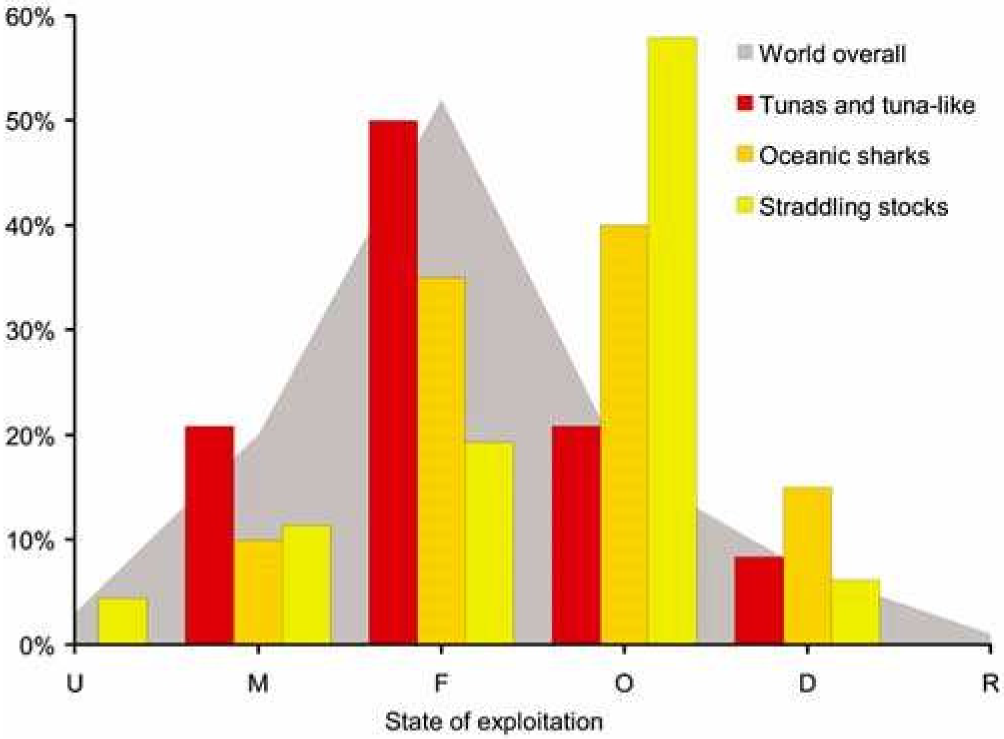

Figure 5: The state of exploitation of the fishery. (Source: Maguire, 2006).

The state of exploitation is classified as underexploited (U), moderately exploited (M), fully exploited (F), overexploited (O), depleted (D) or recovering (R). Percentages are calculated for stocks for which the state of exploitation can be determined. It is unknown for 73 percent of the stocks considered in this report. For highly migratory tuna and tuna-like species, 30 percent of the stocks are either overexploited or depleted. About 50 percent of the stocks are fully exploited (i.e. near their level of maximum productivity) and exploitation could be increased for about 20 percent of them as they are moderately exploited. The state of exploitation of tuna and tuna-like stocks is very similar to that of the world overall.

The economic and social viability however is dependent on a restoration of the productivity of fish stocks. But still there is a high danger that social objectives (such as job security) advocate short-term fishing opportunities that further deplete the already vulnerable fish populations. Figure 10 gives an overview on the management effectiveness and sustainability of the world's fisheries. Economic instruments can help to improve this situation, at the current stage of scientific research and practical experiences in this field however it has to be said that many of the instruments still need a lot of improvement. It has to be considered that some concerns in the fisheries sector have to be met at the international level. The fisheries industry at least at the large scale is bound to the global market (, which is very much influenced by European and Northern American policies. Therefore not all instruments presented in this chapter are directly applicable in the GCLME context and some of them need to be harmonised at the global and international level in the framework of international conventions, treaties and agreements.

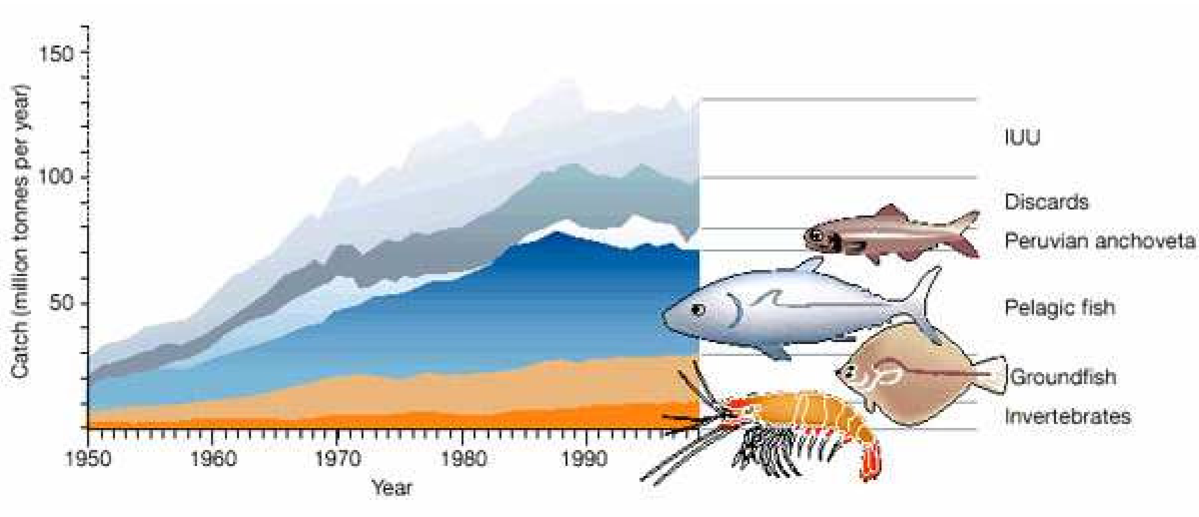

Figure 6: World fish landings. (Source: Pauly et al., 2002)

Figures for invertebrates, groundfish, pelagic fish and Peruvian anchoveta are from FAO catch statistics, with adjustment for over-reporting from China. Fish caught but then discarded were not included in the FAO landings; data relate to the early 1990s and were made proportional to the FAO landings for other periods. Other illegal, unreported or unregulated (IUU) catches were estimated by identifying, for each 5-year block, the dominant jurisdiction and gear use (and hence incentive for IUU); reported catches were then raised by the percentage of IUU in major fisheries for each 5-year block. The resulting estimates of IUU are very tentative (note dotted y-axis), and we consider that complementing landings statistics with more reliable estimates of discards and IUU is crucial for a transition to ecosystem-based management.

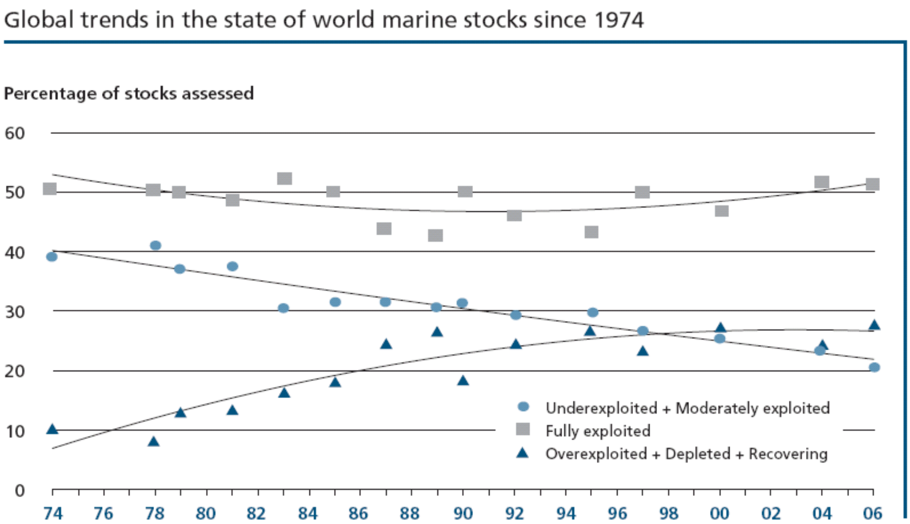

Figure 7: Global trends in the state of world marine stocks since 1974 (Source: FAO, 2009)

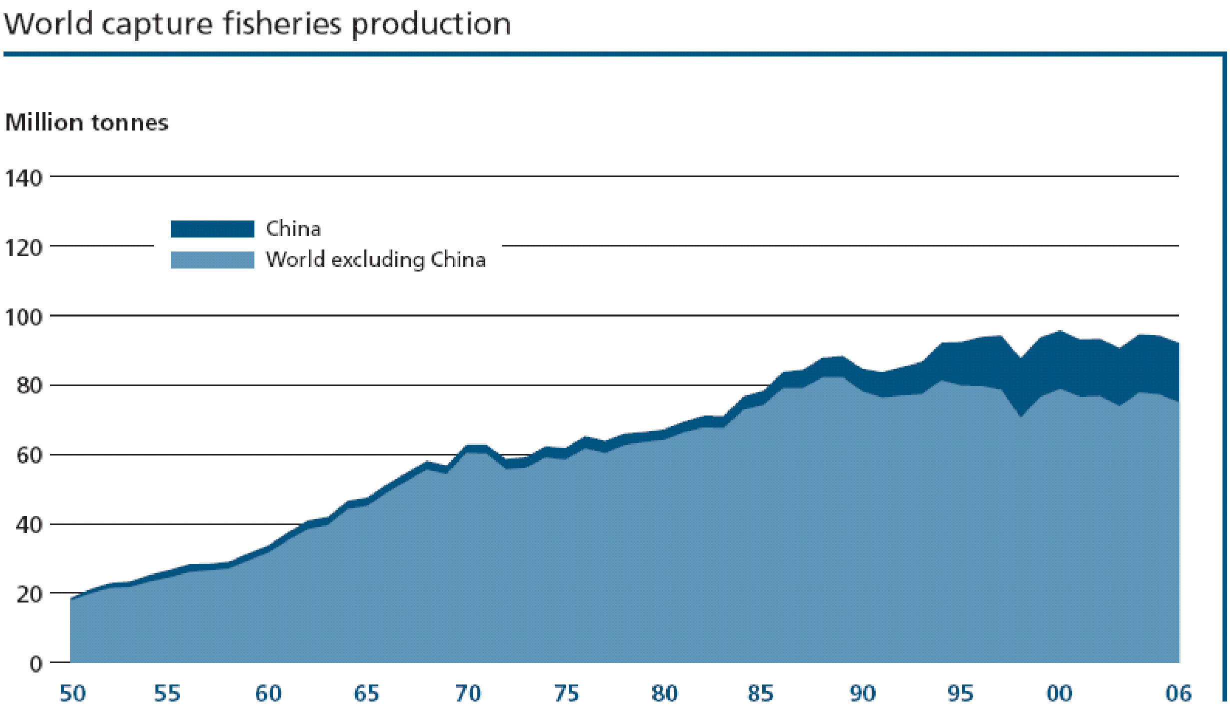

Figure 8: World capture fisheries production (Source: FAO, 2009)

Eastern Central Atlantic (FAO area 34)

Fish	Status	Main fishing countries	Tons/year
Common sole *Solea solea*	Overexploited	Morocco, Italy	4,000
Various other flatfish *Pleuronectiformes*	Overexploited	Spain, Senegal, Morocco, Mauritania	25,000
Other flounders, halibut and sole like fish	Overexploited	Nigeria, Korea, Cameroon, Sierra Leone	3,000
Senegalese hake *Merluccius senegalensis*	Overexploited	Spain	8,000
Other cods, hakes and haddocks	Overexploited	-	5,000
Bigeye Tuna *Thunnus obesus*	Overexploited	Spain, China, Taiwan, Japan	44,000
Common Octopus *Octopus vulgaris*	Overexploited	Spain, Italy	9,000
Various other octopus *Octopodidae*	Overexploited	Morocco, Senegal, Mauritania	63,000

Figure 9: List of fish stocks in the Eastern Central Atlantic ranked as either "overexploited", "depleted" or "recovering" by FAO statistical region (Stock assessments based on 2004 data, catch volumes based on 2002 data) (Source: FAO, 2006)

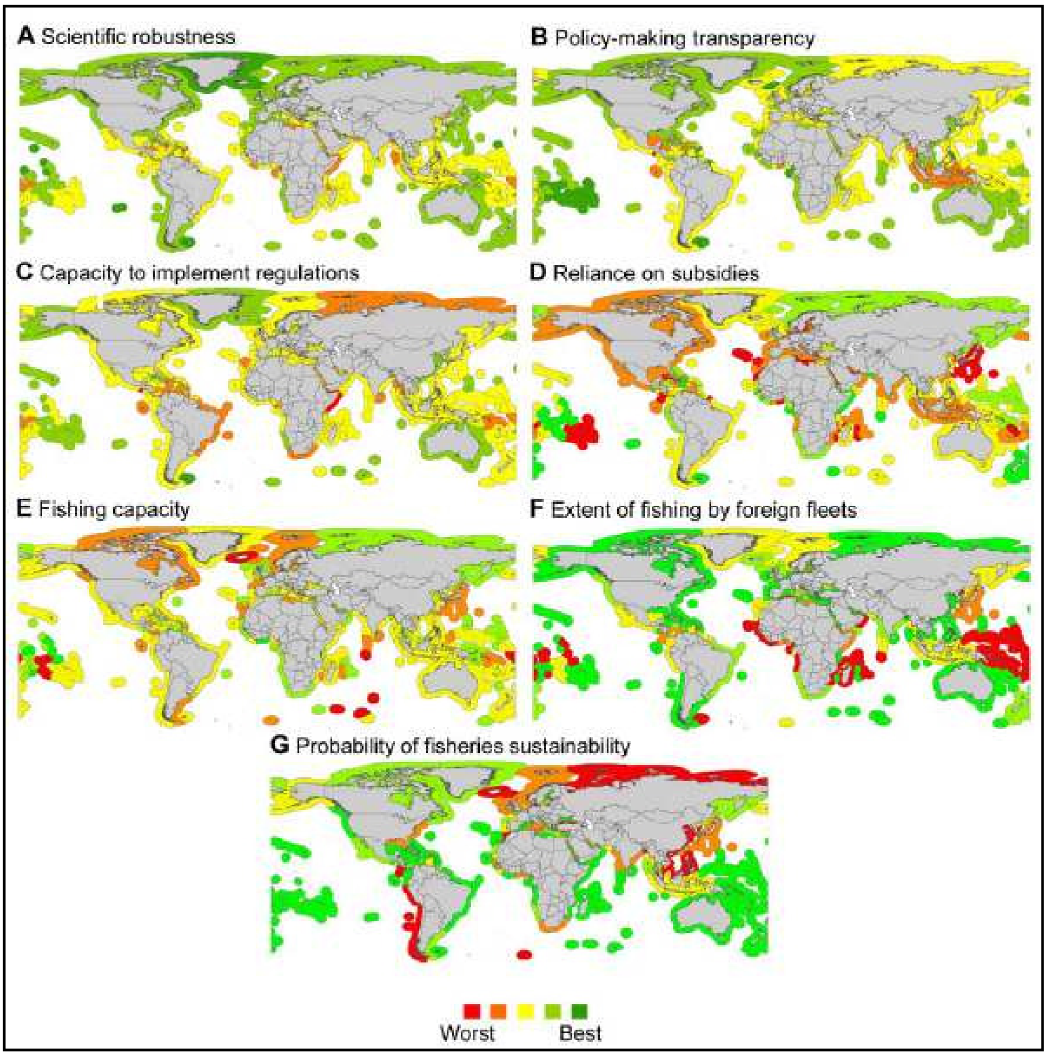

Figure 10: Management effectiveness and sustainability of the world's fisheries. (source: Mora et al. 2009)

These figures depict the results of experts' opinions on the valuation of scientific robustness (A), policymaking transparency (B), implementation capability (C), subsidies (D), fishing capacity (E) and access to foreign fishing (F). (G) depicts the probability that fisheries in each EEZ are sustainable in 2004.

Transferable rights of fishing quotas

Transferable rights of fishing quotas basically follow the same principle as the cap-and-trade programmes established for carbon trading. An example for such a trading system is New Zealand, that introduced a transferable individual fishing quota system in 1986. Individual Fishing Quotas (IFQs) are allocated to eligible fishermen, allowing them a specific portion of the total allowable catch (TAC). The government of New Zealand denominated the quotas as a share of the TAC. As of 1998 the system included 33 species and more than 150 markets for fishing quotas. Kerr et al. (2002) have analysed this system and have revealed that is has proven to be successful in contributing to a policy combating the depletion of fish stock. (Kerr et al., 2002)

The PEW Environment Group (2009) has elaborated design principles for catch share programmes that read as follows:

- science-based annual catch limits that include all fish killed by fishing (target fish landed and
- non-target fish—or bycatch—discarded at sea

- adequate monitoring of the target fish catch and the incidental catch of non-target species
- identification of explicit conservation, social and economic goals and objectives and metrics for measuring progress
- permits issued for no more than 10 years and a regular evaluation of program performance, with an opportunity to modify and improve it
- adequate enforcement, including validated catch and discard reporting and, to the extent possible, real-time management that has the power to close the fishery as soon as the quota is reached
- fair and equitable quota allocation that is conducted through a transparent and open process, including mechanisms to provide access opportunities to recreational anglers, working fishermen and coastal communities; ownership caps so that one entity does not hold an excessive amount of quota; and opportunities for new fishermen to enter the fishery. (PEW Environment Group, 2009)

Environmental subsidies in the fishery sector

Subsidies play an important role in the fishery sector. Unfortunately often these subsidies create more harm to the environment than benefits. Thus subsidies in the fishery sector should be carefully scrutinised according to the rules of detecting environmentally harmful subsidies as described in chapter 3.3. In addition subsidies play an inglorious role at the international agenda, especially the industrial northern countries still protect their fishery sector with subsidies that have led to significant depletion of the global fish stock. The European Union currently makes efforts to eliminate these subsidies and other negative policies. In this respect a green paper (Commission of the European Communities, 2009) has be circulated for comments in the community of scientists and environmental NGOs. At present this consultation process has been closed and further steps of the EU are to be expected.

Briefly summarised environmental harmful subsidies and incentives include:

- subsidies leading to over-investment in fishing capacity in a fishery in which management is unable to control fishing effort;
- buy-back programmes in which receipts from the sale of older boats are reinvested in modernized boats, thereby increasing fishing capacity;
- contradictory regulations leading people to ignore the laws all together;
- laws loaded with unintended negative effects, such as prohibiting the selling of bycatch leading to increased discards; and
- governmental inducements for use of fishing methods with relatively great negative impacts on the ecosystem (e.g., modernisation subsidies leading to greater use of bottom-contact gears). (FAO, 2009)

Strengthening market opportunities by eco-labelling of fish-products

Catch documentation and trade certification schemes could be developed by regional fisheries management organizations (RFMOs) and voluntary eco-labelling schemes. Eco-labelling help producers of fish and fish products to differentiate their products. Eco-labels can also improve fisheries practices towards more sustainability, if properly designed and implemented. The FAO has issued a guideline for the eco-labelling of fish and fishery products from marine capture fisheries[2].

An example for eco-labelling in the fishing sector is the Marine Stewardship Council (MSC), which has set an environmental standard according to the FAO guidelines to measure and reward well-managed fisheries. Seafood products that meet this standard are signed with a blue eco-label. (more information on MSC can be found at the website http://www.msc.org/)

Increase the capacity of small-scale fisheries and coastal communities

2 FAO (2005a): FAO Guidelines for the Ecolabelling of Fish and Fishery Products from Marine Capture Fisheries, http://www.fao.org/docrep/008/a0116t/a0116t01.htm, visited 10. April 2010

In regard to poverty alleviation small-scale fisheries significantly contribute to the well-being of coastal communities. The promotion of small-scale fisheries also include a targeted design of economic instruments. But since this is only a small part of the policy that needs to be considered in the whole set of measures, we provide for a reference of a technical guidance of the Food and Agriculture Organisation (FAO) that has addressed this issue in a holistic and comprehensive approach[3]. Figure 11 provides for an overview on the different dimensions of poverty alleviation in relation to small-scale fisheries.

	Poverty alleviation				
	Poverty reduction: **Fishery contributes to lift people out of poverty**		***Poverty and vulnerability prevention:*** **Fishery contributes to maintain a minimum standard of living**		**Fishery as a source of vulnerability**
Level	**Contribution**	**Mechanisms**	**Contribution**	**Mechanisms**	**Causes**
Individual/ Intra-household	Livelihood support to other household members, particularly dependents	Fishing income spent on children's' education, and building other household assets (e.g. farm inputs, investment in small enterprises for other household members to run)	Household subsistence	Fishing income contributes to household budget – expenditure on food, clothing and healthcare	Strongly gendered roles and frequent absence of (migrant) male fishers may limit intra-household income distribution Absence from home and fishing lifestyle may increase vulnerability of partners to HIV infection
Household level/ sector	Generation of wealth	Effective capture of fishery rent (capital accumulation) High level of commercialization Access to effective market mechanisms Fish as cash crop for investment and diversification	Safety-net function (transient poverty) Activity of last resort for the poorest (chronic poverty)	Reduce vulnerability and mitigates poverty effects Food security through direct contribution (subsistence) but also fish as immediate cash-crop for safety-net	High occupational risk Risks of losing physical assets
Local level	Engine for rural development	Increased demand for goods and services Rise in wages and employment opportunities (income and employment multipliers)	Social-redistributive system (welfare)	Alternative sources of income, food and/or employment.	Unpredictability of the natural resource availability Natural disaster risk Conflicts
National level	Economic growth	Trickle up to government through taxes and foreign exchange earnings (regional or international trade)	Re-distributive	Government expenditure from fisheries-related tax and foreign exchange earnings on poverty alleviation measures	High susceptibility to macro-economic fluctuations

Figure 11: The different dimensions of poverty alleviation in relation to small-scale fisheries, including the specific issue of vulnerability (Source: FAO, 2005b)

[3] FAO (2005b): Increasing the contribution of small-scale fisheries to poverty alleviation and food security, technical guidelines for responsible fisheries, download at ftp://ftp.fao.org/docrep/fao/008/a0237e/a0237e00.pdf, 10. April 2010.

Prevention of illegal, unregulated and unreported fisheries (IUU)
IUU is a global problem that is one of the major factors for the depletion of fish stocks world wide. The OECD defines IUU as: "IUU fishing is now commonly understood to refer to fishing activities that are inconsistent with or in contravention of the management or conservation measures in force for a particular fishery." (OECD, 2004)
Figure 12 presents the simulation of different levels of IUU fishing for the 14 commercial groups in the five LMEs. Across the simulations, the following cost estimates has been reached:

- A total cost to EU Member States of lost catches from 2008 to 2020 of10.7 billion – this is an average cost in lost catches of 825 million per year which equates to about 15% of total fishery value and more than 30% of the value of the fisheries considered.
- Over 27,800 lost job opportunities in fishing and processing industries: around 13% of total fisheries employment.
- Significant stock depletion across most of the fisheries assessed: the models suggest that IUU fishing is preventing stock recovery and keeping fisheries locked in low-value states. It is difficult to put a number on this, but valuing lost stocks at the same value per tonne as landings suggests a total cost of almost € 9 billion. (EFTEC, 2008)

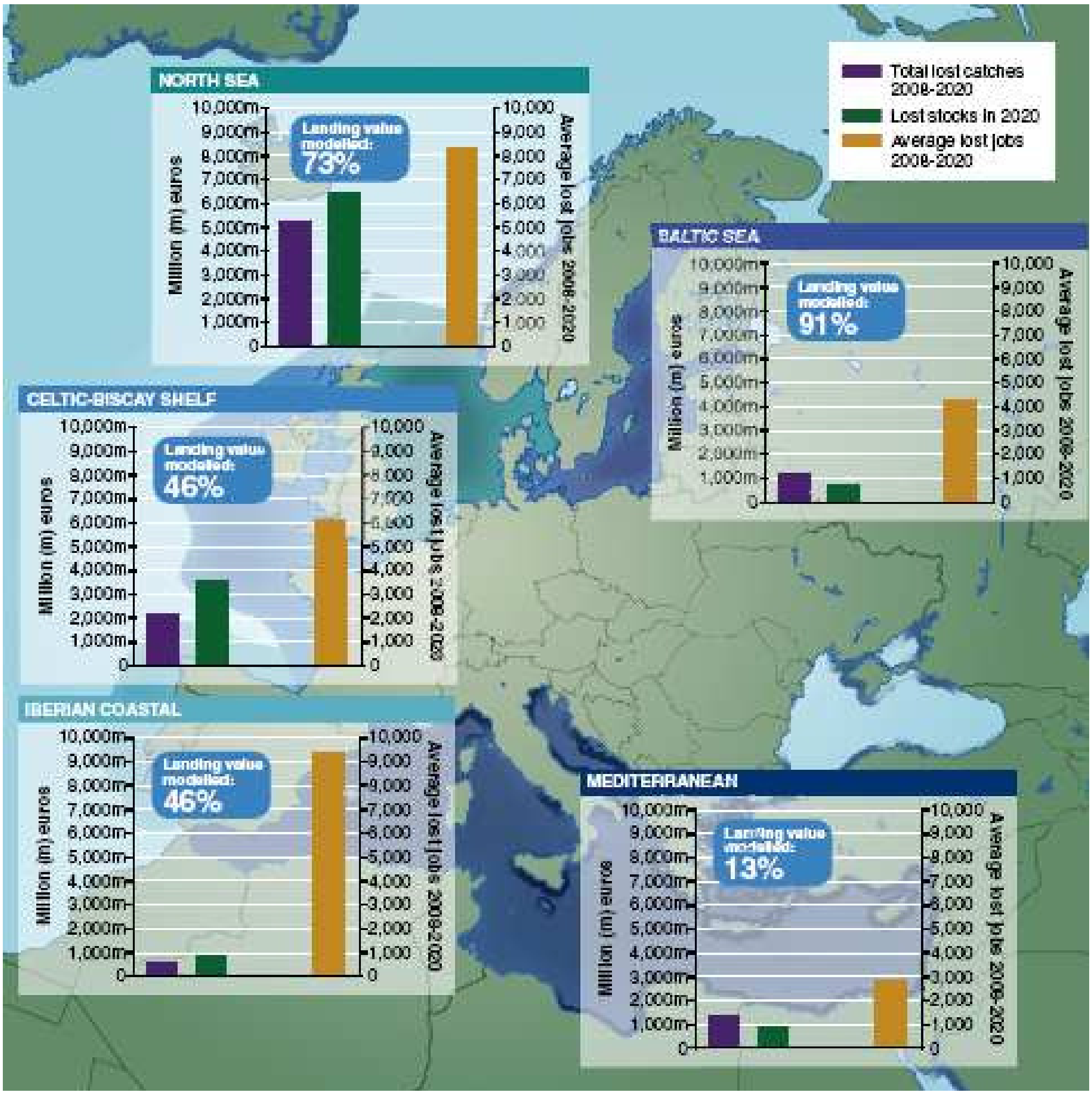

Figure 12: Summary of costs of IUU fishing for five LMEs in Europe (Source: EFTEC, 2008)

IUU needs to be tackled at the global scale but national economic instruments can contribute to mitigate this problem. However it is not possible to single out specific measures that could be applicable to the GCLME case. Therefore we would like to refer to two major publications in this regard that provide for exhaustive detail on this matter.[4]

4.2 Economic instruments for pollution prevention and control

4.2.1 Water pollution

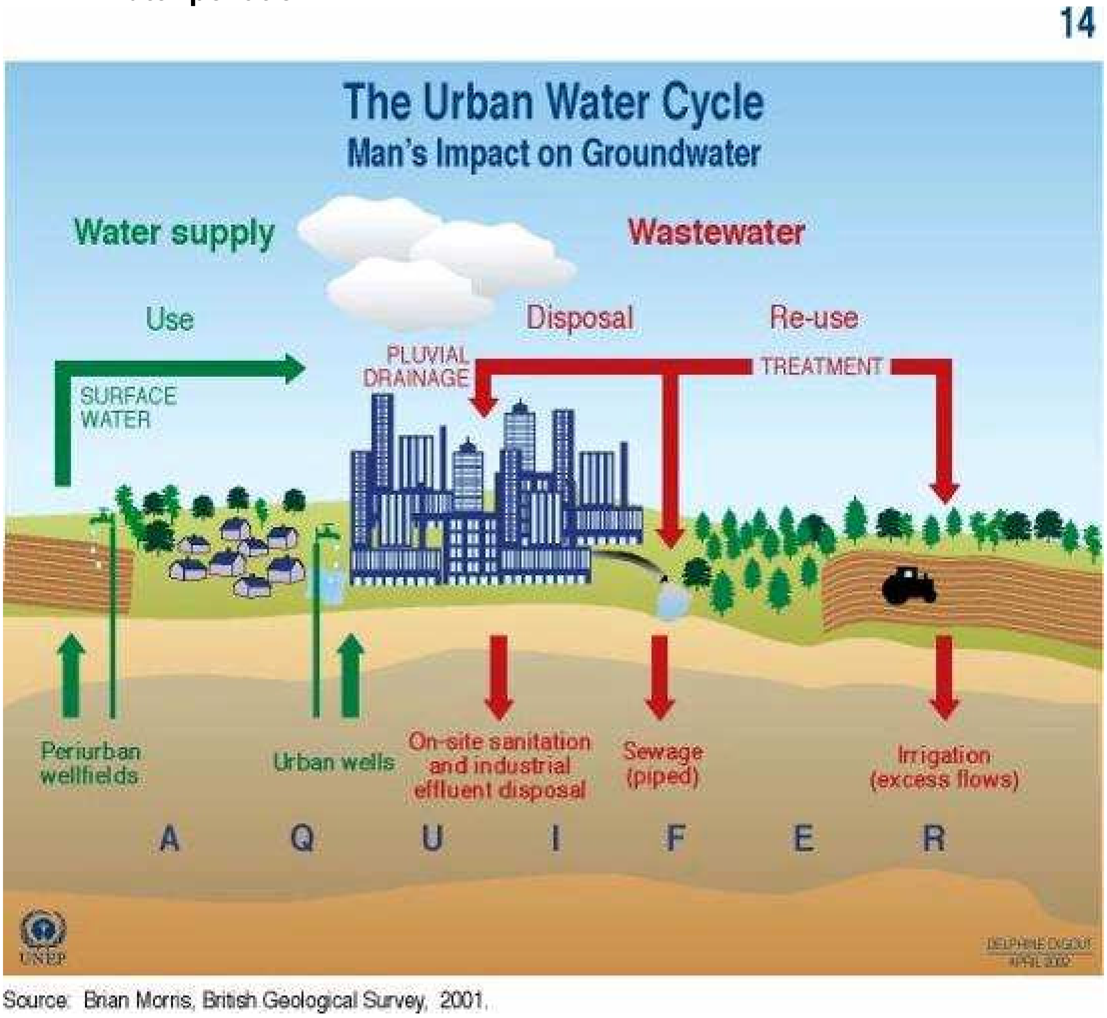

Figure 13: The urban water cycle (source: UNEP 2001)

The pollution of water as a common environmental good in most cases occurs on the cost of those who have not caused it. The introduction of the “polluter pays principle” (PPP) was a corner stone of the development of the European Water Framework Directive.

[4] OECD (2004): Fish Piracy - Combating Illegal, Unreported and Unregulated Fishing OECD, OECD Publishing, download at http://www.oecdbookshop.org/oecd/get-it.asp?REF=5304021E.PDF&TYPE=browse, 10. April 2010.
EFTEC (2008): Costs of Illegal, Unreported and Unregulated (IUU) Fishing in EU Fisheries, download at http://www.pewenvironment.eu/resources/costs_of_IUU.pdf, 10. April 2010.
EJF (2007): Pirate Fish on Your Plate – Tracking illegally-caught fish from West Africa into the European market. Environmental Justice Foundation, London, UK
EJF (2009) Lowering the Flag – Ending the use of Flags of Convenience by Pirate Fishing Vessels, London.
EJF (2009) Dirty Fish – How EU Hygiene Standards facilitate illegal fishing in West Africa. Environmental Justice Foundation: London

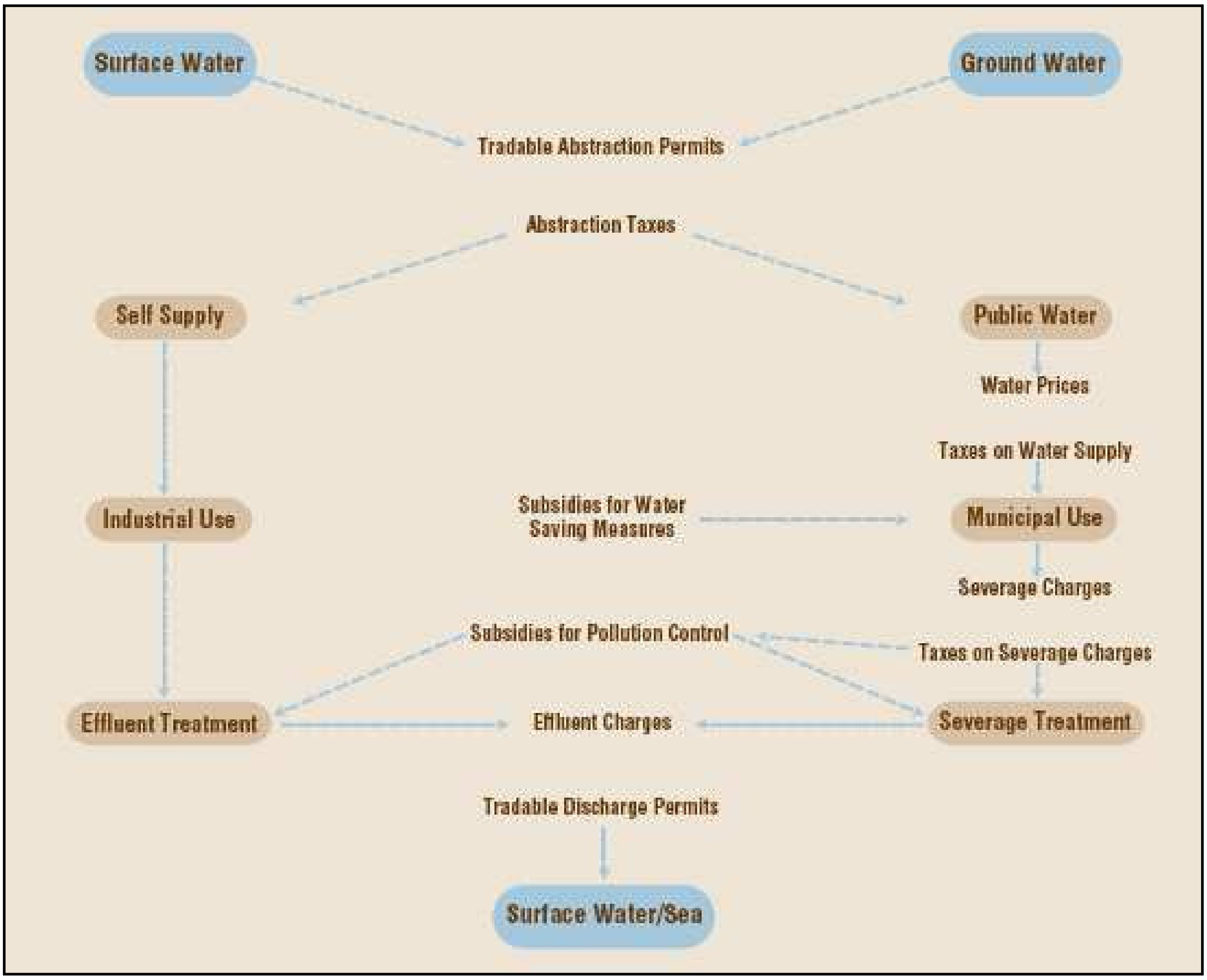

Figure 14: Economic Instruments for Water Management (Source: adapted from Kraemer 2002)

The experiences made in the European Union provide for valuable insights how PPP could be applied in practice. However, these experiences cannot be applied on a 1:1 basis in other contexts. Decision makers in other regions such as the Guinea Current LME need to reflect their specific situation. In this context it is important to analyse the affordability and social equity of such instruments, esp. in view of the situation in the GCLME countries. In this context it is important to identify instruments that first of all provide for more transparency in environmental costs, followed by the establishment of a pricing system that introduces the principles of social and environmental responsibility, but that still ascertains an affordable access to clean water and sanitation especially for poorer and disadvantaged people.

In general two goals need to be simultaneously addressed by the design of a tariff structure: on the one hand the service provider must achieve financial sustainability and on the other hand the service must be affordable to low-income households. An important issue is the assessment of affordability limits. A thorough analysis of the ability and willingness to pay (WTP) of low income households needs to be done at local level. If this information is absent it won't be possible to establish a tariff structure that meets the two above mentioned goals. There is not only the danger of allocating tariffs that exceed the budget of the poor. Furthermore an under-financed service does not secure needed investment and maintenance, which finally leads to lack of access to water services, a matter that affects poor the most.

As a result the water policy sector must resolve the problem of securing finance for the water services. For many countries in the world the goal of full cost-recovery through tariffs is more than unrealistic. The World Panel on Financing Water Infrastructure also called Camdessus Panel, that presented its final report "Financing Water for All" at the 3rd World Water Forum in Kyoto, 2003 rather recommends to aim for the goal of sustainable cost recovery. In this report it is stated, that

> "Increasing resource mobilisation for water must start with closing the revenue cycle. Only operators or water authorities that generate sufficient cash can operate and maintain present systems and attract investments for expanding services and improving management. Water services and management are always paid for by someone, inevitably consumers (through user tariffs) or taxpayers (from fiscal resources) or to a much smaller extent by bilateral and multilateral assistance. Closing the revenue cycle depends both on reducing costs and increasing revenues." (Winpenny, 2003)

Therefore the task is to fill the financial gaps of water service provision by finding the appropriate mix of finance as well as appropriate means to reduce costs. Cost savings can be reached by improving efficiency of operation and maintenance costs. High energy consumption, large water losses and oversized infrastructures are symptoms that substantial cost savings could be achieved. Other factors that open opportunities for cost savings are adaptations of the technological choices for service provisions to realistic assumptions on the sustainability of the operation of these technologies. These cost saving efforts have to be accompanied by an increased supply of finance. Tariffs, taxes and transfers as described above are the only fund that can fill the financing gap.

There is not an optimal solution on which financial source should be given the highest priority. It is very much dependent on the current socio-economic situation of the respective countries. While the most advanced industrialised states in the world already come very much closed to what is expected to be full cost-recovery, the poorest might be dependent to a large share on funds provided by international donors. (OECD, 2009A)

Securing funds of ODA

Development aid in the water sector is not equally distributed to developing countries. Some of those countries that would have been in greater need for support of their water and sanitation services receive less funds than comparatively wealthier countries. The reason is, that ODA funds also require a certain effectiveness of spending in order to maximise their leveraging capacity. Donor organisations are more willing to spend funds, if partner countries exercise strong and effective leadership over their development policies. A means to achieve such a leadership is to exercise a strategic financial planning for the water sector. This is a multi-stakeholder dialogue focussing on a common understanding of how water supply and sanitation services should look like in the next few decades, which measures should or could be affordable and how finance could be secured for it. The OECD publication "Managing Water for All" analyses some past experiences with this tool. (OECD, 2009A)

The considerations describe above set the overall basis for the design and application of economic instruments. The following paragraphs provide for details what needs to be kept in mind if applying different economic instruments for improving the water and sanitation sector.

Water abstraction taxes

Taxes for water abstractions are charged for the abstraction of a specified amount of ground or surface water. Abstraction taxes can have an incentive function by inducing a behavioural change towards lower water demand and avoidance of water leakage. Taxes should reflect the marginal costs of water abstractions to increase cost effectiveness of water provisions. Often these taxes are earmarked for maintaining water management infrastructure and as such they indirectly return to the tax payers. The allocation of water abstraction taxes might be coupled to relative water scarcity and could vary from region to region. (OECD, 2009A)

Water prices

The instrument of water pricing should contribute to the goal of sustainable cost recovery (see above) and is targeted to finance the water supply infrastructure. To the farthest extend they should reflect direct economic cost, social costs and environmental costs. The complex of these problems shall be briefly discussed in the following:

Direct cost:
Direct costs include the operation and maintenance of water infrastructure, investments on its construction and future investments for infrastructures. While operation and maintenance is often not the problem if executed in an efficient manner, investments in water services infrastructure might become problematic since the water sector often is perceived to be a risk investment in regard to cash-flow return.
Social costs:
Social costs accrue basically if the provision of water services leads to disadvantage to certain social group, e. g. through increased cost of health care services. In the same context sound water management can also result in direct and indirect social benefits. Howsoever put, social burden or benefits very much depend on the actual circumstances. As such they need to be analysed on a case by case basis.
Environmental costs:
Environmental costs are seldom included in market prices, so are most cases externalised. Despite the problem of a still lacking sound methodological appraisal to internalising environmental cost, there is a growing call for political action in this regard. Water pricing can have a signal function and convince water users to more efficiently use the scarce resources. (OECD, 2009B)

Sewerage and effluent charges (indirect emissions)
Sewerage charges belong to the tariffs that are levied for indirect discharges of used water, such as domestic sewage or other effluents to a sewer system. They aim at the provision of funds to the environmental authorities for water management activities. They are further intended to encourage behavioural change towards less pollution and thus contribute to the polluter-pays principle, because they aim at internalising treatment cost of pollution. (Zabel, 2007)

Water pollution charge
The water pollution charge is a levy on the quantity or quality of a polluting substance emitted to the natural environment. It contributes to the polluter-pays principle, but it will be however difficult to actually charge for the full environmental and social costs. It is nevertheless a signal and should encourage abatement measures for pollution by the polluters themselves or if earmarked to water quality improvement measures, this charge helps to cover the costs of environmental improvements. The allocation of the levy however is difficult since the calculation of the costs of pollution are difficult to estimate. It would require extensive monitoring and control measures for both the damage and the amount of pollution that accrue additional costs. (Sunman, 2009, similar Zabel, 2007)

Subsidies
The problem set of subsidies in environmental resource management have already been extensively discussed in chapter 3.3. A thorough analysis of the benefits and constraints of subsidies in the water management is very necessary. There are however some sound arguments for subsidies. They can:

- Compensate providers of water services for market failures and external benefits;
- Promote the consumption of merit goods (meritorious goods and services whose value consumers may not fully realise, e.g. household sanitation and hygiene);
- Be a transitional measure to enable tariffs to rise gradually and in order to address concerns about the affordability of higher charges;
- Provide services at below normal cost to vulnerable consumer groups, e.g. the very poor, large families, those with certain medical conditions. (OECD, 2006a)

Tradable Permits
In theory tradable permits could be an effective means of settling disagreements on water allocation rights and/or to create a cap on the amount and quality of polluting substances. In practice however few examples exist that demonstrate the efficiency of this instrument. A problem in this context is the allocation of property rights to water resources (since they

constitute common goods) and that it is difficult to actually create a user pool, because water resources are in general bound to a water shed with upstream and downstream dwellers that are differently independent from each other. However, some experiences have been made. One prominent example has already been discussed in chapter 3.4. But for the context of the GCLME countries trading schemes in the water sector do not appear to be the best choice, because this would always requires sophisticated monitoring systems which costs might highly exceed the provided environmental benefits. (Stavins, 2001; OECD, 2009A)

Liability for damage to waters

As state in chapter 3.5 environmental liability serves at an incentive for polluters to more carefully consider environmental risks of their actions and second to ensure that (potential) victims are compensated for their damage. These schemes are more functional in cases where the expected costs for cleaning-up the damage exceed the benefits of non-compliance, because the prevention of damage must be the overall target of environmental policy. Liability schemes are most appropriate if damage is concrete and quantifiable. Thus there is always a need for sound monitoring and control and it is therefore not suitable for diffuse pollution that is hard to monitor. Nevertheless it can be an effective instrument if the polluter takes action for pollution avoidance due to the risk of the cost for damage repair in case of hazardous incidents. (EEA, 2005)

4.2.2 Pollution by navigation

Pollution of the maritime environment by ships and vessels is a serious problem that only can be resolved at the international level. The most comprehensive international regulation is the “International Convention for the Prevention of Pollution from Ships”, ratified already in 1973, and modified by the Protocol of 1978 relating thereto (MARPOL). The regulations on pollution prevention control by navigation are regulated in six annexes. Contracting parties to the convention must also ratify Annexes I and II, but the remaining Annexes need to be ratified separately, which basically means that they are voluntary. The annexes to the convention are the following:

Annex I	Regulations for the Prevention of Pollution by Oil
Annex II	Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk
Annex III	Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form
Annex IV	Prevention of Pollution by Sewage from Ships
Annex V	Prevention of Pollution by Garbage from Ships
Annex VI	Prevention of Air Pollution from Ships (entry into force 19 May 2005)

The regulations of the annexes contain the enforcement of technical standards that member states need to transpose to their national law and which they are obliged to control. In principle economic instruments like taxes could help to further improve these standards, but the problem about navigation is, that single states or port authorities can not do much on their own in this regard, but it would need the concerted action of the international community. Thus negotiations in this regard are better placed at the level of the International Maritime Organization or at least at a regional scale. (Krause, 2007)

For the abatement of air pollution from ships first experiences with trading schemes have been made in the SOX Emission Control Areas (SECAs) of the Baltic Sea and the North Sea/English Channel. A Sulphur Emissions Abatement and Trading (SEAaT) group, set up between two major oil companies and several shipping companies, recently carried out a pilot exercise to explore the principles of offsetting of sulphur emissions within a SECA. The pilot used a control group of seven international shipping companies and 58 participating vessels to demonstrate that a data gathering scheme could operate in a SECA.

The pilot demonstrated that the cost of compliance (i.e., achieving the prescribed environmental standard) through offsetting can be significantly reduced compared with compliance through all vessels burning low-sulphur fuel. (IPIECA, 2007)

4.3 Economic instruments for financing biodiversity conservation

This section discusses the options for creating funds targeted at the conservation of biodiversity. Biodiversity conservation is vital for the survival of future generations the costs however are in most cases the burden of the whole society. Modern approaches to biodiversity conservation seek for solutions that internalise the costs also into economies with the aim to secure the needed funds, but also to prevent further deterioration and increase social responsibility. This section will investigate the potential for the following instruments in support of biodiversity conservation. Table 4 depicts major instruments for Traditional and Innovative Financial Mechanisms for Biodiversity Conservation.

	FINANCIAL MECHANISM (FM)	COMMENTS
More used / Traditional	**Tourism** 45. Foreign tourists and ecotourists (households) 46. Tourism and ecotourism industry catering to foreign visitors	**Current importance:** High to low, depending on location **Recent trend:** Growing **Future prospect:** Fast-growing activity, but impact on PA may be problematic and distribution of tourism benefits may pose challenges **Focused on/more appropriate for:** PA / BZ
↕	**Businesses initiatives** 47. International businesses' goodwill environmental investments 48. Businesses' codes of conduct and voluntary standards 49. Private-public partnerships 50. Private-NGO partnerships	**Current importance:** Medium **Recent trend:** Growing **Future prospect:** Good **Focused on/more appropriate for:** PL
Innovative / Never used	**Green markets** 51. Ecolabeling schemes 52. Promotion of green consumption and production 53. International trade in organic, fair trade and sustainable products 54. International green investment funds	**Current importance:** Medium **Recent trend:** Growing **Future prospect:** FMs 50, 51, 52 – very large opportunities; FM 53 – slow growth outside the clean energy sector **Focused on/more appropriate for:** PL

Table 4: Traditional and Innovative Financial Mechanisms for Biodiversity Conservation (Source: Gutman; Davidson, 2008)

4.3.1 Attracting and administering external funds

This category of financing mechanisms is concerned with mobilizing and using funding that originates from external sources, i.e. outside PAs themselves. A variety of mechanisms exist to attract funding from governments, NGOs, individuals and companies, and to administer and manage these financial resources for biodiversity conservation.

Government support and ODA

Government support and foreign assistance is a cornerstone in financing biodiversity conservation and it is likely that these funds will be also of high importance in the far future. However, budgets are tight and there is a felt shift to more spending on broader environmental goals that include also the perspective on sustainable economic development and poverty alleviation, away from traditional biodiversity conservation focussing on the maintenance of protected areas. Partly government and ODA funding are replaced by private charity of larger environmental NGOs, but still conservationist have to be more creative for attracting new public funds for biodiversity conservation. Today the management of protected areas and endangered species conservation also include perspectives on socio-economic development through the provision of ecosystem services. On the long term biodiversity conservation contributes to achieving goals of poverty alleviation and sustainable development. Even if this insight is not very new, conservationist need to raise more awareness on this matter and to integrated sustainable socio-economic development into biodiversity conservation plans in order to convince other government sectors, that by financing biodiversity they would also enter a win-win situation. (Gutman; Davidson, 2008)

Private charity

Contributions to biodiversity conservation finance from private charity comes mainly from private foundations, corporate funding and personal donations. Private foundation established by wealthy persons or companies. Examples are the Rockefeller Foundation for the western hemisphere or the Aga Khan Foundation for the East. Corporate funding are donations of companies. Corporate funding is often disbursed for regions or purposes that are related to the company. A German manufacturer of bicycle tyres for example has supported the conservation of rare swallow species in northern Germany, because the companie's name is Schwalbe (engl. swallow). Corporate funding is also often related to advertisements and sponsorship. Corporate funding has significantly increased in the past decade this is due to increased public awareness on environmental issues that puts pressure on corporate responsibility. Finally personal donations also contribute to conservation finance. These are often channelled through environmental NGOs, but also by direct sponsorship of single protected areas or even prominent animals (e. g. a tiger).

The acquisition of private charity however requires close cooperation with the private sector. Sponsor often want to know how the money was spent and protected areas and conservationist need to make some efforts to maintain the dialogue with them. (Emerton et al. 2006)

Environmental funds and debt-for-nature swaps

Within a Debt-for-nature swap agreement the public debt of a country is purchased by and outside agency and in exchange the government of the concerned state commits funding for conservation activities often in form of creating a trust funds. Trust funds may attract also additional funding sources for conservation purposes. There are different types of trust funds. Those which spent the money that builds the original stock (sinking funds and revolving funds) and others that spend only the income and that try to keep or increase the capital. The latter is often in the position of being able to attract additional funding and can be regarded as a revenue-generation financial instrument. (Emerton et al, 2006)

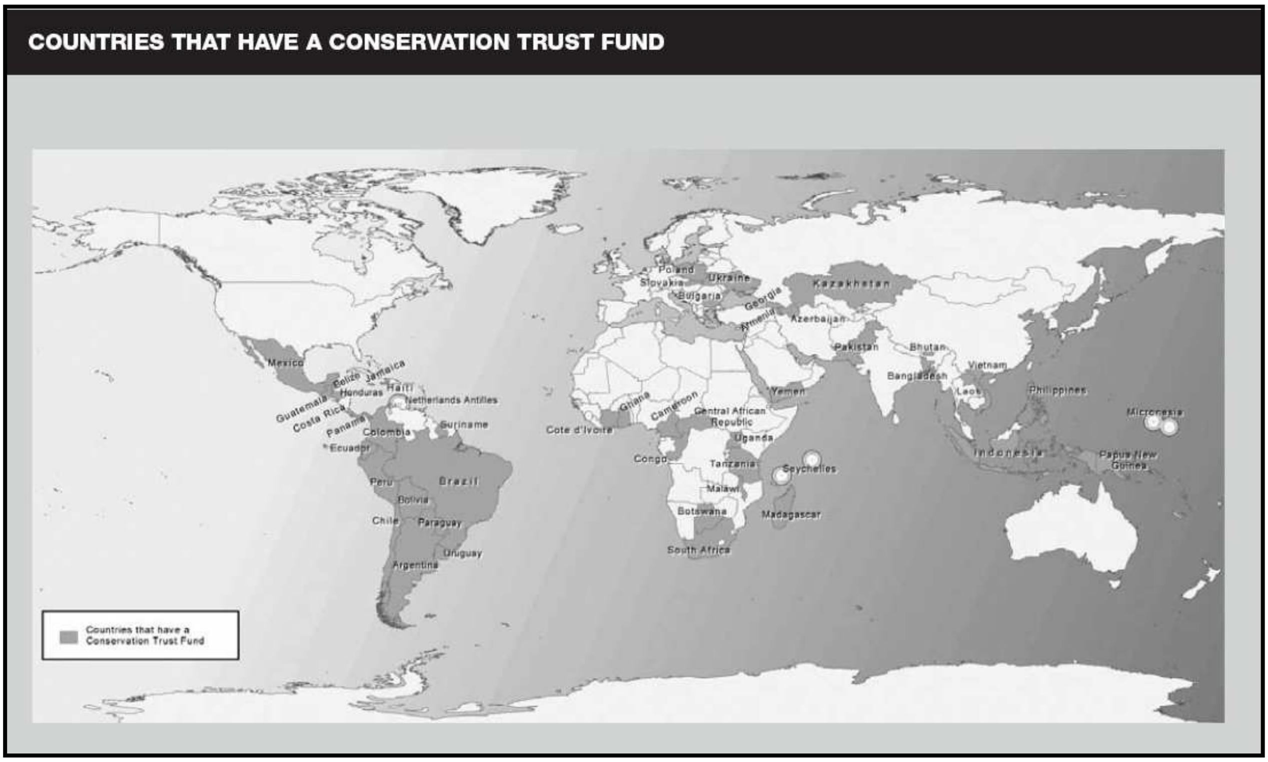

Figure 15: Countries that have a conservation trust fund (Source: WWF, 2009)

4.3.2 Government funds and other sources

Fiscal instruments

The use of fiscal instruments (taxes and subsidies) is already extensively discussed in chapter 0 and 2.3. The main pros and cons discussed in this chapter are also valid for financing biodiversity conservation. The full potential of taxes and subsidies in support of biodiversity conservation is not yet taped. Since taxes and the redistribution of government funds need broader social acceptance within the society, awareness raising for the need of biodiversity conservation in combination with well targeted tax and subsidies schemes that really reach its purposes could significantly raise the finance for conservation. (OECD, 2003)

Benefit sharing and revenue sharing

The involvement of local communities into biodiversity conservation often creates a win-win situation for both the communities and protected sites. Today most management strategies of protected areas include mechanisms to raise and allocate funds or other benefits for surrounding communities. Strategies include the facilitation of local investments in alternative livelihood options that substitutes environmentally harmful activities or the transfer of protected area management or use rights to local communities. While benefit sharing must not have the effect of fund raising in terms of additional cash flow to nature conservation management, the involvement of local communities is still very beneficial to conservation goals, because protected areas that are fenced against local communities seldom have the chance of long persistence. On the contrary. Local communities are dependent on natural resources and they are more willing to accept certain restrictions if they are remunerated by other means. (UNDP/GEF, 2004)

Box 6: Example for Benefit sharing: Costa Rica and the Merck Company

Costa Rica and the Merck and Company entered an agreement of benefit sharing which obliged Merck to pay 90 per cent of the 1.1 million dollars which was spent on the process of extraction of native plants in Costa Rica. The project was carried out by InBio (a private Costa Rican non-profit organization).

The company also agreed to provide for technical assistance and training in order to establish pharmaceutical research programmes in Costa Rica. In addition the National Fund for Costa Rican Parks would receive 50 per cent of the patents and royalties obtained for drugs created from these plants.

Sharing the costs of managing protected areas and their facilities

In cost sharing agreements with the private sector private firms take over some of the cost and/or management measures of protected areas. Examples are diving operators that offer guiding tours and environmental education in marine protected areas, others that provide for equipment of rangers or are engaged in monitoring and surveillance. Private tour operators could be granted concessions to build and operate tourism facilities, that are also of use to the management. A challenge in this construct is that public opinion is still widely convinced that the management of protected areas is the business of the government. An other perspective however is that protected areas constitute a highly valuable capital for tour operators and it is more than justified that they invest into this capital stock.

Box 7: Example for Cost sharing in Chumbe Island Coral Park, Zanzibar

Limited public funding and staff capacity make maintaining Zanzibar's network of marine protected areas a major challenge. Since the early 1990s, cost sharing and joint management have helped overcome these constraints.

In 1992 a private company was created to facilitate the conservation of Chumbe, a small coral island of 22ha near Zanzibar Town. After a long process of negotiation involving private investors, government and local villages,
Chumbe was established as a PA in 1994, and Chumbe Island Coral Park Ltd (CHICOP) was granted a lease to manage the island and the reef sanctuary. CHICOP has assumed responsibility for financing and managing the island and reef sanctuary, developed nature trails, constructed a visitor education centre and seven tourist bungalows for which funds were raised privately of which 60% were used for conservation, education and research, and 40% for the construction of tourism facilities.
Tourism revenues are the main source of funding used to cover the operating costs of the PA and associated ecotourism business. Public donor funds have not contributed to the running costs of the reserve. PA operational expenditures are strictly controlled and funded where possible through cost-sharing or in-kind arrangements. And are fully covered by the proceeds from tourism.
While funding has focused on establishing and maintaining the PA as a commercially viable operation, CHICOP has also sought to engage community members and to increase local environmental awareness. Former fishermen are employed as park rangers and guides. Wherever possible, foodstuffs and other items are purchased locally.
The project and PA are well-accepted by local communities. Destructive and illegal resource use have declined.
Although tourism generated increased demand for marine resources and contributed to over-exploitation, and high prices make fishing an attractive occupation, infractions have fallen from about 45 per month in 1994/5 (when the park was established) to less than five per month today. This is partly due to patrolling and enforcement of regulations on marine resource use.

Investment, credit and enterprise funds
Biodiversity enterprise funds (BEF) secure funding on a credit basis to mainly small and medium enterprises that are engaged in conservation or sustainable use of biodiversity. Typical sectors in this context are eco-tourism, sustainable forestry, wild food products etc. Investors to BEFs expect financial returns of their investments. (Ali; Yano, 2004)

4.3.3 Market-based fees for biodiversity goods and services

Tourist charges
Tourism charges are important revenues for both biodiversity conservation and socio-economic development. Surveys have revealed that the potential for raising fees from tourism activities has not yet been exhausted. Especially tourists from industrialised countries would often be willing to pay entrance and other fees, if this would benefit biodiversity conservation and/or the maintenance of protected areas. (Emerton et al., 2006)
But beside entrance fees tourism activities can yield income also in other fields. These are:
Fees for outdoor activities inside of protected areas such as camping, fishing, hiking etc
Visitor donations
Concessions charged to private businesses inside of the protected areas (souvenir stands, restaurants, tour operators, camp sites)
Fees and taxes charged to tourist related activities outside but related to the protected area (charges on nearby accommodation facilities, transport, excursions etc)
(Gutman; Davidson, 2008)

Resource extraction fees
If compatible with the conservation objectives of a protected area a levy on resource extraction can also provide substantial finance to protected areas. This can be linked in general to any extraction from mining activities, timber logging, fibres such as papyrus and reed, wild plant and animal food products etc. A great challenge in this context is the threat of overexploitation of resources and disturbance of wildlife. The pressure of financial gaps could

lead a weak management to issue more licenses than acceptable and by doing this to thwart conservation goals of the area. (Emerton et al. 2006)

Box 8: Example for Resource extraction fees at Sultan Sazligi Nature Reserve, Turkey

In the wetlands of Sultan Sazligi Nature Reserve in Turkey in the Develi plain the government management agency allows communities to cut reeds for their own use or for sale to processors. Reeds are used for various purposes including wall screens, roof thatch, insulating houses and handicrafts. Waste material is sometimes used as cattle fodder or cushioning.

Reed cutting has long been practised by local communities but increased pressure on the resource has led the General Directorate of National Parks to impose limits on both the amount of reeds harvested and the period when they may be cut. The government also charges an annual fee for the right to cut reeds in the Reserve which is normally issued only to persons from local communities.

Reed collection and processing are important sources of income to local communities.

Bio-prospecting charges

Similar to resource extraction also bio-prospecting charges could be an option. But also here strict rules for the maintenance of the conservation goals of the protected area need to be respected. Pharmaceutical companies and the cosmetic industry are very much interested to receive genetic material and other substances from wild plants and animals. This market is still growing and for some protected areas this could be a welcomed additional funding source.

Box 9: Example for Bioprospecting agreements: Merck and INBio of Costa Rica

One well-known example is the collaboration between Merck – an international pharmaceutical company – and the National Biodiversity Institute (INBio) of Costa Rica. Their agreement, which dates from the early 1990s, grants Merck access to natural material from which compounds are extracted and screened using various bioassays to see whether they have medically useful properties. Compounds identified as having potential are, of course, not immediately brought to market but must go through a long process of animal and human trials and certification before they can be produced and sold. INBio coordinates the collection of material and the initial extraction of compounds. Under the terms of the agreement, Merck supports the strengthening of INBio's capacity to carry out its work, as well promising a portion of the profits arising from any successful drug produced. INBio in turn provides a share of this funding to Costa Rica's protected areas (some US$300,000 has been paid, most of which has gone to Cocos Island National Park). INBio now negotiated similar agreements with a number of other companies, including Givaudan-Roure (fragrances for use in the cosmetic industry), Recombinant Bio-Catalysis (micro-organisms living in harsh conditions), Bristol-Myers Squib (insects as input to drug development), AnaLyticum and INDENA (dermatological products). Despite criticism of these deals (mainly concerning transparency, public accountability and the price paid by companies for access to resources), there is no doubt that INBio's innovative approach has demonstrated the potential of securing additional funding for PAs from commercial bio-prospecting. (Emerton et. al, 2006)

Payment for protected area ecosystem services

The instrument of payments for ecosystem services have been extensively discussed in chapter 3.6. PES schemes for financing protected areas function in almost the same way, therefore we can not add much in this context. PES for the finance of protected areas mainly occur in the context of wetlands management and water resource protection, carbon trading and biodiversity conservation.

Box 10: Example for Payments for ecosystem services in hydropower generation schemes in Costa Rica:

Private landowners in Costa Rica are compensated for the maintenance or increase of forest areas upstream of hydropower stations by the National Government and Energia Global, a private hydroelectric company. the government of Costa Rica established a fund, consisting largely of a 5% tax on fossil fuel through the National Forest Office and National Fund for Forest Financing (FONAFIFO) in order to finance this compensation. A local NGO, FUNDECOR (Fundacion para el Desarrollo de la Cordillera Volcanica Central) assisted in the administration of the project.
The main objective of the hydroelectric company Energia Global was to increase the regularity of stream flow and to reduce reservoir sedimentation, which are the major concern for the operation of water reservoirs with limited water storage capacities.
The individual landowners receive direct payments of $48 per hectare through the local NGO. Payments are not based on the value of the hydroelectric services, but on the approximate equivalent of the opportunity cost of foregone land development, which is primarily cattle ranching. (Shilling, Osha, 2003)

Habitat Banking

Charges and fees could be channelled through the application of habitat banking. Habitat banking is a concept that has been applied in the United States in wetland management and in Germany in biodiversity conservation over several decades. Originally the concept is targeted at the remediation of environmental impacts of new urban development and infrastructure construction. It could be therefore located somewhere between environmental liability and payments for ecosystem services.
Habitat banking is a concept that makes available appropriate areas for the remediation of ecosystem damage that occurs for example if new urban areas are developed. A definition is given by Gillespie and Hill (2007) who define habitat banking as "an entity that restores, creates, enhances or preserves a habitat. It sells tangible units of habitat (or facilitates land purchase and creation of habitat), termed credits, to a developer to use as compensation for equivalent units that a development would impact upon, termed debits."
Different forms of habitat banking exist, but the concept of all of them is quite similar. The areas attributed to a habitat bank should not belong to existing protected areas, but they should build up a coherent network of ecosystems that are promising for further development towards a natural like status. As a result the pool of areas comprising different ecosystems offer the opportunity to create ecosystem network that could link existing protected areas and other valuable ecosystem into a network of bio-corridors. In regard to remediation this concept promises also better results, because up-grades of the ecosystems start at the moment of the set-up of the bank and not at the moment of environmental damage. Habitat banks are mostly managed with specific land registers, that could be operated or by a public administration or a private entity such as a foundation or private agency.

The habitat bank consists of a pool of areas that are available for remediation measures. The set-up of such a pool should be based on a specific conceptual framework. Spang et al. (2005) state the following essential elements that need to be considered:

- Analysis of the expected demand of areas for remediation;
- Assessment of the potential or possible up-grade of these areas;
- Credits should be incremental to baseline (e.g. areas that would have been protected anyway cannot be counted as credit in a habitat bank);
- Qualified planning instruments for the development of the pool areas;
- Implementation of sustainable and long-term mechanisms for maintenance;
- Set-up of a monitoring system; and
- Transparent financial accounting.

The area that will be provided in the framework of a habitat bank has to be secured for the long term.
According to Böhme et al. (2005), appropriate areas for habitat banking should:

- Have a high potential for ecological development and upgrading;
- Be secured for remediation use on the long-term;
- Have a functional coherency with the impacted site;
- Not be competing with other uses;
- Be cost-effective in implementation and maintenance, and
- Not lie within current and future development areas that are exposed to projects and
- interventions with adverse effects on the natural environment.

5 Conclusions and outlook

Economic instruments are helpful tools for fostering environmental resource management. There is however no blue-print for the selection of appropriate tools. The correct application of economic instruments is too much dependent on the specific socio-economic situation in different countries. Subsidies can have both positive and also very negative effects on the environment. The same is true for most other instruments. In addition trade-offs between different sectors and social groups need to be considered and also international policies play and important role, which can have very different implications on national choices in different countries.

Economic instruments are powerful tools to foster environmental management, but they are not a stand-alone option for achieving LME conservation goals. Regulatory instruments as listed in Table 1 are still mandatory if best compromise solutions should be reached. Even if regulatory instruments are in most cases induced by government agencies, they do not necessarily are bound to a top-down approach. On the contrary, the first stage of a sound management planning is to agree on the objectives for LME conservation. On the one hand this includes a consideration of merely scientific calculations such as emission standards that should be met, the status of biodiversity conservation that should be maintained, what quality of the natural resources should be the target and on the other it includes the consideration of the needs of social equity, the vulnerability of the poor and other marginalized groups in order to guarantee the welfare of current and future generations. To set these targets it requires intensive negotiation and consultation processes among all relevant stakeholders. The result might be a goal that appears to be difficult to reach. Limitations of government budget obstacle the achievement of many desirable objectives. In this context however, economic instruments can help to realise programmes and measures that are regulating the use of natural resources.

Unfortunately a blue-print or a check-list for the application of these instruments does not exist. The specific situation of an LME always commands which tools are applicable and which are less favourable.

In the context of the GCLME a major issue is to assure the livelihood of poor and vulnerable people without compromising environmental and conservation goals. Relevant economic instruments are in this context participation of local communities in revenues from ecosystem services, promotion of small-scale fisheries and well-targeted subsidies. This however requires substantial effort in local organisation and administration, that need to be secured or by the local economic activities themselves (e. g. fisheries income or payments for ecosystem services) or additional government funding is needed. These could be raised from environmental taxation and charges that ideally would also encourage the industries and land-users to shift their attitude towards a more environmentally friendly behaviour.

A major concern for the GCLME will be - like in other LME - the impact of international activities. To these belong certainly the consequences of the global environmental degradation, but also the pressure of international competition and esp. in regard to the fisheries sector the case of illegal and unreported fishing. At local, regional and maybe also on national level the possibilities for efficient action are limited. Still the GCLME countries should use their strength of operating in joint efforts at the international level.

The next step in regard to the application of economic instruments will be a regional workshop on options for an ecosystem wide valuation of the economic value of environmental and social services and the economic damage from loosing these services. Participants to this workshop will be National Experts of the GCLME for Socio-Economy. The workshop aims at a discussion of problems with information collection in order to close gaps.

A generic list of economic instruments will be presented and discussed in order to develop the way forward and agree on workplan and milestones for the translation of results of ecosystem wide valuation onto national level by the national socio-economic experts.

6 References

Agnew, D.J.; Barnes, C.T. (2004): Economic Aspects and Drivers for IUU Fishing: Building a Framework, in OECD (2004): Fish Piracy - Combating Illegal, Unreported and Unregulated Fishing OECD, OECD Publishing, download at http://www.oecdbookshop.org/oecd/get-it.asp?REF=5304021E.PDF&TYPE=browse, 10. April 2010.

Ali, Paul A. U.; Yano, Kanako (2004): Eco-Finance: The Legal Design and Regulation of Market-Based Environmental Instruments (International Environmental Law and Policy Series), Kluwer Academic Publ.

Böhme, C. ; Bruns, El. et al. (2005): Flächen und Maßnahmenpools in Deutschland, Bonn.

Commission of the European Communities (2009): Green Paper - Reform of the Common Fisheries Policy, COM(2009)163 final, Brussels, download at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0163:FIN:EN:PDF, 10. April 2010.

Duraiappah, Anantha Kumar (2007): Markets for Ecosystem Services A Potential Tool for Multilateral Environmental Agreements, download at https://www.cbd.int/doc/external/iisd/iisd-economics-ecosystem-ens.pdf, 10. April 2010.

EEA (2000): Environmental Taxes - Recent Developments in Tools for Integration, Environmental Issue Series No. 18, Copenhagen, download at http://www.eea.europa.eu/publications/Environmental_Issues_No_18/at_download/file, 10. April 2010.

EEA (2005): Market-based instruments for environmental policy in Europe, EEA Technical report 8/2005, Copenhagen, download at http://www.eea.europa.eu/publications/technical_report_2005_8/at_download/file, 10. April 2010.

EEA (2006): Using the market for cost-effective environmental policy, EEA Report No 1/2006, Copenhagen, download at http://www.eea.europa.eu/publications/eea_report_2006_1/at_download/file, 10. April 2010.

EFTEC (2008): Costs of Illegal, Unreported and Unregulated (IUU) Fishing in EU Fisheries, download at http://www.pewenvironment.eu/resources/costs_of_IUU.pdf, 10. April 2010.

EJF (2007): Pirate Fish on Your Plate – Tracking illegally-caught fish from West Africa into the European market. Environmental Justice Foundation, London, UK

EJF (2009) Dirty Fish – How EU Hygiene Standards facilitate illegal fishing in West Africa. Environmental Jus□□ce Founda□□on: London

EJF (2009) Lowering the Flag – Ending the use of Flags of Convenience by Pirate Fishing Vessels, London.

Emerton, L., Bishop, J. and Thomas, L. (2006). Sustainable Financing of Protected Areas: A global review of challenges and options, IUCN.

FAO (2005a): FAO Guidelines for the Ecolabelling of Fish and Fishery Products from Marine Capture Fisheries, http://www.fao.org/docrep/008/a0116t/a0116t01.htm, visited 10. April 2010

FAO (2005b): Increasing the contribution of small-scale fisheries to poverty alleviation and food security, technical guidelines for responsible fisheries, download at ftp://ftp.fao.org/docrep/fao/008/a0237e/a0237e00.pdf, 10. April 2010.

FAO (2009): Fisheries management – 2. The ecosystem approach to fisheries, 2.2 The human dimensions of the ecosystem approach to fisheries, technical guidelines for responsible fisheries, download at ftp://ftp.fao.org/docrep/fao/011/i0151e/i0151e00.pdf, 10. April 2010.

FAO Fisheries and Aquaculture Department (2009): The State of World Fisheries and Aquaculture 2008, FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS Rome, 2009

GEF (2008): Financing the Stewardship of Global Biodiversity, download at http://www.thegef.org/gef/sites/thegef.org/files/publication/financing-stewardship-global-biodiversity.pdf, 10. April 2010.

Gutman, P.; Davidson, S. (2008): A review of innovative international financial mechanisms for biodiversity conservation, download at http://assets.panda.org/downloads/final_z.pdf, 10. April 2010.

HM Treasury (2002): Tax and the environment: using economic instruments, London, download at http://www.hm-treasury.gov.uk/d/adtaxenviron02-332kb.pdf, 10. April 2010.

Hope, R. A. et al (2007): Negotiating watershed services, download at http://www.iied.org/pubs/pdfs/15508IIED.pdf, 10. April 2010.

International Petroleum Industry Environmental Conservation Association (IPIECA) (2007): Maritime air emissions and MARPOL Annex VI: Strategies and consequences, download at http://www.ipieca.org/activities/fuels/downloads/publications/MARPOL.pdf, 10. April 2010.

Jessel, B.; Schöps et al (2006): Flächenpools in der Eingriffregelung und regionales Landschaftswassermanagement, Bonn.

Kerr, Suzi; Sanchirico, James; Newell, Richard, (2002): Fishing Quota Markets, Discussion Papers dp-02-20, Resources For the Future, download at http://www.rff.org/documents/RFF-DP-02-20.pdf, 10. April 2010.

Kraemer, R. Andreas et al. (2002): Economic Instruments for Water Management: Experiences from Europe and Implications for Latin America and the Caribbean, download at http://ecologic.eu/download/projekte/1850-1899/1872/1872_final_report_en.PDF, 03.07.2010.

Krause, Karsten (2007): Marktorientierte Umweltpolitik im Seeverkehr - Anreize zur Reduzierung atmosphärischer Emissionen aus der Verbrennung von Schiffskraftstoffen, download at http://www.sub.uni-hamburg.de/opus/volltexte/2007/3289/pdf/Karsten_Krause_Dissertation_Gruener_Seeverkehr.pdf, 10. April 2010.

Maguire, J.-J. et al.. (2006): The state of world highly migratory, straddling and other high seas fishery resources and associated species. FAO Fisheries Technical Paper. No. 495. Rome: FAO. 2006. 84p.

Mora, Camilo et al. (2009): Management Effectiveness of the World's Marine Fisheries, PLoS Biology, June 2009, Volume 7, Issue 6, download at http://www.plosbiology.org/article/info%3Adoi%2F10.1371%2Fjournal.pbio.1000131, 03.07.2010.

OECD (1998): Improving the environment through reducing subsidies, OECD, Paris, download at http://www.oecdbookshop.org/oecd/display.asp?K=5LMQCR2K8530&lang=EN&sort=sort_date%2Fd&stem=true&sf1=Title&st1=Improving+the+environment+through+reducing+subsidies&sf3=SubjectCode&st4=not+E4+or+E5+or+P5&sf4=SubVersionCode&ds=Improving+the+environment+through+reducing+subsidies%3B+All+Subjects%3B+&m=4&dc=5&plang=en, 10. April 2010.

OECD (2001): Environmentally related taxes in OECD countries: Issues and strategies, Paris, download at http://www.oecdbookshop.org/oecd/get-it.asp?REF=9701101E.PDF&TYPE=browse, 10. April 2010.

OECD (2003): Harnessing Markets for Biodiversity - Towards Conservation and Sustainable Use, OECD Publishing, download at http://www.oecdbookshop.org/oecd/get-it.asp?REF=9703031E.PDF&TYPE=browse, 10. April 2010.

OECD (2004): Fish Piracy - Combating Illegal, Unreported and Unregulated Fishing OECD, OECD Publishing, download at http://www.oecdbookshop.org/oecd/get-it.asp?REF=5304021E.PDF&TYPE=browse, 10. April 2010.

OECD (2005): Environmentally Harmful Subsidies: Challenges for Reform, OECD, download at http://www.oecdbookshop.org/oecd/get-it.asp?REF=5105081E.PDF&TYPE=browse, 10. April 2010.
OECD (2006a): Subsidy Reform and Sustainable Development - Economic, Environmental and Social Aspects, OECD Publishing download at http://www.oecdbookshop.org/oecd/images/look-inside-EN.png, 10. April 2010.
OECD (2006b): The Political Economy of Environmentally Related Taxes. OECD Publishing, download at http://www.oecdbookshop.org/oecd/get-it.asp?REF=9706081E.PDF&TYPE=browse, 10. April 2010.
OECD (2007), Subsidy Reform and Sustainable Development: Political economy aspects, OECD, Paris. Paris., download at http://www.oecdbookshop.org/oecd/get-it.asp?REF=5105081E.PDF&TYPE=browse, 10. April 2010.
OECD (2009a): Managing Water for All - An OECD Perspective on Pricing and Financing, OECD Publishing, download at http://www.oecdbookshop.org/oecd/get-it.asp?REF=9709021E.PDF&TYPE=browse, 10. April 2010.
OECD (2009b): Pricing Water Resources and Water and Sanitation Services, OECD Publishing, download at http://www.oecdbookshop.org/oecd/get-it.asp?REF=9710041E.PDF&TYPE=browse, 10. April 2010.
OECD (2010): Innovative Financing Mechanisms for the Water Sector, OECD Publishing, download at http://www.oecdbookshop.org/oecd/get-it.asp?REF=9710051E.PDF&TYPE=browse, 10. April 2010.
Pauly, Daniel et al. (2002) : Towards sustainability in world fisheries , Nature 418, 689-695(8 August 2002)
Pearce, David (2006): Environmentally harmful subsidies: barriers to sustainable development, in OECD (2006a): Subsidy Reform and Sustainable Development - Economic, Environmental and Social Aspects, OECD Publishing download at http://www.oecdbookshop.org/oecd/images/look-inside-EN.png, 10. April 2010.
PEW Environment Group (2009): The Pew Environment Group's European Marine Programme contribution to the consultation on the reform of the Common Fisheries Policy, December 2009: Annex III Design Matters - Making Catch Shares Work, download at http://www.pewenvironment.eu/resources/03_Annex_3_Report_Design_of_Catch_shares.pdf, 10. April 2010.
PRI (2004): Economic Instruments for Water Demand Management in an Integrated Water Resources Management Framework, download at http://policyresearch.gc.ca/doclib/SR_SD_EconomicInstruments_200502_e.pdf, 10. April 2010.
Shilling John D.; Osha, Jennifer (2003): Paying for Environmental Stewardship - Using Markets and Common-Pool Property to Reduce Rural Poverty while Enhancing Conservation, WWF TECHNICAL PAPER: ECONOMIC CHANGE, POVERTY, AND THE ENVIRONMENT, download at http://www.panda.org/downloads/policy/shilling.pdf, 10. April 2010.
Smith, M., de Groot, D., Perrot-Maîte, D. and Bergkamp, G. (2006). Pay – Establishing payments for watershed services, download at http://data.iucn.org/dbtw-wpd/edocs/2006-054.pdf, 10. April 2010.
Spang, W. D.; Reister, S. (2005): Ökokonten und Kompensationsflächenpools in der Bauleitplanung und der Fachplanung, Berlin.
Stavins, R.N. (2001): Experience with Market-Based Environmental Policy Instruments, Washington, download at http://www.rff.org/documents/RFF-DP-01-58.pdf, 10. April 2010.
Stern, Nicholas Herbert (2007): The Economics of Climate Change: The Stern Review, Great Britain Treasury, download at http://webarchive.nationalarchives.gov.uk/+/http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm, 10. April 2010.

Sukhdev, Pavan; Leader, Study (2008): The Economics of Ecosystems and Biodiversity (TEEB), Remote document, Publisher: European Communities, Institution European Commission, download at http://www.teebweb.org/LinkClick.aspx?fileticket=5y_qRGJPOao%3d&tabid=1018&language=en-US, 03.07.2010.

Sunman, Hilary (2009): The application of charging schemes for the management of water pollution - Experience and prospects, Natural Resources Forum, Volume 17 Issue 2, Pages 133 – 141.

UNDP/GEF & the Zambian Ministry of Tourism, Environment and Natural Resources, (2004): Financial and economic analysis of the costs and benefits of managing the Protected Area Estate, download at http://www.conservationfinance.org/Documents/CF_related_papers/Economic%20Analysis%20of%20Protected%20Areas%5B1%5D.%20zambia%20report.pdf, 10. April 2010.

UNEP (2004): Economic Instruments in Biodiversity-related Multilateral Environmental Agreements, download at, http://www.biodiversityeconomics.org/applications/library_documents/lib_document.rm?document_id=964, 10. April 2010.

Valsecchi C., ten Brink P., Bassi S., Withana S., Lewis M., Best A., Oosterhuis F., Dias Soares C., Rogers-Ganter H., Kaphengst T. (2009), Environmentally Harmful Subsidies: Identification and Assessment, Final report for the European Commission's DG Environment, November 2009, download at http://ec.europa.eu/environment/enveco/taxation/pdf/Harmful%20Subsidies%20Report.pdf, 10. April 2010.

Whitten, S. (2003): An Overview of Market-Based Instruments and Environmental Policy, download at http://www.ecosystemservicesproject.org/html/publications/docs/MBIs_overview.pdf, 10. April 2010.

Winpenny J (2003): Financing Water for All: Report of the World Panel on Financing Water Infrastructure. Geneva: World Water Council/Global Water Partnership/Third World Water Forum, download at http://www.financingwaterforall.org/fileadmin/wwc/Library/Publications_and_reports/CamdessusReport.pdf, 10. April 2010.

Wunder, Sven (2005): Payments for environmental services: Some nuts and bolts, download at http://www.cifor.cgiar.org/publications/pdf_files/OccPapers/OP-42.pdf, 10. April 2010.

WWF (2003): From Goodwill to Payments for Environmental Services, download at http://assets.panda.org/downloads/fin_alt.pdf, 10. April 2010.

WWF (2009): Guide to Conservation Finance, download at http://www.conservationfinance.org/upload/library/arquivo20100514183209.pdf, 03.07.2010.

Zabel, T. F.; Andrews, K. (2007): The Use of Economic Instruments for Water Management in Selected EU Member Countries, Water and Environment Journal, Volume 12 Issue 4, Pages 268 – 272.