Agulhas and Somali Current Large Marine Ecosystems Project

Cost/benefit assessment of marine and coastal resources in the western Indian Ocean: Mozambique and South Africa

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1 BACKGROUND

1.1 The ASCLME Region

The Agulhas Somali Current Large Marine Ecosystem (ASCLME, Figure 1) comprises two systems situated in the western Indian Ocean region along the east coast of Africa, the Agulhas Current and Somali Current systems (NOAA 2008, Heileman *et al*. 2009). The Somali Current LME extends from the horn of Africa to the Comoros Islands and the northern tip of Madagascar and includes Somalia, Kenya and Tanzania on mainland Africa (ASCLME Project 2009). The Agulhas Current LME encompasses the continental shelves and coastal waters of Mozambique, eastern South Africa, Madagascar as well as the archipelagos of the Seychelles, the Comoros, and Mauritius (ASCLME Project 2009, Heileman *et al*. 2009). The Agulhas Current is a warm western boundary current that forms part of the south Indian Ocean gyre (Heileman *et al*. 2009).

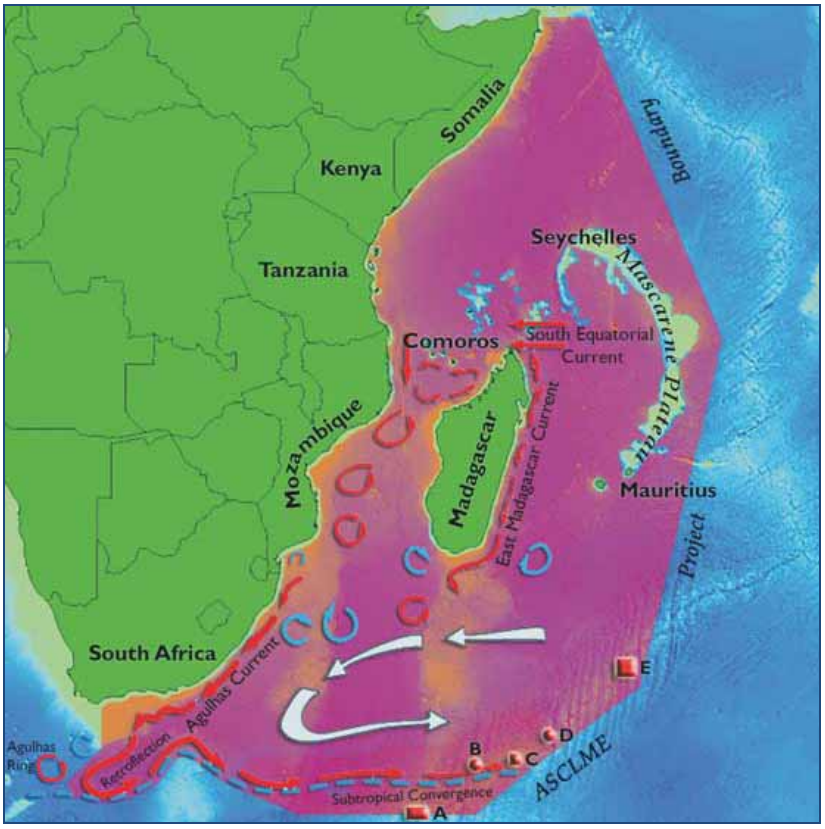

Figure 1: Map of the western Indian Ocean showing the ASCLME region and project area in purple (Source: Vousden *et al*. 2008).

The ASCLME has a variety of submerged landforms, and its coastal areas are characterised by high faunal and floral diversity, and display very high levels of endemism (ASCLME Project 2009, Heileman *et al*. 2009). Large river systems and estuaries provide substantial freshwater and sediments into the east African coastal zone which influences its productivity (Heileman *et al*. 2009). The diverse marine life found in the ASCLME varies from phytoplankton and zooplankton to thousands of species of larger invertebrates, fish and mammals (ASCLME Project 2009). Many of these are of economic importance to the ASCLME countries (ASCLME Project 2009, Heileman *et al*.

2009). Seagrass beds, coral reefs and mangroves provide critical habitats for invertebrates, fish and numerous other organisms. These habitats serve as a breeding ground and nursery area for over 11,000 marine species currently recorded from the western Indian Ocean (ASCLME Project 2009).

Approximately 160 million people live in the nine countries bordering the ASCLME and there are an estimated 56 million people that depend on the resources of the two large marine ecosystems (ASCLME Project 2009). The ASCLME region is, however, characterised by some of the highest levels of poverty in the world, with communities in the coastal regions relying heavily on marine and coastal resources, which provide a source of food and of employment in artisanal fisheries, transport and coastal tourism (ASCLME Project 2009). Fisheries along (including harvesting, processing, and marketing) generate livelihoods for approximately 2.2 million people in the ASCLME region (ASCLME Project 2009, Heileman *et al*. 2009). In general, coastal and marine ecosystem play a crucial role in supporting the livelihoods of the people and national economies. However, increasing pressure from poor communities, urbanisation, tourism and poor catchment management resulted in the over exploitation and collapse of many of the fish stocks as well as habitat destruction (ASCLME Project 2009, Heileman *et al*. 2009). This deterioriation is resulting in a reduction in the capacity of these systems to contribute to human well-being.

Recognising this, Global Environment Fund (GEF) is supporting the countries of the region in implementing an ecosystem-based management approach so as to optimize and sustain the benefits for meeting Millennium Development Goals (MDGs) and the targets identified during the World Summit on Sustainable Development (WSSD). This is being done through the ASCLME Programme.

1.2 The ASCLME Programme

The ASCLME Programme consists of three partner projects; one that addresses coastal degradation and pollution in the western Indian Ocean (WIO-LaB, implemented by UNEP), one that primarily addresses the management of industrial fisheries (South West Indian Ocean Fisheries Project - SWIOFP, implemented by the World Bank), and thirdly the ASCLME project itself implemented by the UNDP. The activities of the ASCLME project are focused on filling the significant coastal and offshore information and data gaps for the large marine ecosystems by capturing essential information relating to oceanographic aspects, coastal livelihoods, critical data on artisanal fisheries, persistent organic pollutants, fish spawning and larval transport and nursery areas along the coast (Vousden *et al*. 2008, Heileman *et al*. 2009).

The ASCLME project will have a phased approach to addressing environmental concerns and transboundary developments, building political will to undertake threat abatement activities, and leveraging finances proportionate to management and governance needs. This study forms part of the first phase, which focuses on the collection and synthesis of coastal and offshore data and information, and capacity building. The overall objective of this phase is to deliver (i) national Marine Ecosystem Diagnostic Analyses (MEDAs) that feed into national policy and governance, and (ii) regional Transboundary Diagnostic Analyses (TDA) that feeds into a comprehensive Regional Strategic Action Programme (SAP).

To this end, it is very important that the economic value of these ecosystems is recognized, and their contribution to sustainable economic welfare estimated. This will help to provide support for the leveraging of finances critical for the management of coastal and marine resources.

2 PURPOSE AND SCOPE OF ASSIGNMENT

The purpose and overall objective of this project is to calculate the total economic value of the marine and coastal resources in both Mozambique and South Africa and to assess the impacts of implementing a sustainable use policy for the region. These individual country reports on the value of the coastal and marine resources will be collated with the various other country assessments of the same nature to create a single ASCLME regional report.

The report also focuses on the contribution of coastal and marine resources to poverty alleviation as well as different policy options for the sustainable use of these resources. The valuation assessment seeks to promote sustainable development in the coastal areas of the ASCLME by providing stakeholders with powerful economic analysis for the decision making based on the economic value of the marine and coastal resources of the ASCLME region.

Terms of reference for the brief desktop study were as follows:

1. Assess the total economic value of marine and coastal resources and their contribution to the national economy of South Africa and Mozambique. The resources include all fisheries, coastal tourism, coastal agriculture and forestry, mariculture and/or aquaculture, energy, ports and coastal transport, and coastal mining.
2. Assess the distribution of economic benefits among various stakeholders and the need for cooperative governance to ensure the benefits accrued are optimised for all stakeholders.
3. Assess the contribution of marine and coastal resources towards poverty alleviation.
4. Provide local resource managers with policy analyses and indicators about the economic impact of different governance options for sustainable use of resources.
5. Increase capacity in government and other stakeholders in the ASCLME region to use environmental economics effectively in decision making and management.

3 AVAILABLE INFORMATION

Sources of data used in the study are summarised in Tables 1 and 2.

Table 1. Available information and data for South Africa

Source	Information/Data
Coastal Livelihoods Assessment Report (2010)	Summarised coastal livelihoods information for all the sectors (fisheries, tourism, mariculture, agriculture & forestry, mining, ports & harbours, energy). Some detailed information on employment and production for these sectors.
Department of Environmental Affairs (2010)	A short document on the sustainable coastal livelihood programme with some information on the value of the coast
StatsSA (2010)	Information and data for fisheries as well as national accounts information and the GDP Report for 2010.
Kashorte (2003)	Report on the fishing industry in South Africa. Information and some data for valuation of the commercial fishing industry.
Sauer *et al.* (2003)	Volumes 1 and 2: An Economic and Sectoral Study of the South African Fishing Industry. Data on the various fisheries.
Lamberth & Turpie (2003)	The role of estuaries in South African fisheries – production and values.
Lamberth *et al.* 1997 McGrath *et al.* 1997 Turpie *et al*. 2003 Clark *et al*. 2003	Data and information on net fisheries, long line fisheries, subsistence fisheries, and the value of coastal resources and fishing.

Source	Information/Data
White Paper on Sustainable Coastal Development (2000)	Information on the value of the South African coast. Actual values given for the various coastal resources.
Tourism SA	A number of reports from the South African Tourism Board on tourism in South Africa, the role tourism plays in the economy, domestic tourism accounts, and annual tourism reports.
World Travel and Tourism Council (2011)	Report on travel and tourism impact in South Africa for 2011 – information and data on visitor numbers and expenditure, contribution to GDP, and employment.
Turpie *et al.* 2005 Findlay 1997 Dicken & Hosking 2009 Hara *et al.* 2003 Dicken 2010	Papers on the economic valuation of a number of eco-tourism activities along the east coast of South Africa, such as whale watching, shark diving and the sardine run.
Atkinson & Clark (2005)	National state of the environment report: marine and coastal ecosystems. Tourism and fisheries data.
Wio-Lab (2008)	Trans-boundary Diagnostic Analysis of Land-based Sources and Activities in the Western Indian Ocean Region – information on the economic value of ecosystem goods and services.
Britz *et al.* (2009)	AISA 2009 Aquaculture Benchmarking Survey: Primary Production and Markets. Data and information on aquaculture in South Africa.
Petro SA and Richards Bay Mineral websites	Coastal mining and energy information and data collected from various websites.
Chasomeris (2005)	South Africa's Port Performance: Policy, Pricing and Growth. Information and data collected on the harbours and ports along the east coast.

Table 2. Available information and data for Mozambique

Source	Information/Data
Coastal Livelihoods Assessment Report (2010)	Summarised coastal livelihoods information for all the sectors (fisheries, tourism, mariculture, agriculture & forestry, mining, ports & harbours, energy). Some detailed information on employment and production for these sectors.
USAID (2010)	Report on the competitiveness of Mozambique's fisheries sector. Information and data on production, values, employment, exports and imports etc.
Afonso (2006)	Review of Mozambique fisheries
Food & Agricultural Organisation of the United Nations	Fishery Country Profile for Mozambique: some data on the different fisheries
Suich (2006) WWF Report on the economic valuation of natural resources in Mozambique	Some data on the value of natural resources in a number of towns/villages in Mozambique.
Jones (2010)	A report on the economic contribution of tourism in Mozambique using a Social Accounting Matrix. Information and data on tourism and its contribution to the GDP.
Visser (2004)	A report on tourism in Mozambique: regional data, bed nights, arrivals and some values.
World Travel and Tourism Council (2011)	Report on travel and tourism impact in Mozambique for 2011 – information and data on visitor numbers and expenditure, contribution to GDP, and employment.
The Government of Mozambique: National Institute of Statistics	National Accounts for the country 2008, 2009.

Source	Information/Data
Wio-Lab (2008)	Trans-boundary Diagnostic Analysis of Land-based Sources and Activities in the Western Indian Ocean Region – information on the economic value of ecosystem goods and services.
Ecosystem services for poverty alleviation : marine and coastal situational analysis (2008)	Report on the marine and coastal ecosystem and how they support livelihoods and well-being of the rural and urban poor living in developing countries. Some focus on the WIO.

4 THE VALUATION FRAMEWORK

4.1 Ecosystem services

Ecosystems offer a range of **goods, services and attributes** that generate value as well as contribute to human welfare (Barbier 1994). The concept of ecosystem goods and services stems from the observation of ecosystems as natural capital which contributes to economic production. Goods, services and attributes can be defined as follows:

- **Goods** are harvested resources, such as fish or mangroves.
- **Services** are processes that contribute to economic production or save costs, such as water purification.
- **Attributes** relate to the composition and organisation of biodiversity, such as beauty, rarity or diversity, and generate less tangible values such as spiritual, educational, cultural and recreational value.

The Millennium Ecosystem Assessment (2003) has in more recent years categorised the services obtained from ecosystems as follows:

- **Provisioning services** such as food and water;
- **Regulating services** such as flood and disease control;
- **Cultural services** such as spiritual, recreational, and cultural benefits; and
- **Supporting services**, such as nutrient cycling, that maintains the conditions for life on Earth.

4.2 Total Economic Value

The Total Economic Value of an ecosystem comprises Direct Use, Indirect, Option and Non-Use values.

- **Direct use values** are generated through the consumptive use of resources (e.g. fishing) or non-consumptive use (e.g. photographic tourism, recreational diving).
- **Indirect use values** are values generated by outputs from ecosystems that form inputs into production by other sectors of the economy, or that contribute to net economic outputs elsewhere in the economy by saving on costs. These outputs are derived from ecosystem functioning such as carbon sequestration, flow regulation and provision of wildlife refugia.
- **Non-use values** include the value of having the option to use the resources (e.g. genetic) of ecosystems in the future, and the value of knowing that their biodiversity is protected. Even though they are far less tangible than the above values, non-use values are reflected in society's willingness to pay to conserve these resources.

4.3 Measuring value

In this study, value derived from coastal and marine resources was measured in terms of direct output (gross value added) but for fisheries also included economic rent, income to labour, returns to capital, jobs supported and multiplier effects.

Gross value added is the measure of the value of goods and services that are produced in an area or sector of an economy.

Economic value is identified as the total value added to national income, which is a reflection of all income generated as a result of an activity and not just the net profit for the investor or community. It includes payments to government and other economic factors, such as payment to employees, taxes, interest and capital repayments, and rental payments. These all jointly represent the annual contribution made by the activity to the national income. This measure allows the value to be assessed in terms of statistics that are generated for the whole economy on a regular basis. These statistics include *gross national income* (GNI) and *net national income* (NNI), which are the returns in gross and net value added to factors of production owned by a country's citizens (Gittinger 1982).

Value added to national income includes **direct value added** and **indirect value added** (Figure 2). Direct value added is the income produced in the first round of expenditure. The expenditure on inputs from other sectors then generates a further round of income, and so on. These 'backward linkages' create a multiplier effect, resulting in the overall impact being larger than the direct value added alone. Input output models such as social accounting matrices (SAMs) are used to calculate the extent of these multiplier effects.

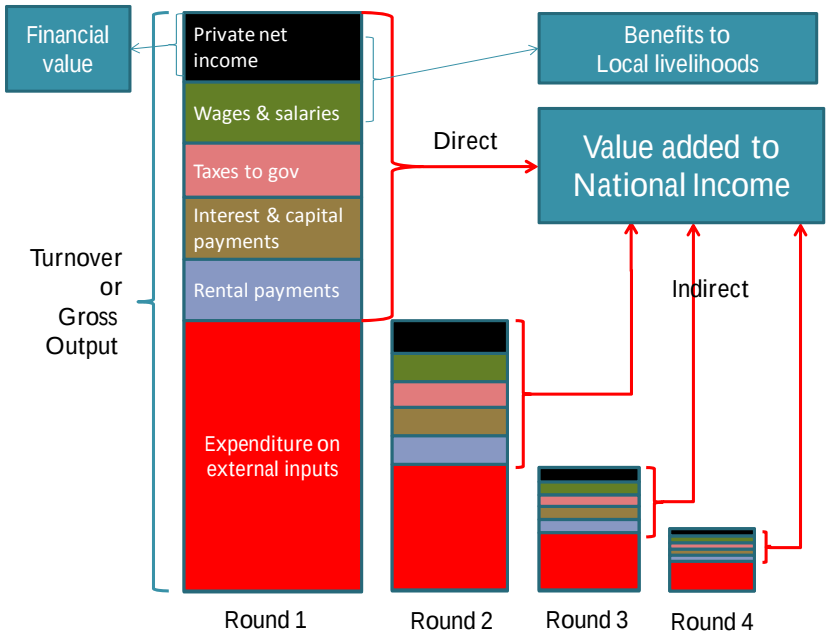

Figure 2: Schematic diagram of the measures of value that are explained in the text (Source: Turpie *et al*. 2011).

4.4 Valuation approach

The study approach involved both a value assessment as well as a policy assessment, and was based entirely on a review of available data. The study focuses on values of the major ecosystem goods and services; fishing, tourism, mariculture, coastal transport (ports), coastal agriculture and forestry, and ocean based gas/oil/minerals. All values are expressed in US Dollars and are standardised to 2009.

More detail, such as number of fishers, number of vessels, and gear type is supplied for fisheries. The value for fisheries is described as far as possible in terms of direct output, economic rent, income to labour, returns to capital, jobs supported and multiplier effects. All other values for the remaining sectors are expressed in terms of gross output and/or direct value added, depending on what information was available. The distribution of value/income among different types of stakeholders is described as far as available information allows. In particular, comment is made on the contribution of coastal and marine resources to poverty alleviation. Indication is given as to how government and stakeholders might be able to use information on ecosystem service values to help with decision-making, and identify policy priorities where economic valuation can make the greatest contribution.

5 SOUTH AFRICA

5.1 Study area and resources

South Africa has a total coastline of about 3000km. Due to its geographic position, there are three distinct biogeographical regions along the West, South and East coasts (CLA Report 2010). This division is a result of differences in landform, weather pattern and oceanography. The coastal waters in these three regions have markedly different faunal and floral communities due to the different water temperatures and currents that dominate (CLA Report 2010). The Agulhas Current flows along the east coast of South Africa following the shelf edge closely until it passes the eastern side of the wider Agulhas Bank where it starts to meander quite extensively on either side (Heileman *et al*. 2009). The current then passes the most southern tip of Africa where it retroflects in an easterly direction in the Agulhas Return Current (Heileman *et al*. 2009). The Agulhas Current supports a great diversity of marine life along the east and south coasts, whilst the cold Benguela upwelling system on the west coast supports greater numbers of marine animals but with less diversity (ASCLME Project 2009). The powerful, warm Agulhas Current flows from the tropical waters off Mozambique creating a favourable environment for coral reefs, mangroves and coastal forests (CLA Report 2010). The tropical coral reefs are found on northern coast on Kwa-Zulu Natal whereas the mangroves are found further south in the estuaries along the Kwa-Zulu Natal and Eastern Cape Province coastline.

Approximately 10,000 species of marine plants and animals have been recorded in South Africa's marine waters, representing 15% of the global marine species diversity (ASCLME Project 2009). Commercially important fish species are predominantly found on the west coast of South Africa where the cold waters are more productive than the warmer waters on the east coast. Although there are fewer commercially important species on the east coast, the number of different species found here is much higher. Small-scale and artisanal fishing communities are found along the entire coastline and recreational fishing is undertaken in the coastal waters and in the estuaries along the coast. Communities living along the coast rely heavily on marine resources for food as well as for employment through tourism. Whale watching, scuba diving, shark diving, sport fishing and turtle

watching are all eco-tourism activities that contribute significantly to the attractiveness of the east coast of South Africa as a tourism destination.

About 30% of South Africa's population of about 47.9 million (2007 estimate) live within 60 kilometres of the coast (CLA Report 2010). South Africa has one of the highest coastal population densities in Africa with approximately 80 people per square kilometre, compared to the average African density of 55 people per square kilometre (DEA 2010).

The South African GDP in 2009 (current prices) was US$319 billion or R2.4 trillion (Stats SA 2010a). The largest contributing sectors were manufacturing, mining and quarrying, and finance and business services which are centred in the Gauteng Province. Agriculture, forestry and fisheries contributed 2.9% of the GDP, with fisheries accounting for approximately 0.5% of this (Stats SA 2010a). The coastal provinces are however the second highest contributors to the GDP after Gauteng. In 2009 the coastal provinces on the east coast (Western Cape, Eastern Cape and Kwa-Zulu Natal) of South Africa contributed approximately 38% to the annual GDP (Stats SA 2010a, Figure 3), highlighting the importance of the coast to the South African economy.

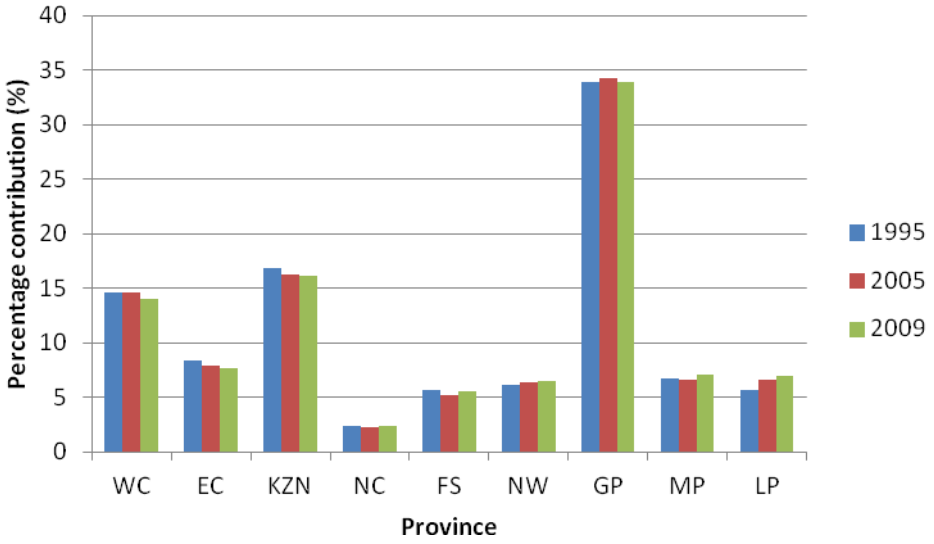

Figure 3: Provincial contribution to the South African economy 1995, 2005, 2009 (Stats SA 2010a).

(WC: Western Cape, EC: Eastern Cape, KZN: KwaZulu-Natal, NC: Northern Cape, FS: Freestate, NW: North West, GP: Gauteng Province, MP: Mpumalanga, LP: Limpopo Province)

5.2 The value of the coast

5.2.1 Fisheries

The cold waters of the Atlantic Ocean on the west coast of South Africa support large numbers of commercially-important fish species, such as pilchard and anchovy, hake, sole, kingklip and rock lobster (CLA Report 2010). Most commercial fishing activities are found along the more temperate western and southern coastal regions of the country. The warm waters of east coast however support fewer large-scale commercial species, but do have a higher number of species (CLA Report 2010). Small-scale fishing communities can be found along the entire South African coastline, using a variety of different fishing methods and catching a variety of different species. Recreational fishing is very

important along the coastline and is undertaken in the inshore waters as well as in many of the estuaries along the coast (CLA Report 2010).

The users of marine resources are divided into three major groups, recreational, subsistence and commercial. The recreational users collect or catch fish and other marine species as part of leisure activities. These include shore anglers, spear fishers, shellfish and bait collectors and recreational boat anglers (Stats SA 2010b). Subsistence fishers are largely individuals that collect fish for their own consumption. The commercial fisheries make up the formal fishing industry and range from relatively small-scale and labour intensive inshore fisheries to the highly industrialised deep-water trawls (Stats SA 2010b).

5.2.1.1 Commercial Fisheries

There are 18 recognised commercial fisheries, which are divided into four clusters (Table 3). In 2010, it was estimated that the commercial fishing industry made an annual turnover of approximately US$12 billion or R80 billion and contributed 0.5% to the South African GDP (CLA Report 2010). Catch in the commercial sector was estimated at R5-6 billion per annum and it is estimated that this sector provides direct employment to some 27,000 people and indirectly to a further 81,000 people (CLA Report 2010). These numbers and values are dominated by a few large fisheries, but also include some small-scale fisheries such as the west coast rock lobster, oysters, traditional line fish, net fisheries and white mussels.

Table 3: South Africa commercial fishing industry clusters (StatsSA 2010b)

	Species	**Type of fishing**
Cluster A	Hake (*M. paradoxus; M. capensis*)	Deep water bottom trawl
	Hake (*M. paradoxus; M. capensis*)	Inshore bottom trawl
	Sole (*Austroglossus pectoralis*)	Inshore bottom trawl
	Horse mackerel (*Trachurus spp*.)	Mid-water trawl
	Patagonian toothfish (*Dissostichus eleginoides*)	Long-line
	South coast rock lobster (*Palinurus gilchristi*)	Trap long-line
	KZN prawn (*Metapenaeus monoceros*)	Bottom trawl
Cluster B	Hake (*M. paradoxus; M. capensis*)	Long-line
	West coast rock lobster (*J. lalandii*)	Off-shore traps
	Squid (*Loligovulgaris reynaudii*)	Jigging
	Seaweed	Harvesting
	Tuna Albacore (*Thunnus alalunga*)	Pole
	Demersal shark	Long-line
Cluster C	Hake (*M. paradoxus; M. capensis*)	Handline
	West coast rock lobster (*J. lalandii*)	Near-shore hoop-nets
Cluster D	Net fish	Gillnets, beach seine & KZN beach seine
	Oysters	
	White mussels	

The bulk of the commercial fishing value in South Africa is derived from off the West and South-western coasts, but these fisheries do extend around Cape Agulhas into the ASCLME to some extent. Over the past few decades the distribution of these fisheries have changed significantly and it is

expected that in the future climate change will impact on the distribution and range of some of these fisheries around the west and south coasts of South Africa. This requires further investigation and understanding.

The **demersal** (deep water) sector is the most valuable commercial fishery in South Africa and is worth over US$187 million (R1.4 billion) annually (Kashorte 2003). The two hake species (*M. paradoxus; M. capensis*) are the most important of the fishery. However as with most trawl fisheries there are a number of other commercially important and valued species that are caught as by catch, these include, kingklip, monkfish and sole (Kashorte 2003). There are approximately 61 vessels and 7767 employees in the deep-sea trawl industry, with a market value of around US$146 million (R1.1 billion, 2009 Rands) (Sauer *et al*. 2003) and a payroll of US$69 million (R518 million, 2009 Rands) (Sauer *et al*. 2003). This fishery is, however, concentrated in the Western Cape and reliant on the productive cold waters of the west and south coasts, and for the most part does not fall within the ASCLME area. Using distribution information for the demersal fishery, it can be estimated that approximately 40% of the commercial catch falls east of Cape Agulhas (Pecquerie *et al*. 2004). Therefore the fishery has a market value of some **US$58 million** (R435 million).

The **hake inshore fishery** has a total of 29 vessels and employs 1171 people (Sauer *et al.* 2003). The fishery targets shallow water hake and Agulhas sole from Mossel Bay eastwards to Port Elizabeth. The fishery has a market value of **US$77 million** (R576 million, 2009 Rands) and a payroll of US$9 million (R66.5 million, 2009 Rands) (Sauer *et al.* 2003).

The **pelagic fishery** is the second most valuable fishery in the country. Pelagic fish have a lower unit price than the demersal fish and are used mainly for canning, fish meal and oil (Kashorte 2003). Pelagic catches fluctuate every year mainly as a result of environmental conditions. There are approximately 7800 employees and 65 purse-seine vessels involved, with a total value of approximately US$92 million per annum (R691 million, 2009 Rands) (Sauer *et al.* 2003). Roughly 50% of the pelagic catch falls east of Cape Agulhas with a total value of **$46 million** (R345 million).

The **rock lobster fishery** is based on two species, one on the west coast and one on the south coast. The west coast rock lobster is caught using traps and hoopnets that are deployed from small vessels, whereas the south coast species is a deep water species and caught using long lines of traps set by larger vessels (Kashore 2003). Only the south coast rock lobster fishery will be considered for this study of the Western Indian Ocean Region. There are approximately 13 vessels engaged in the south coast rock lobster fishery which extends from East London to Cape Agulhas (Sauer *et al.* 2003). It supports 400 employees and has a total landed value of **US$12.4 million** per annum (R93 million, 2009 Rands), with a wholesale value of US$21 million (R156 million, 2009 Rands) (Kashore 2003).

The **squid fishery** is based in the Eastern Cape Province and supports around 2500 employees on 120 vessels and is worth approximately **US$45 million** per annum (R338 million, 2009 Rands) (Kashore 2003). Between 2000 and 10 000 metric tons of squid are harvested annually.

The **commercial line fishery** harvests approximately 13 000 tons of line fish species, such as yellowtail, snoek, kob and reef fish every year with a value of about US$133 million (R1 billion, 2009 Rands) (Kashore 2003). The majority of this value is however attributable to the west coast of South Africa and it is estimated that 60% of the line fishery value comes from the west and south-western Cape. Forty percent or **US$53 million** (R400 million, 2009 Rands) is attributable to the ASCLME area. The commercial line fishery can be broken up into traditional line fishery, the hake handline fishery and the tuna handline/pole fishery.

The **KZN prawn fishery** harvests approximately 400 tons of crustaceans annually (Sauer *et al*. 2003). There are 5 inshore and 3 offshore permits for the fishery with an annual catch value of approximately US$2 million (R15.5 million, 2009 Rands) with a retail value of **US$4 million** (R29.6 million, 2009 Rands) (Sauer *et al.* 2003).

The **beach-seine and gill-net fisheries** are South Africa's oldest commercial fisheries (Lamberth *et al.* 1997). Lamberth *et al.* (1997) recorded a total of 316 gill nets and 121 beach seine nets on the southern Cape coast, Eastern Cape coast and KwaZulu-Natal coast. Of these 52% were in the southern Cape coast, 4% in the Eastern Cape and 45% in KwaZulu-Natal (Lamberth *et al.* 1997). Lamberth *et al.* (1997) worked on a net-to-crew ratio of three and 10 persons for gills nets and beach seine nets respectively, equating to 2158 fishers involved in the two fisheries on the east coast. The seine and gill net fisheries on the East coast have a total value of **US$2.3 million** (R16.7 million, 2009 Rands) (Lamberth & Turpie 2003).

5.2.1.2 Subsistence Fishery

There are approximately 147 fishing communities along the South African coastline with an estimated 28,388 fishing households and 29,233 people who are considered to be subsistence fishers (Clark *et al*. 2002). Most of these subsistence fishers were found on the east coast in KwaZulu-Natal and the former Transkei (Clark *et al*. 2002). They live in both rural and urban settings and harvest a variety of different species from the intertidal, shallow subtidal and near shore environments (Clark *et al*. 2002). The majority of households reported that fish was the most commonly caught/harvested resource with mussels, octopus, rock lobster, sand and mud prawns, limpets and redbait also being important marine resources harvested by subsistence households (Branch *et al*. 2002). Fish, rocky intertidal invertebrates and sandy beach invertebrates are harvested by subsistence fishers around the entire coast but estuarine invertebrates feature more prominently on the southern and northern regions of the East coast (Clark *et al*. 2002). On the east coast of South Africa from Cape Agulhas to the Mozambican border there are an estimated total of 163 422 people that are dependent on subsistence fishing for their livelihoods (Clark *et al*. 2002).

The White Paper for Sustainable Coastal Development (DEAT 2000) valued subsistence fishing along the coast at **US$3.6 million** per annum (R27.5 million, 2009 Rands). This value includes some line fishing, intertidal collecting and beach netting.

5.2.1.3 Recreational Fishery

It is estimated that there are some 750 000 recreational anglers in South Africa (McGrath *et al.* 1997). There are three groups of recreational anglers; shore anglers that fish directly from the shore, off beaches and in estuaries, boat-based recreational fishing which takes place off from small boats in estuaries or from larger boats that target reef fish or game fish offshore, and underwater spearfishing which is practised along the entire coastline (CLA Report 2010).

Recreational shore angling is very intense; especially along the southern Cape coast the length of the Agulhas Plain, with 2.29 anglers km^{-1} on average, compared with 0.36 km^{-1} further east (Turpie *et al*. 2003). Recreational shore angling is important to the economy and supports other industries such as bait and tackle outlets, which result in further employment (Turpie *et al*. 2003). Shore angling contributes the most in generating income and employment (McGrath *et al*. 1997). The recreational

shore and ski-boat anglers in the southern Cape, Eastern Cape and KwaZulu-Natal are estimated to contribute **US$453 million** (R3.4 billion, 2009 Rands) and **US$4.3 million** (R32.5 million, 2009 Rands), respectively, to the economy (McGrath *et al*. 1997). Underwater spearfishing is entirely recreational and has an estimated 7000 participants in South Africa (Turpie *et al*. 2003). The landed catch value for the fishery as a whole is approximately US$200 000 (R1.5 million, 2009 Rands), and the total value of the fishery is estimated to be in the order of **US$12.8 million** (R96 million, 2009 Rands) (Turpie *et al*. 2003). The total gross output for the recreational fishery section is estimated at **US$470 million** (R3.5 billion, 2009 Rands).

Table 4 is a summary of the different economic value measures that were calculated during this study for the commercial, subsistence and recreational fisheries in South Africa.

Table 4: Summary of the economic values for the fisheries sector in South Africa

Type of fishery	Gross economic output	Number of jobs
Hake Offshore	58	7 767
Hake Inshore	77	1 171
Pelagic	46	7 800
South Coast Rock Lobster	12.4	400
Squid Fishery	45	2 500
Commercial Line fishery	53	
KZN Prawn Fishery	2	
Net fishery	2.3	2 158
Recreational Fishery	470	-
Subsistence Fishery	3.6	29 233
Total	**769.3**	**> 51 029**

5.2.2 Coastal agriculture and forestry

The South African coastline provides significant opportunities for agriculture, especially on the east coast where soils are rich and productive (CLA Report 2010). There are over 3 million people (users and dependents) that rely on subsistence agriculture at the coast and important commercial agricultural products on the coast include sugar-cane and bananas. However subsistence and commercial agriculture and plantation forestry along the coast are not attributable to the coast per se (i.e. they are not dependent on the coast). Nevertheless some of these activities, such as plantation forestry, do impact on the coastal zone and catchment areas.

It is understood that a large number of the coastal population are involved in agriculture – but the value that is ascribed to this cannot be linked to the coast unless the product being farmed is only able to be farmed at the coast. The White Paper for Sustainable Coastal Development in South Africa (DEAT 2000) found that over 3 million people living along the coast depended on coastal agriculture and the estimated value of this was **US$264 million** or R1.9 billion (2009 Rands). This calculation is however based on generic global values and should be considered as a rough estimate.

5.2.3 Mariculture

Aquaculture development in South Africa has focused on medium to large scale commercial on shore systems that are designed primarily for abalone but also include recent developments into finfish production (CLA Report 2010). These commercial aquaculture farms provide employment opportunities in rural communities – although many of these farms are located in urban areas, there are some that are found in the more rural areas of the Eastern Cape Province. The high wave energy on the South African coastline can be very problematic for the establishment of small scale or subsistence aquaculture production systems (CLA Report 2010). Most of the mariculture is conducted in the Western and Eastern Cape with some finfish production occurring along the KwaZulu-Natal coast (Britz *et al.* 2009). The South African Government is currently taking steps to expand offshore finfish aquaculture production.

A total of 2 441 tons of seafood was produced in South Africa in 2008 (Table 5), with abalone contributing 934 tons of this and employing a total of 1 040 people on 18 different farms (CLA Report 2010). The total gross output (at farm gate) for mariculture in South Africa in 2009 was US$37.9 million (R284 million, 2009 Rands) (Britz *et al.* 2009). Abalone production is far more valuable than any of the other aquaculture products, and most of the farms are located to the west of the ASCLME area. It has been estimated using the numbers of farms on the east coast of South Africa, that the mariculture value associated with the ASCLME coast is **US$10 million** (R75 million, 2009 Rands).

Table 5: Mariculture production and value in South Africa (US$ 2009) (Britz *et al.* 2009)

Farming activity	Annual Production in 2008 (tons)	Value (Million US$)	Employment	Number of Farms
Abalone	934	35.9	1040	18
Seaweed	608	0.09	-	
Mussels	600	0.8	26	1
Oysters	289	1.13	100	9
Finfish	10	0.06	68	7
TOTAL	**2441**	**37.98**	**1234**	**35**

5.2.4 Energy

South Africa's oil and gas deposits are relatively small but its refining and downstream oil sector is developing fast (SA Government 2011). Exploitation of the natural gas fields off the South African south coast at Mossel Bay led to the development of PetroSA's gas-to-liquids (GTL) refinery, one of the largest GTL refineries in the world (SA Government 2011). The refinery produces 36 000 barrels per day – a crude oil equivalent of 45 000 barrels per day. The Mossel Bay GTL plant serves up to 15% of South Africa's transport fuel requirements by producing unleaded gasoline, low sulphur diesel, kerosene, drilling fluids, liquid petroleum gas, fuel oil, liquid oxygen, liquid nitrogen and waxes (PetroSA 2010). PetroSA is currently developing Project Jabulani off Sandbaai on the south coast for further GTL production. Gas production will start in mid 2012 (PetroSA 2010).

A total of 45 000 barrels of crude oil a day equates to 16 425 000 barrels per annum. In 2009 the average price for global oil per barrel was US$76, resulting in a total gross output of **US$ 1.25 billion** (R9.4 billion, 2009 Rands).

5.2.5 Ports and Coastal Transport

With 95 percent of South Africa's trade volume being seaborne (or approximately 80 percent in value terms) the country is dependent upon the effectiveness and efficiency of the commercial ports found along its coastline (Chasomeris 2005). South Africa's commercial ports are important not only for trade but also for economic growth and development of the entire southern African region (Chasomeris 2005). In 2002 total port cargo handled was roughly 190 million tons, representing 3.5 percent of the world sea trade volumes (Chasomeris 2005). South Africa is placed within the top 12 international maritime trading nations.

The South African Indian Ocean coastline is 1620 kilometres long stretching from Cape Agulhus to the Mozambican border at Manguze (CLA Report 2010). Along this coast there are six major commercial ports; Mossel Bay, Port Elizabeth, Ngquru (Coega), East London, Durban and Richards Bay (CLA Report 2010). These ports are all linked to the interior of the country via road and rail. In 2009, these ports handled a total of 224 million tons of deepsea import-export cargo and 3 million tons of petroleum products via coastwise shipping (CLA Report 2010). The South African maritime division has had an average year on year revenue growth of 9.5% between 1996 and 2006 (Trade and Industry Chamber 2007). The revenue generated from the maritime division was estimated to be **US$1.5 billion** per annum (R11.2 billion, 2009 Rands, Trade and Industry Chamber 2007).

5.2.6 Coastal mining

The coastline of South Africa is mined for heavy metals (titanium and zirconium), mineral sands, and cement and aggregates (RBM 2011). South Africa is Africa's main producer of titanium and zirconium, and supplies 30% of world production (RBM 2011). Ilmenite, rutile and leucoxene are the primary ore minerals of titanium and usually found in localised beach deposits, known as Heavy Mineral Sands. Richards Bay Minerals (RBM) on the north east coast of KZN are the main producers in South Africa of titanium minerals, high purity pig iron, rutile and zircon, as well as space-age metals. Sand is mined extensively along the coastline, especially in the former Transkei. Most of the sand mining is illegal and large, with a very small proportion actually having legal licenses. Production is unknown, and as result the value of sand mining cannot be estimated.

Mining and quarrying in South Africa contributed US$26.4 million or R198 million (9.1%) to GDP in 2009 (StatsSA 2010a). 'Other Metal Ores' represented 2.2% of this or US$6.3 million (R47 million, 2009 Rands). Heavy mineral sand mining along the coastline would fall within this category. KZN contributed US$900 000 (R6.8 million), the Western Cape US$100 000 (R755 000) and the Eastern Cape US$91 000 (R683 000) (StatsSA 2010a). However, it is not known how much of this can be attributable to the coast. Using mineral production values and the standard prices for Ilmenite in 2009, it was estimated that the KZN mineral mines have a gross value of **US$200 million** (R1.5 billion).

5.2.7 Coastal tourism

Tourism contribution to the South African economy has grown significantly over the past 15 years (Pan African Research & Investment Services 2010). South Africa's cultural diversity, biodiversity, natural beauty and unique location on the African continent all contribute to its attractiveness as a leading tourist destination. The South African coastline represents an important attraction and contributes significantly to the overall tourism value. Leisure accounted for the major reason for travel in the country, representing 57% of total arrivals (Pan African Research & Investment Services 2010). The coast of South Africa east of Cape Agulhas is characterised by beautiful beaches with warm

water and a number of different eco-tourism activities, such as scuba diving, shark diving, turtle watching, whale watching and a number of coastal hiking adventures, such as the Whale Route and the Otter Trail. Recreational activities like game fishing, spear fishing and surfing also attract a large number of tourists and holiday makers to the east coast of South Africa.

Tourism contributed 9.3% to the GDP in 2008 (Pan African Research & Investment Services 2010) and the World Travel and Tourism Council (WTTC) has predicted that tourism will contribute approximately R328.2 billion or 11.4% to GDP in 2011 (WTTC 2011). Tourism is the third largest contributor to the economy after manufacturing and mining and quarrying (CLA Report 2010). Tourism in South Africa is expected to support directly 594,000 jobs (4.5% of total employment). This includes employment by hotels, travel agents, airlines and other passenger transportation services (WTTC 2011). The total contribution of travel to employment in South Africa is expected to be 1,334,000 jobs (10.1% of total employment) in 2011 (WTTC 2011). This includes the wider effects from investment and the supply chain (WTTC 2011). It is expected that South Africa will attract 11,877,000 international tourist arrivals in 2011, generating approximately R82.8 billion in visitor exports (foreign visitor spending, including spending on transportation) (WTTC 2011). This is a 23% increase from the 9,600,000 international tourist arrivals in 2009 (Pan African Research & Investment Services 2010).

Nature based tourism can be divided into passive or active forms, the latter being further divided into ecotourism and adventure tourism (Figure 4, Turpie *et al.* 2003).

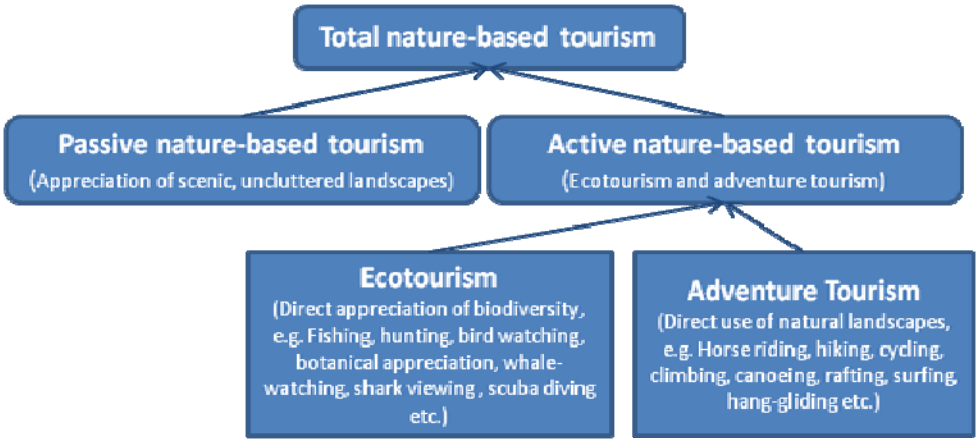

Figure 4: The different nature based activities that contribute to total nature-based tourism (Source: Turpie et al. 2003).

Nature-based tourism activities contribute significantly to the attractiveness of the coastline as a tourist destination. An economic assessment of the boat-based whale watching industry in South Africa (Turpie *et al*. 2005) established that this industry generates US$8.3 million (R62 million, 2009 Rands) in tourist expenditure and contributes approximately US$6.8 million (R51 million, 2009 Rands) to South Africa's GDP each year. A study by Findlay (1997) found that the shore-based whale watching industry had an estimated tourist expenditure of US$1.5 million (R11 million) per year. Diving with sharks is another ecotourism activity that contributes largely to the value of the coast. Diving with Tiger sharks on the east coast at Aliwal Shoal was found to have a direct value of US$1.65 million (R12.4 million) (Dicken & Hosking 2009) and great white shark diving in the Gansbaai area was found to generate US$5.6 million each year (R42 million, 2009 Rands) (Hara *et al.* 2003). The Sardine Run on the east coast of the country is directly influenced by the Agulhas Current and

contributes to tourism as well as local livelihoods. A study in the Pondoland MPA which runs boat based diving and photographic packages during the sardine run was estimated to have a direct value of US$720 000 (R5.4 million) (Dicken 2010). It is estimated that the total gross value for guided ecotourism activities (such as whale watching, shark diving, scuba diving, eco-trails etc.) is approximately US$16 million (R120 million, 2009 Rands), with around 80% of this or US$ 13.3 million (R100 million) being attributable to the ASCLME coast. The gross value of other nature based tourism (which includes adventure tourism, and passive nature based tourism) is in the region of US$186 million (R1.4 billion, 2009 Rands).

Gauteng was the most visited province with a 46% share of the total arrivals whereas the Western Cape, Eastern Cape and KwaZulu-Natal had a share of 31.2% of total arrivals in 2009 (Tourism SA 2010). These three coastal provinces captured 40% of the bed nights in 2009, a total of 28 472 000 bed nights spent in these provinces (Tourism SA 2010). Gauteng and the Western Cape captured most of the tourism revenue in South Africa followed by KwaZulu-Natal. The Western Cape, Eastern Cape and KwaZulu-Natal had a total foreign direct spend of US$4.2 billion (R31.7 billion, 2009 Rands) (Tourism SA 2010). Not all of this can be attributable to the coast, and Cape Town in the Western Cape does not fall within the ASCLME. Therefore, it has been estimated (using information on bed nights in each region) that the total foreign direct spend attributable to the ASCLME coast is **US$1.8 billion** (R13.1 billion, 2009 Rands).

5.2.8 Other ecosystem services

Coastal ecosystems (coral reefs, mangroves, seagrass beds and coastal forests) cover almost 20 000km^2 in South Africa. These habitats provide regulatory services, food and raw materials, as well as recreational and cultural services. The Wio-Lab Report (2008) presented the value of ecosystem goods and services attributable to these habitats, however, the calculations were based on generic global values as found in Costanza *et al.* (1997). Empirical evidence is needed to make a more confident and accurate estimate of the economic value of these coastal ecosystems and therefore the values presented here are considered to be a rough approximation that warrants further investigation. Regulatory services provided by coastal habitats were found to have a value of some **US$2 945 million** (Table 6). Coral reefs cover a relatively small area of 50km^2 off the north coast of KwaZulu-Natal, and the regulatory services value provided by the reefs has not yet been estimated. Coastal forests contribute 98.7% of the regulatory services value in South Africa, with mangroves and seagrass beds contributing 0.9% and 0.4% respectively (Table 6).

Table 6: Valuation (million US$) of regulatory services provided by mangroves, coastal forests and segrass beds (Wio-Lab 2008 based on Costanza *et al*. 1997).

	Seagrass	Coastal Forest	Mangroves
Climate regulation	-	434.9	-
Disturbance regulation	-	9.8	5.6
Water supply	-	15.6	-
Erosion control	-	477.8	-
Nutrient cycling	13.0	1 798.1	-
Waste treatment	-	169.7	20.1
Biological control	-	-	-
Habitat refuge	-	-	0.5
TOTAL	**13.0**	**2 905.8**	**26.2**

5.3 Role of coastal resources in poverty alleviation

5.3.1 Fisheries

Fishing communities occur along the entire South African coastline with an estimated 29 000 subsistence fisher households (Clark *et al*. 2002). Poverty levels amongst the subsistence fishing communities were found to be high; shown by low household income, low levels of employment and high rates of food insecurity (Branch *et al*. 2002). Branch *et al.* (2002) also found that it was low levels of education and high unemployment rates that were central to this. Subsistence harvesting made a significant contribution to the basic needs of food security in these communities, either by consumption of their catch or by sale to generate money to buy their own food (Branch *et al*. 2002). South Africa has a high coastal population density with some 80 people per one km^2, and there is considerable dependence on coastal and marine resources for both income and food (Brown *et al.* 2008).

Branch *et al.* (2002) found that poverty was differentially distributed along the South African coastline, with the poor and ultra-poor being over represented along the former Transkei and KZN coasts, where education levels were lower than elsewhere and unemployment reached 50% or more. Relative poverty levels were highest on the former Transkei Coast (57% poor) and in KZN (49% poor) and are much lower than on the South and West coasts of South Africa (Branch *et al*. 2002). This may be a result of the biogeographic distribution of marine and coastal resources because the western and southern coasts experience higher productivity and support the majority of the commercial fishery stocks (Branch *et al*. 2002). Poverty is generally higher in rural areas as there is less opportunity for employment, isolation from markets, low levels of education and poor service delivery – Branch *et al*. (2002) found that rural fishers were twice as likely to be poor than fishers found in other areas. The marine and coastal resources that are harvested by coastal communities are either sold, eaten or used for bait with almost all of the fish and rock lobster being sold and rocky intertidal organisms being eaten, such as mussels and limpets. Branch *et al*. (2002) also found that the use of subsistence resources was the most intense along the KZN coast, where biomass of marine and coastal resources is lowest.

5.3.2 Tourism

Tourism in South Africa is one of the largest contributors to the economy and coastal tourism contributes significantly to this. The coastline of South Africa is a major attraction for a significant proportion of international tourists as well as domestic tourists. The promotion of tourism has been identified as a key strategy that can lead to economic upliftment, community development and poverty relief in the developing world (Binns & Nel 2002, Myeza *et al*. 2010). Ecotourism is one of the fastest expanding tourism markets and presents an excellent opportunity for local economic development (Myeza *et al*. 2010). Coastal ecotourism is considered to be particularly effective in providing economic upliftment and social benefits to poor communities (Myeza *et al*. 2010). Ecotourism activities such as whale watching, shark cage diving and coastal hikes offer some employment opportunities and reliable income for communities living on the coast, but most of this seems to go to the wealthy investors with very little making its way down to the local level or poorer population.

In the Eastern Cape and KZN where poverty and unemployment levels are some of the highest in South Africa, there are opportunities for increased tourism and community outreach and involvement. An example of this is in KZN along the Hibiscus Coast where the annual sardine run presents an ecotourism opportunity that could benefit the local communities in the Ugu District (Myeza *et al*.

2010). The sardine run, which is an annual phenomenon, has become a major tourist event over the past few years attracting crowds of international and local tourists. Myeza *et al*. (2010) found that the participation in the sardine run by the poorer residents was very low when compared to the wealthier residents along the coast, with most of the tourism value going into hotels, bed and breakfasts and restaurants along the south coast. The study also found that 17.6% of the community gained financially from the event and that over 70% showed a willingness to receive training about the event in order to benefit more from it. Myeza *et al*. (2010) also calculated that total earnings by the poor sector of the community (110 000) amounted to an average of R160 per person for the season. The total population could therefore earn around R18 million per year from the sardine run (Myeza *et al*. 2010). With a multiplier effect of 2 to 3, then the financial benefit to the local community could be as much as R36 - R54 million (Myeza *et al*. 2010). Management strategies and development plans are needed to assist these communities in training exercises that would enable them to benefit from this ecotourism activity.

5.3.3 Mariculture

The AISA aquaculture benchmarking survey states that the odds are stacked heavily against the entry of small businesses into aquaculture, which is a serious concern for policy makers who favour small business development as a way to create jobs in developing countries (Britz *et al.* 2009). The aquaculture sector is still young and developing but it was found that 51% of the aquaculture businesses were operating at below 50% capacity and that the marine aquaculture sector was very capital intensive, favouring medium sized enterprises. Most of the aquaculture enterprises in South Africa were financed by private investments and loans, with only a small percentage having government participation of any kind (Britz *et al.* 2009). Although the sector is young and developing, employment grew by 80% between 2005 and 2008, with permanent employment growing substantially. The sector has potential for creating jobs and for creating alternative livelihoods for those living along the coast. However a number of interventions are needed in order to achieve this (Britz *et al.* 2009):

- Research, technology development and transfer.
- Capacity to monitor and guarantee the safety of the aquaculture producers
- Facilitate access to finance
- Monitoring of water quality for export purposes
- Promotion of aquaculture education, training and skills development

5.3.4 Energy, coastal mining and ports

The energy, coastal mining and coastal transport sectors play an important role in employment and the national economy. These sectors employ a significant number of skilled and unskilled labourers living along the coast. There are six large ports along the east coast of South Africa and these are important in terms of economic growth and development in southern Africa. The mining and energy sectors are however often linked with conflict and negative impacts. Mining is often associated with exploiting the poor, not recognising labour rights, not following regulations and being unsustainable (Bourassa 2009). Mining often benefits only the local elites and not the indigenous communities or labourers. A number of these negative associations have been attributed to poor governance, poor strategies and policies, and an ineffective balance of power in society (Bourassa 2009). The mining sector requires transformation towards sustainability, capacity for good governance and an enabling environment in order for more equal benefit distribution and development to be felt (Bourassa 2009).

The following table is a summary of the contribution of coastal resources to national income and poverty alleviation in South Africa. The estimated total contribution (without regulatory services) to the South African economy is in the order of some US$5.7 billion (Table 7).

Table 7: Summary of the contribution to national income (million US$) of the different activities and their contribution to poverty alleviation in South Africa.

Activity		Contribution to Gross Economic Ouput (Million US$)	Jobs	Contribution to poverty alleviation
Renewable resource extraction	Commercial	242.8	30 000	Important in west and south west
	Subsistence	3.6	29 500	Very important
	Recreational	470	(750 000)	Negligible
Non-renewable resource extraction		1 450	±10 000	Important – jobs and national income
Coastal Tourism		1 734	594 000	Very important – national income, jobs and opportunities for small entrepreneurs
Coastal agriculture & forestry (not necessarily attributable to the coast)		264	?	Small-scale/subsistence agriculture very important. Commercial agriculture – declining employment.
Mariculture		9.6	±1500	Important in some areas – jobs and alternative livelihoods
Ports/harbours		1 500	?	Important – jobs and national income
Regulatory Services		2 945	-	

6 MOZAMBIQUE

6.1 Study area and resources

Mozambique is located on the south-eastern coast of Africa and is bordered by the Tanzania to the north, Malawi and Zambia to the northwest, Zimbabwe to the west and Swaziland and South Africa to the southwest (ASCLME Project 2009). The Mozambican coastal plain is wide and low-lying and the coastline is approximately 2,700 kilometres long, broken up by 25 rivers that flow into the Indian Ocean.

Mozambique has an estimated population of 21 million people, 32% of which live in coastal districts (CLA Report 2010). Of all the mainland African countries that adjoin the Indian Ocean, this is one of the highest percentages of any country's population that is living in the coastal zone (CLA Report 2010).

The Mozambican coastline is characterised by a variety of ecosystems such as estuaries, extensive mangrove forests, dunes, coastal lakes, coral reefs, seagrass beds, and swamp forests (CLA Report 2010). The coastal waters off Mozambique are very productive with the main fishing areas occurring at the Sofala Bank, Inhambane, Vilanculos, Chiluane and Beira (ASCLME Project 2009). The narrow, warm and productive Agulhas Current flows south-westwards down the east coast of Africa through the Mozambique channel contributing to this high diversity found along the coast. The coastal population rely heavily on these productive coastal waters and the marine resources found within them not only for food but also for employment through artisanal fishing, tourism and coastal transport services (ASCLME Project 2009). The mangroves, estuaries, seagrass beds and coral reefs provide food and shelter for thousands of different marine species. The main commercial species in Mozambique are deep sea prawns, shrimps, crabs, lobster, squid, octopus, sea cucumber, sea bream and bivalves. Other important species include dugong, turtles, sharks and dolphins which contribute to the attractiveness of the Mozambican coastline as an eco-tourism destination.

The Mozambican coastline can be divided into three distinct sections:

- The northern coast (coral coast) which is approximately 770 kilometres long with a narrow continental shelf, a rocky sea bed, sheltered islands and bays (CLA Report 2010).
- The central coast (swamp coast) is approximately 980 kilometres long facing the Sofala Bank. There are numerous rivers along this section of coastline which are bordered with mangrove forests that provide sheltered areas. There are also sandy coasts which are sometimes protected by coastal islands (CLA Report 2010).
- The south coast (dune coast) is about 950 kilometres long. There are beaches in some areas, sea beds with coral reefs and rocks, sheltered bays, high parabolic dunes and barrier lakes (CLA Report 2010).

The Mozambican GDP (current prices) in 2009 was US$9.65 billion (National Institute of Statistics 2010). Agriculture is the largest contributor to GDP at 25%, with trade and repair services (14%), manufacturing (12.9%), transport and communication services (9.4%) and real estate and business services (5.4%) also contributing significantly (Figure 5, National Institute of Statistics 2010). The fisheries and aquaculture sector (which includes inland fisheries) contributed 1.6% and accommodation and restaurants only 1.5% to GDP in 2009 (National Institute of Statistics 2010).

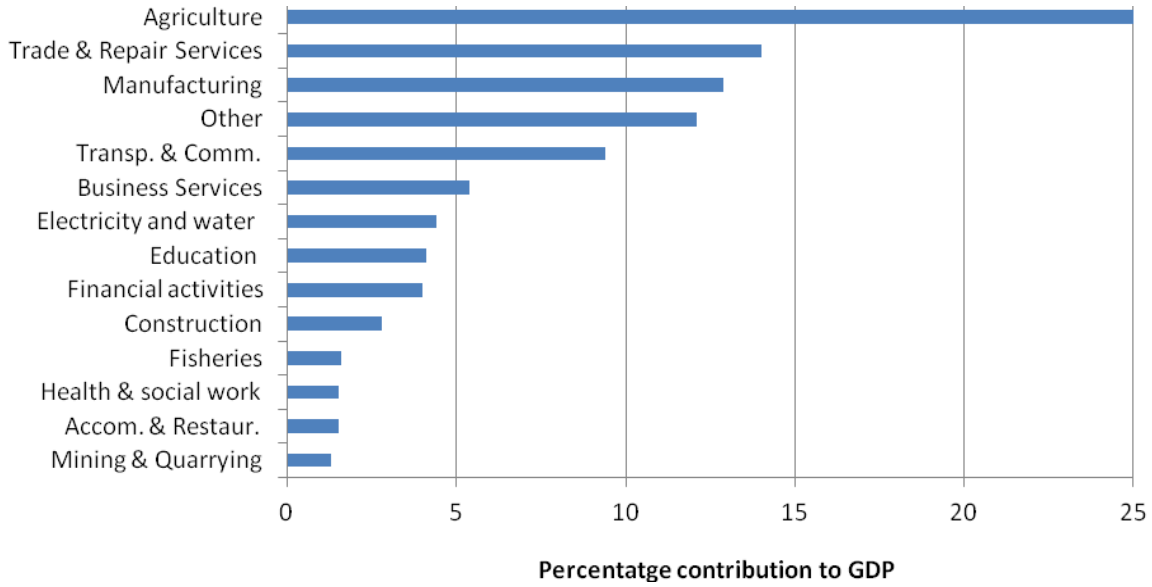

Figure 5: Percentage contribution of each sector to Mozambican GDP in 2009

6.2 The value of the coast

6.2.1 Fisheries

The Mozambican fishery sector can be divided into three subsectors; industrial, semi-industrial and artisanal fisheries. The industrial and semi-industrial fisheries are often grouped together and called the commercial sector. During a four year period between 2004 and 2008, there was an overall increase in the domestic fish production in Mozambique (USAID 2010). However, this increase was a result of a 71% increase in production by artisanal fishermen. During this same four year period, production by the commercial fishery declined by 39% (USAID 2010). In 2008, 15% of the domestic fish production came from commercial fisheries whilst 84.3% was from the artisanal fisheries (Table 8, USAID 2010). Currently the fisheries sector contributes approximately 1.6% to the Gross Domestic Product (GDP) (National Institute of Statistics 2010).

Table 8: Total fish landings (tons) by sub-sector 2004-2008 (USAID 2010)

Subsector	2004	2005	2006	2007	2008
Commercial	30210	26248	27926	19377	18437
Artisanal	60379	57747	63973	72894	103364
Total	**90589**	**83995**	**91899**	**92271**	**121801**

6.2.1.1 The industrial and semi-industrial fishery

The shallow water shrimp is the most commercially valuable marine resource and is the second most important species by volume, accounting for 29%, followed by the deep water shrimp at 8% (USAID 2010). Although kapenta forms the highest production volume, it is a freshwater species that is part of

the inland fishery in Mozambique. Other commercially important species include fish, langoustine, crab, cephalopods and lobster. There are approximately 192 industrial vessels and 106 semi-industrial vessels in the commercial fleet using different types of gear (Table 9). There are approximately 6300 people employed in the industrial fishery (Omar 2006). The marine semi-industrial fishery consists of approximately 106 vessels with 1700 fishers (CLA Report 2010, USAID 2010). These vessels are distributed among the Southern Sofala shrimp trawling fishery, the Maputo Bay shrimp trawling fishery, Limpopo River mouth shrimp trawling fishery, the Angoche shrimp trawling fishery, and the line fishery on coastal rocky beds (CLA Report 2010). There are 76 vessels involved in the trawl fishery and 30 involved in the hand line fishery (Table 9, USAID 2010).

Table 9: The number of industrial and semi-industrial vessels in Mozambique

Type of fishing	Industrial		Semi-Industrial	
	Vessels	No. employed	Vessels	No. employed
Trawl	67		76	
Hand line	2		30	
Purse seine	47			
Long line	76			
Total	**192**	**6300**	**106**	**1700**

The most commercially valuable marine resource, the shallow water shrimp, is currently fully exploited, while the deep water shrimp and other marine species offer the potential for increased catches (USAID 2010, Table 10).

Table 10: Commercial (industrial & semi-industrial) marine fishing production (tons) by species or groups for 2004-2008

Species	2004	2005	2006	2007	2008
Shallow water shrimp	8106	8520	7393	7046	5395
Deep water shrimp	993	1774	1803	1366	1448
Fish	484	660	665	764	649
Langoustine	132	149	94	153	100
Crab	184	158	107	125	74
Cephalopods	195	165	114	138	42
Lobster	2	1	8	8	4
Bycatch	1 354	1830	1725	895	670
TOTAL	**11 450**	**13 257**	**11 909**	**10 495**	**8382**

Prices for commercial fisheries are not readily available and statistics associated with catches in Mozambique are often poor. Average export prices over the period 2004-2008 (USAID 2010) were used to calculate the gross value of the commercial fishery sector (Table 11). The gross output of the commercial fishery is estimated to be some **US$63.5 million**.

Table 11: Estimated gross value of the Mozambican marine commercial fishery (US$ 2009)

Species	Catch (tons)	Trade value (US$/ton)	Value (2009 US$)
Shallow water shrimp	5 395	8 356	46 430 816
Deep water shrimp	1 448	8 356	12 461 876
Fish	649	4 514	3 017 474
Langoustine	100	8 732	899 417
Crab	74	6 508	496 055
Cephalopods	42	5 094	220 384
Lobster	4	8 732	35 977
Bycatch	670		-
TOTAL	**8 382**		**63 561 998**

6.2.1.2 Artisanal Fishery

The artisanal fishery accounts for approximately 85% of domestic fish production and has been increasing steadily over the past few years (Table 12; CLA Report 2010, USAID 2010). Fish are the most important in terms of volume for artisanal fishermen, accounting for 72% of production (USAID 2010). Fish caught in the inland fishery are the second most important at 18% (USAID 2010). Other important resources include bivalves, mangrove crabs, shallow water shrimp, squid and octopus (CLA Report 2010).

Table 12: Artisanal marine fishing production (tons) by group for 2004-2008 (USAID 2010)

Species	2004	2005	2006	2007	2008
Shallow water shrimp	3783	4555	1367	838	2087
Paste shrimp			2018	2022	2443
Fish	51908	50024	57457	45511	74870
Crab	202	161	176	121	254
Cephalopods	255	239	247	551	773
Lobster			5	33	1
Shark	268	893	776	746	181
Other	3962	1875	1926	2351	2156
Bycatch				5522	2268
TOTAL	**60378**	**57747**	**63972**	**57695**	**85033**

Average monthly retail prices for marine species were used to estimate the value of the artisanal catch. The retail values were averaged for each species and converted to US Dollars. It is estimated that the artisanal fishery has a gross value of some **US$292.5 million** (Table 13). This is almost five times the value of the commercial fishery.

Table 13: Estimated gross value of the Mozambican marine artisanal fishery (US$ 2009)

Species	Catch (tons)	Value (US$/ton)	Value (2009 US$)
Shallow water shrimp	2087	6740	14 488 371
Paste shrimp	2443	3087	7 767 787
Fish	74 870	3370	259 881 257
Crab	254	2190	572 948
Cephalopods	773	2950	2 348 761
Lobster	1	8732	8 994
Shark	181		
Other	2156	3370	7 483 692
Bycatch	2268		
TOTAL	**85 033**		**292 551 809**

There are currently approximately 595 fishing centres along the Mozambican coastline. Artisanal fisheries data collected during a census in 2007 includes data on the number of fishers, the number of boats and the number of crew members for both the marine and inland fisheries together. However the CLA Report (2010) estimated the work force for the marine artisanal fishery by taking into account an average of 11 workers per fishing gear for beach seining, two for gillnetting and 2 for hand-line fishing. It is therefore estimated that the marine artisanal fishery has a total of 144 400 people (Table 14). This value excludes those people that are professionals working at fishing centres as traders, processors and mechanics.

Artisanal fishermen that own boats and gear earn substantially more income than those that work as crew or fish independently. The boat and gear owners have an annual average income of approximately US$4900 (US$408 per month, 2009 Dollars) whereas those that fish independently earn an average annual income of US$680 (US$60 per month, 2009 Dollars) (CLA Report 2010).

Table 14: The number of fishers involved in the different artisanal fisheries

Fishing Method	Resource	Area	Fishers
Beach seining	Small pelagics, penaeid shrimps	Central and south zones	81 300
Beach seining	Demersals	North and south zones	
Line Fishing	Demersals	The whole coast	19 300
Gillnets	Pelagics and demersals	The whole coast	34 700
Traps	Demersals and benthos	The whole coast	9100
TOTAL			**144 400**

Mangroves play an important role as nursery habitats for juvenile fish and crustaceans and therefore contribute significantly to fisheries production along the Mozambican coastline. Mangroves cover an area of approximately 3 902 km^2 (Wio-Lab 2008). Mangroves are currently under threat from increased economic development in the coastal zone, over exploitation of mangrove resources, and the conversion of mangrove area into other land use options with the motive of increased monetary profits (e.g. slat pans, fish ponds and real estate) (Soto 2007). Saket & Matusse (1994) estimated that the annual rate of mangrove deforestation between 1972 and 1990 was 0.2%. It is estimated that mangroves in Mozambique have a habitat refuge value of some **US$66 million** which contributes to fisheries production.

Table 15 is a summary of the different economic value measures that were calculated during this study for the commercial and artisanal fisheries in Mozambique.

Table 15: Summary of the economic values for the fisheries sector in Mozambique

Sector	Gross economic output (turnover) $ millions	Number of jobs
Industrial and semi industrial	63.5	8000
Artisanal	292.6	144 400
TOTAL	**356.1**	**152 400**

6.2.2 Coastal agriculture, forestry and natural resources

Agriculture contributed 25% to the GDP in 2009 and agricultural commodities contribute 10-15% of total exports (National Institute of Statistics 2010). Cassava and maize are the two staple food crops in Mozambique, representing approximately 50% of the value of production and 55% of the potential to alleviate income poverty in the small holder sector (CLA Report 2010). The main export crops include cotton, cashew nuts, fruit and sugarcane. The forestry sector is estimated to contribute between two and three percent to total GDP in Mozambique (Suich 2006). In excess of 70% of the value added of forestry and forestry products is thought to be accounted for by subsistence production with the remainder consisting of market fuelwood production, industrial roundwood and processed wood production (Suich 2006). Although this sector contributes significantly to national income, subsistence and commercial agriculture and plantation forestry along the coast are not attributable to the coast per se (i.e. they are not dependent on coastal ecosystems) and as a result should not be considered in this study.

A number of studies have been undertaken in Mozambique to determine the use of various natural resources, however most of these have been conducted in small areas (i.e. one village) around the country and very few have quantified the volume and/or value of these resources (Suich 2006). Fuelwood, poles for construction and food items (mainly game, fish and mushrooms) are the most collected and used natural resources (Suich 2006). A study by Lizon (2002) in the Gile District found that the exploitation of wild resources is almost twice as valuable as that of agricultural production (crops only). The analysis found that the total annual value of forest resources was approximately US$113 per household, whereas agriculture was estimated to be worth approximately US$70 per household per annum. Domestic stock (pigs and poultry only) was found to be six times less than wild resources at US$19 per household per year (Lizon 2002). A WWF study (Suich 2006) evaluating the economic valuation of natural resources in Mozambique focused on three areas; Bazaruto, Chirindzene and Vilanculos. According to these results, the average annual gross income to households from forest resources is approximately US$200 in Bazaruto, US$363 in Chirindeze and US$224 in Vilanculos (Suich 2006). Coastal forestry and agriculture is however considered based on their dependence on coastal ecosystems. Mangroves, coco-nut and casuarina trees are examples of such habitats that are dependent on coastal ecosystems and as a result should be considered here. There is however very little information in the literature about use, production and economic value of these agricultural products.

6.2.3 Mariculture/aquaculture

Mozambique experiences favourable environmental conditions for prawn farming, with an extensive coastline and a climate that allows for 2-3 production cycles per annum (CLA Report 2010). The central-north coast has been identified as the best area for shrimp and prawn farming and the overall potential for prawn culture development is estimated in excess of 170 000ha. There are currently five commercial prawn farms that have an annual production of 1000 tons (Table 16, CLA Report 2010). In 2008 the net weight of prawns and shrimp exported from Mozambique was 7,311 tons with a trade value of US$48 million (USAID 2010). This equates to a trade value of US$6,604 per ton. Prawn mariculture therefore has an estimated market value of some US$6.6 million. The prawn farms employ approximately 1000 workers, of which 30% are women (CLA Report 2010).

Seaweed cultivation has increased significantly over the last decade and in some areas along the coast it is an extremely important livelihood opportunity providing a secure and constant source of income (CLA Report 2010). Large areas of lagoon and lengths of the coastline are suitable for either off bottom and shallow water culture or for deep water and line culture (CLA Report 2010). The seaweed is commercially produced for export but is community based, with over 2000 people being involved in the cultivation process. Of the 2000 employed in seaweed farming, 70-80% are women and the monthly income is US$60 per person (CLA Report 2010). Therefore, wages per annum for the 2000 workers are approximately US$1.4 million. In 2008 the annual production of seaweed was 350 tons (CLA Report 2010). Using data found for Tanzania and Madagascar, the average export value for seaweed was approximately US$300 per ton. This equates to a total gross value of US$105,000 per annum for seaweed farming.

Other forms of aquaculture include finfish (dusky kob, milkfish and mullet) for subsistence purposes as well as mud crab. The mud crab and dusky kob farms are currently in experimental stages and no data are available for the scale of production and/or the value of these species. In 2008 a total of 1.2 tons of milkfish and mullet were farmed for subsistence purposes. The total gross value for aquaculture in Mozambique is therefore estimated to be some **US$6.7 million** per annum (Table 16).

Table 16: The value, types, production and areas used in Mozambique for aquaculture

Type	Production scale*	Area*	Annual Production (tons)*	Value (US$)
Prawns	Commercial	Beira, Quelimane, Angoche, Pemba	1000	6 600 000
Seaweed	Commercial	Cape Delgado, Nampula	350	105 000
Finfish (Milkfish & Mullet)	Subsistence	Nampula Province	1.2	
Finfish (Dusky kob and cobia)	Experimental	Pemba Bay, Cabo Delgado	0	
Mud Crab	Experimental	Maputo estuary	0	

*Source: CLA Report 2010

6.2.4 Energy

Mozambique is set to become a major natural gas producer in Africa with substantial reserves being established over the past few years (GlobalData 2010). Currently there are four proven gas fields Mozambique - Pande, Buzi, Temane and Inhassoro (GlobalData 2010). Mozambique's exploration and production activities lie in natural gas rather than in oil, with current gas potential estimated at 25 trillion cubic feet (TCF). The natural gas produced at the Pande/Temane area is transported via

pipeline to Mozambique markets in the region surrounding the central processing facility, such as Inhassoro, Vilanculos, Bazaruto as well as markets and industries in and around Maputo (CLA Report 2010). However most of the gas is piped to the Sasol Secunda complex in South Africa. The current production capacity of the fields is approximately 120 billion cubic feet per year (GlobalData 2010). In February 2010, a gross column of more than 1200 feet of natural gas was encountered in the frontier Rovuma Basin offshore of Mozambique (GlobalData 2010), highlighting the huge potential of the relatively unexplored northern Mozambican coast.

There are no consistent figures on employment or wages for the oil and gas sector in Mozambique (CLA Report 2010). The national company Petromoc has 616 permanent staff, while the building of the processing centre and pipeline in Telemane employed approximately 1000 Mozambicans, there are only 300 permanent jobs that remain (CLA Report 2010). In 2009 the developed and undeveloped reserves in the Pande and Temane fields was 1667 billion cubic feet equivalent (bcfe). At a cost of US$6.25 per million cubic feet in 2009, the value of these fields can be estimated at **US$10.5 million**.

6.2.5 Ports and Coastal Transport

Maputo is the main port situated approximately 100 km north of the South African border. Other important ports include Beira, Chinde and Nacala with smaller fishing and leisure ports including Inhambane, Vilanculos, Sofala, Quelimane, Angoche and Pemba (CLA Report 2010). The main terminals at Maputo include citrus, sugar, minerals and coal with exports totalling over 3.5 million tons per annum. Ports play an important role in the transport of cargo, passengers and in port handling. Ports are also important for the coastal communities that rely on fishing as a main source of income, with commercial fishing boats as well as subsistence boats using these ports as a base and for operation. Prawn, crayfish and long-lining vessels all operate from most of the Mozambican ports.

In 2002 the Mozambican ports handled approximately 8.2 million tons of cargo. The revenue generated from the ports (transport of cargo, transport of passengers and port handling) in 2009 was estimated to be **US$60 million** (National Institute of Statistics 2010).

6.2.6 Coastal mining

There are large mineral deposits in Mozambique but exploration has been constrained by the civil war and poor infrastructure (CLA Report 2010). Mining and quarrying contributed 0.3% to the GDP in 2002 and employed 0.5% of the economically active population in 1997 (Maher 2004). Only coal, bauxite, marble, gold and salt are exploited in significant quantities (Maher 2004). Of the coastal mines, only the Moma mine is operational (CLA Report 2010). The Moma mine in Nampula Province on the north-east coast produces ilmenite (titanium oxide from heavy sands) (CLA Report 2010). The mine employs (directly and indirectly) 2200 people. In 2009 the Moma mine produced 800,000 tons of ilmenite, 56,000 tons of zircon and 21,000 tons of rutile for the export market (CLA Report). In the first half of 2010 it made up 4% of exports (CLA Report 2010). Using mineral production values and the standard prices for Ilmenite in 2009 (US$90 per ton), it is estimated that ilmenite production has a gross value of **US$72 million**.

Informal sand mining (largely illegal) is conducted along the entire coastline and is very extensive. However production amounts and values are unknown.

6.2.7 Coastal tourism

Tourism in Mozambique has been steadily increasing over the last decade. The principal tourism product in Mozambique has been the pristine beaches, overall biodiversity and cultural uniqueness (CLA Report 2010). Coastal tourism is important in Mozambique with the focal points and activities concentrated on the southern and northern parts of the Mozambican coastline, with the central coastline being less popular as a tourist destination because of the high fluvial sediment loads from the large river systems (CLA Report 2010). The largest concentration of coastal tourism development is found in the southern region of the country, particularly in Inhambane Province (CLA Report 2010). The Bazaruto Archipelago and the coastal resort town of Vilanculos in Inhambane Province are both popular tourist destinations. The primary focus and main tourist activities along the coast include recreational diving, sports fishing, spear fishing, birding, luxury island lodges and resorts, quad biking, snorkelling, visiting cultural heritage sites and swimming with dolphins and whale sharks (Suich 2006, CLA Report 2010).

Statistical data on tourism in Mozambique is weak, making it difficult to calculate the overall contribution of coastal tourism to the GDP (CLA Report 2010, Jones 2010). Jones (2010) distinguished three kinds of foreign tourist in Mozambique; business visitors, self-drive visitors and other leisure visitors (often visiting family and/or friends) (Table 17). Most of the self-drive tourists are from neighbouring African countries, in particular South Africa, who bring with them camping equipment, food and their own vehicles (Jones 2010). Business and self-drive tourists were found to stay on average for 3 days whilst other leisure tourists stayed on average for a week. Business tourists spent US$98, self-drive tourists US$54 and other leisure tourists US$60 on average per day in Mozambique (Jones 2010). The weighted average spend per visitor in Mozambique was calculated to be US$260, which is considered to be very low when compared to other sub-Saharan African countries (Jones 2010). Jones (2010) also found that the total expenditure in 2003 for business tourists was US$47.5 million, US$31.7 million for self-drive tourists and US$35.3 million for other leisure visitors. The total number of annual foreign visitors to Mozambique was 441 000 in 2003 (Table 17, Jones 2010).

From the Social Accounting Matrix (SAM) conducted by Jones (2010) the contribution of tourism to the Mozambican GDP in 2003 was calculated at US$137.8 million or 3.2%. Foreign tourism accounted for 1% of this, whilst domestic tourism accounted for 2.2% (Jones 2010).

Table 17: Profile of foreign tourism expenditure for 2003 (Jones 2010)

		Leisure		
	Business	**Self-drive**	**Others**	**Weighted avg.**
Expenditure (daily US$ pp)				
Accommodation	56.8	25.9	32.6	38.5
Food & Restaurants	21.6	14.5	8.9	16
Other	19.6	13.8	18.6	16.8
Total	**98**	**54.1**	**60.1**	**71.3**
Average stay (number of days)	3	3	7	3.8
Spend per visit (US$ per day)	294.1	162.3	420.8	259.7
Total number of visitors ('000s, annual)	161.6	195.6	83.8	
Total expenditure (US$ million)	**47.5**	**31.7**	**35.3**	

The World Travel and Tourism Council (WTTC) have recently published a travel and tourism economic impact 2011 report for Mozambique (WTTC 2011). The report defines the economic contribution of travel and tourism in Mozambique, the direct contribution to GDP, contribution to employment and visitor export statistics. The report estimates that the direct contribution of travel and tourism to the Mozambican GDP will be US$340 million or 3.1% in 2011 (Table 18). The total contribution is estimated to be double this at US$800 million or 7.2%. Travel and tourism is expected to generate 243,000 jobs directly in 2011 (2.6% of total employment), which includes hotels, travel agents, airlines and other passenger transportation services (WTTC 2011). Visitor exports are a key component of the direct contribution of Travel and Tourism in Mozambique. The country is expected to attract 1,852,000 international tourists (overnight visitor) arrivals in 2011, generating US$250 million in visitor exports (foreign visitor spending, including transportation) (Table 18, WTTC 2011).

Table 18: Estimates for travel and tourism contribution to GDP, employment and visitor exports for Mozambique in 2011 (WTTC 2011)

	MZN bn	US$ bn	% of total	Growth
Direct contribution to GDP	11.5	0.34	3.1	6.5
Total contribution to GDP	26.7	0.8	7.2	7.7
Direct contribution to employment*	243		2.6	1.5
Total contribution to employment*	581		6.3	2.3
Visitor exports	8.3	0.25	8.3	2.9
Domestic spending	11.7	0.35	3.2	7.7
Leisure spending	11.6	0.35	3.2	4
Business spending	8.5	0.26	2.3	8
Capital investment	3.3	0.09	5.2	9.4

* '000 jobs

Mozambique has a total lodging capacity of around 12 500 beds, and in 2003 registered 660 000 room nights, by approximately 360 establishments (Visser 2004). Tourism statistics show that the predominant form of tourism in the country is still business, although leisure tourism is increasing steadily with each year (Visser 2004). Maputo City accounted for 50% of total registered room nights and guests in 2003. The real market size for leisure tourists in Mozambique is unknown but tourism receipts demonstrate that Inhambane in the south is Mozambique's leading province in leisure tourism (Visser 2004). The coastal provinces accounted for 57.5% of the total beds and 41% of room nights in 2003 (Visser 2004). Using these values, it is estimated that the total direct spending is approximately **US$145 million** along the coast (US Dollars 2009).

6.2.8 Other ecosystem services

Coral reefs, mangroves, coastal forests and seagrass beds provide a number of ecosystem goods and services. These important habitats all provide shelter and food for a number of marine organisms, provide habitat and nursery areas for juvenile fish and invertebrates, provide resources for many communities along the coast and play an important role in attracting tourists and eco-tourism activities to the Mozambican coastline. The ecosystem goods and services that these habitats provide were valued by Wio-Lab (2008), based on Costanza *et al*. (1997). These values are however calculated using generic global values and should therefore be considered with caution.

These coastal habitats provide a number of regulatory services such as disturbance regulation, nutrient cycling and habitat refuge. Based on the values given in the Wio-Lab report and Costanza *et al.* 1997 it is estimated that the regulatory services provided by the coastal habitats of Mozambique have an economic value of some **US$5 billion** (Table 19).

Table 19: Valuation (million US$) of regulatory services provided by coral reefs, mangroves, coastal forests and segrass beds (Wio-Lab 2008 based on Costanza *et al*. 1997).

	Seagrass	Coral Reefs	Coastal Forest	Mangroves
Climate regulation			39.9	
Disturbance regulation		511.4	0.9	724.1
Water supply			1.4	
Erosion control			43.8	
Nutrient cycling	833.9		164.8	
Waste treatment		10.8	15.6	2 612.7
Biological control		0.9		
Habitat refuge		1.3		65.9
TOTAL	**833.9**	**524.5**	**266.4**	**3 402.7**

6.3 Distribution of coastal value and role in poverty alleviation

6.3.1 Fisheries

With approximately 70% of the population living below the poverty line, Mozambique is considered to be one of the world's poorest countries (Afonso 2004). Around 50% of the Mozambican population is illiterate and although there has been significant progress with education, there are serious gaps in the human resources capacity of the country (CLA Report 2010). Coastal and marine resources are therefore extremely important for the majority of the Mozambican population and there is a great dependence on these resources for both food and employment. Most of the artisanal households along the coast engage in a number of economic activities, such as farming, trade of fish, and tourism. However, for the majority of the coastal population, fishing is the most important source of income and food security (CLA Report 2010).

Artisanal fishermen and associated households are reported to be extremely poor with considerable socio-economic differentiation and high rates of illiteracy (CLA Report 2010). Three main groups of artisanal fishermen can be described: (1) the more privileged and wealthy boat and gear owners, (2) crew (employees), (3) shore based fishers and/or collectors (CLA Report 2010). Many fishermen employed as crew on small artisanal vessels are either paid a salary or are paid in "3rd class" fish that are divided amongst the crew (CLA Report). Fishermen working as crew on the industrial and semi-industrial vessels have significantly higher incomes. Aquaculture plays an important role in generating income for many households along the coast, especially those households that are female headed. Seaweed mariculture is especially important as it provides employment and income for some 2000 women along the coastline. Other income sources for the poor are the production of charcoal and firewood as well as reeds and wood products. There are a number of other professionals based at fishing centres along the coast; these include naval carpenters, naval apprentices, traders, processors, mechanics and net makers (CLA Report 2010). There are a total of 26 588 professionals working at the marine fishing centres in the seven coastal provinces (CLA Report 2010). Of these, 44 percent are located in Zambezia Province and 26 percent in Nampula Province. Overfishing and the

destruction of coastal habitats can have a profound effect on these coastal communities that rely on fishing not only for employment but for food security.

6.3.2 Tourism

The tourism sector is growing significantly and in certain coastal provinces, like Inhambane, provides employment and income to a number of households. The industry has an impact at the household level through the wages and salaries paid to employees of the tourism industry (Suich 2006). Coastal resort areas like the Bazaruto Archipelago and Vilanculos employ a significant proportion of the local population for tourism related activities (Suich 2006). The southern resorts of Ponta do Ouro, Inhambane and Bilene are popular beach based leisure spots, Bazaruto and Vilanculos are the more upmarket resorts and lodges and recently there has been increased investment in the northern coastal areas of Pemba, the Quirimbas archipelago and Nacala (Sarmento 2007). The central coastline of Mozambique is less favourable to tourism but plays an important role in fish and prawn farming. The Social Accounting Matrix (Jones 2010) showed that tourism has strong backward linkages across production, household income and value added accounts. Specifically, growth in tourism would provide particular stimulus to the food and beverages processing, agriculture (including fisheries) and service industries (Jones 2010). The SAM showed, however, that a shortage of appropriately skilled labour represents a potentially significant constraint on tourism growth. It also found that the tourism industry was not necessarily a pro-poor industry, with only 10 percent of the final value trickling down to the poorest households (Jones 2010). Agricultural commodities displayed the strongest multiplier and this is because the majority of poor households are active in this sector, suggesting that any exclusively pro-poor tourism agenda should focus on developing linkages between smallholder agriculture (and fisheries) and (domestic and foreign) tourism (Jones 2010).

There are a number of reasons as to why direct benefits do not filter down to the local level or poorer population. The Mozambican national private sector is still in its infancy, local producers and suppliers face constraints as they cannot react adequately to the volumes and standards required by the hospitality and tourism industry, the large majority of the Mozambican micro and small scale businesses have difficulty in directly accessing the tourist market because they are not registered officially, the tourism industry depends heavily on imports instead of local capacity, and lastly direct benefits have been very limited because of poor policy decisions (Sarmento 2007).

6.3.3 Mariculture

Mariculture is in its infancy in Mozambique and has a similar situation to that of South Africa, where the input costs are high and the entry of small enterprises is difficult. Most of the mariculture in Mozambique is situated along the central coastline and is predominantly prawn and shrimp farming. Although these farms provide some employment to local people, the current benefit distribution is thought to be unequal and the impacts of alleviating poverty minimal. The food produced from these farms is exported and the benefits enjoyed mostly by the elite that own these enterprises. Seaweed mariculture is however geared more towards local development, alternative livelihoods and poverty alleviation. Good investment potential does however exist in the sector but this is not always quickly realisable (Muir *et al.* 2009). Mozambique has good coastal and inland natural resources but management issues are unlikely to be quickly resolved, market access is being improved but needs strong local and regional linkages and community development is lacking (Muir *et al.* 2009).

6.3.4 Agriculture and Forestry

Subsistence agriculture and forestry products are extremely important for household income in Mozambique. A high percentage of households rely on agriculture for their main income, especially in coastal areas where the land is predominantly more fertile and accessible for cultivation (CLA Report 2010). Primary production involvement and time allocation for women in the coastal zone lies mainly in subsistence agriculture and natural resources collection (CLA Report 2010). The agricultural sector engages approximately 80% of the labour force and contributes 25% to GDP (National Institute of Statistics 2010). Large proportions (90%) of these labourers are however engaged in the family farm sector which is characterised by a high labour force and low mechanisation grade. Inputs such as tractors, ploughs, pesticides and fertilisers are low and irrigated areas are limited to the larger commercial farms (such as rice, sugar and cotton) (National Institute of Statistics 2010). Productivity per hectare is low and because of limited infrastructure, access to markets is very limited. Most of the small holder farms can only produce enough food for subsistence purposes, while only a few are able to produce enough to sell at the markets. International pricing and changing weather patterns have affected the stability of the agricultural sector over the past decade and restrict the country's ability to gain self-sufficiency in food production.

The following table is a summary of the contribution of coastal resources to national income and poverty alleviation in Mozambique. The estimated total contribution (without regulatory services) to the Mozambican economy is in the order of some **US$650.2 million** (Table 20).

Table 20: Summary of the contribution to national income (million US$) of the different activities and their contribution to poverty alleviation in Mozambique.

Activity		Contribution to national income (Million US$)	Jobs	Contribution to poverty alleviation
Renewable resource extraction	Commercial	63.5	8000	Important – for food and for national income
	Artisanal	292.5	144 400	Extremely important for poverty alleviation
Non-renewable resource extraction		82.5	± 4000	Becoming increasingly more Important – jobs and national income
Coastal Tourism		145	± 100 000	Very important – jobs and opportunities for small entrepreneurs
Coastal agriculture & forestry				Small-scale/subsistence agriculture extremely important. Commercial agriculture – declining employment but important for national income
Mariculture		6.7	± 3000	Important in some areas – jobs and alternative livelihoods
Ports/harbours		60		Important – jobs and national income
Regulatory services		5 028		

7 RISKS AND TRADEOFFS

7.1 Risks to the sustainability of coastal values

Marine and coastal environments in Mozambique and South Africa provide significant value in terms of fisheries and tourism, harbours and mineral resources. In addition they may contribute very high values in terms of the regulating services they provide. The certainty of some of these estimates is fairly low, particularly in the case of fisheries in Mozambique, for which data are fairly unreliable, and the value of regulating services is South Africa and Mozambique, which have been very roughly estimated based on international figures that may or may not be applicable to these coasts. **More detailed studies involving empirical data collection and modelling are highly recommended in order to better understand not only the values generated, but their spatial distribution and their sustainability**. The latter is critical to getting across the urgency of instituting better governance systems in both countries.

Should these systems become degraded, much of this value could be lost, through changes in the ability of the coastal and marine ecosystems to contribute to economic output, growth and poverty alleviation. Marine and coastal environments are becoming increasingly degraded a significant proportion of the world's fish stocks are overexploited or depleted (Pauly *et al*. 2005, FAO 2006). South Africa and Mozambique are no exception. The value of coastal ecosystems in both South Africa and Mozambique are at risk from the proximate threats of habitat degradation and loss, alien invasive organisms, pollution, overexploitation, climate change, sea level rise and hydrological alteration (Table 21). These threats loom large in both countries due to shortcomings in systemic, institutional and individual capacity to manage these threats and ensure the wise use of coastal resources.

Table 21. Proximate threats to the value of marine and coastal resources

Source of risk to coastal value	South Africa	Mozambique
Overexploitation	High, particularly in inshore coastal areas	High, particularly in inshore coastal areas
Habitat degradation and loss	High, due to excessive and/or unplanned coastal development	High, due to excessive and/or unplanned coastal development
Hydrological alteration	Very high – water scarcity in South Africa leading to starvation of water to estuaries and marine environment	Variable – e.g. Low in north, but high e.g. in Zambezi system.
Pollution	Low/Moderate, concentrated around urban areas, ports	Moderate/high, concentrated around urban areas, ports; Being address through development of tanker routes
Alien invasive organisms	Med, some organisms have invaded extensively; Particularly around ports; being addressed internationally	Unknown; Likely to be higher around ports; being addressed internationally
Climate change	Moderate risk of sea temperature changes leading to changes in distribution and productivity	Moderate risk of sea temperature changes leading to changes in distribution and productivity
Sea level rise	High, particularly where coastal development constrains ecosystem capacity to shift	High, particularly where coastal development constrains ecosystem capacity to shift

Overexploitation of resources is one of the more important threats to the value of the coast in both countries. In the long term, human wellbeing can be negatively influenced by overfishing as food availability declines because of fewer fish being available for consumption and increases in fish prices (Pauly *et al*. 2005). Food security is reduced when fishers are forced to fish further offshore and also for extended periods of time due to significant declines in marine resources in coastal habitats. In Mozambique, declines in marine resources because of overfishing, habitat degradation and changing policies all contribute to food insecurity. Some coastal habitats have been converted for other uses, such as mangroves for coastal aquaculture ponds or cage culture for high value species such as shrimp and prawn (Pauly *et al.* 2005). This habitat alteration can have an impact on capture fisheries which depend on these habitats as nursery areas or for various parts of their life cycles. In some cases it has also caused displacement of fishing communities, loss of revenues and social unrest (Pauly *et al.* 2005). Other threats to the productivity of fisheries include hydrological alteration, which has had major impacts on fish and prawn stocks along these coasts, and pollution and alien invasive organisms. The potential impacts of climate change and sea level rise on fisheries productivity are not well understood.

All of threats mentioned in Table 21 are also a potential deterrent to tourists and may lead to loss of tourism value. Tourists are highly fickle and will move to other destinations when one destination loses its appeal. In both South Africa and Mozambique it will be critical to maintain tourism appeal through protection of natural landscapes and resources, in order to retain sustainable development opportunities.

7.2 Value trade-offs

In general, there are tradeoffs between the values derived from consumptive use of resources (e.g. fishing, harbour development) and the values derived from intact ecosystems (e.g. tourism and regulating services). Within these categories, there may be further tradeoffs (e.g. between fishing and harbour development, due to habitat destruction and pollution associated with the latter, and between different types of fishing – industrial, subsistence or small-scale and recreational). Pauly et al. (2005) have highlighted a number of trade-offs and synergies in marine ecosystems, focusing on fishing, aquaculture and tourism (Table 22).

Possibly the biggest trade-offs in both Mozambique and South Africa are between fishing and conservation/ tourism along the coastline. Fisheries and fishery products provide employment for the majority of coastal communities in Mozambique, and many communities in South Africa are dependent on coastal resources for their livelihoods. However, tourism is also an increasingly important employer in both areas. Ecotourism depends on natural, functioning ecosystems and healthy landscapes and tourists want to see and experience wildlife (scuba divers, shark diving, turtle watching, and whale watching). The deterioration of coastal habitats and marine environments from destructive fishing and over exploitation of marine resources negatively impacts on ecotourism and its associated sectors. However, tourism and tourism development along the coast can also have detrimental impacts on coastal and marine environments and their functioning. Marine resources also provide food to poorer coastal communities and in this there is a trade-off between food provisioning and the protection of biodiversity. Tourism in Mozambique has been increasing significantly over the past decade and in provinces like Inhambane is a major contributor to the economy. Mozambique markets itself as an ecotourism destination, as the leading manta-ray and whale shark capital of the world, but at the same time allows the legal catching and selling of sharks and rays (Earthrace Conservation 2011). In order to promote itself as an ecotourism destination, the protection of these charismatic species is needed.

Table 22: Tradeoffs and synergies in marine ecosystems (Source: Pauly *et al.* 2005).

	Extraction		Conservation		Aquaculture		Other
	Bio-prospecting	**Mining, Gas & Oil**	**Tourism**	**Biodiversity**	**Grow-out**	**Farm**	**Shipping**
Fishing	**Minor** tradeoffs if the levels are not excessive and fishing sustainable	**Few** tradeoffs except in immediate vicinity; some gas and oil facilities have provided refuges for fish stocks	**Major** tradeoffs: people enjoy seeing wildlife (especially divers), and lobby for their protection. Can have social consequences if not managed properly.	**Major** & varied tradeoffs. Destructive fishing like trawling: food provisioning traded off against biodiversity, longlining forgoes seabird biodiversity etc.	**Minor** tradeoffs. Fish would be caught anyway, just ensures economic value is realised. However takes away from wild capture fisheries. Potential for coastal communities to improve economically (less time fishing)	**Major** tradeoffs. Genetic dilution & diseases introduced, may provide more high quality fish but less tonnage, reduce the price of wild capture fish, often export oriented, risking food security of developing countries.	**Few** tradeoffs or synergies
Bio-prospecting		**Few** tradeoffs except in immediate vicinity unless areas of mineral, gas and oil exploration also contain organisms of high bioactivity.	**Few** tradeoffs if done with minimal impact or small footprint; strong synergism with ecotourism.	**Few** tradeoffs. String synergism since maintaining biodiversity will maintain bioactivity.	**Minor** tradeoffs. Unless aquaculture introduces diseases that threaten populations of bioactive species. Farms could be used to grow out biologically active species.	**Major** tradeoffs if genetic dilution occurs as well as the introduction of diseases. If produced on large scale could threaten the livelihood of small scale collectors. Provides the facilities for mass production	**Few** tradeoffs or synergies
Mining, Gas & Oil			**Major** tradeoffs. Most tourists seeking natural experience, not high infrastructure & possible pollution.	**Major** local impacts if spill, **minor** if footprint is small & pollution contained. Platform may provide niche for new species to move into area.	**Major** tradeoffs – while the risk of spills on the farms is low, if it does occur the financial and ecological risks are extremely high.	**Major** tradeoffs – while the risk of spills on the farms is low, if it does occur the financial and ecological risks are extremely high.	**Few** tradeoffs or synergies
Tourism				**Minor** tradeoffs. Tourism can leave an impact on biodiversity at the local scale from overfishing, collecting etc. Tourism provides incentive to maintain biodiversity.	The offshore infrastructure and the concept of penned fin may not appeal to many tourists. Also associated pollution with aquaculture facilities as well as with tourism facilities (e.g. diseases in shellfish).	The offshore infrastructure and the concept of penned fin may not appeal to many tourists. Also associated pollution with aquaculture facilities as well as with tourism facilities (e.g. diseases in shellfish).	
Biodiversity						Tradeoffs in terms of the introduction of diseases into wild populations, alterations to population structure, localised habitat alteration, declining food supply for other species that consume small pelagic/krill.	Genetic dilution

Aquaculture in Mozambique is still relatively small but has also seen an increase over the past few years. However, most of the aquaculture that takes place is situated in the central provinces of Mozambique where the river deltas are large and fluvial export high. It is in these areas that tourism demand is not as high, and the trade-off between tourism and aquaculture seem to be minor. However coastal areas altered for aquaculture could have a serious impact on wild capture fisheries and communities along the coast that rely on the mangrove habitats for nursery areas. Overfishing coupled with habitat alteration could have significant negative impacts on the local communities.

Coastal development for harbours, minerals and urban development are traded off against the value of fisheries and/or tourism, but these tradeoffs can be minimised through sensitive development.

8 MAXIMISING COASTAL VALUE – POLICY OPTIONS AND INDICATORS

8.1 Policy objectives and planning

Ultimately, the way in which potential tradeoffs are evaluated depends on biodiversity conservation, social and economic policy objectives, and will usually involve a mixture of these. These need to be defined in very specific terms in order to create clear planning goals. The best way in which to obtain the full range of benefits from coastal resources while minimising trade-offs is through careful spatial planning which allows conflicting types of activities to be separated in a way which maximises overall value. This in turn, requires far more detailed information on the temporal, spatial and distributional aspects of the ecosystem values discussed in this report.

8.2 Governance

Maintenance of the values of the coast, especially the value of ecosystem services provided, depends on a sound system of governance. Both in South Africa and Mozambique there is a critical shortage of capacity to manage coastal ecosystems, and there are shortcomings in the institutional structures in place. Effective, cooperative governance systems that integrate catchment management with coastal development and fisheries management need to be set in place in order to strengthen the management of coastal ecosystems. Co-operative governance will be essential in order to manage the trade-offs involved in coastal management.

8.3 Indicators

Policy indicators are quantitative measures based on monitoring data that are used to measure the trends of complex phenomena (Pinter *et al.* 2004). Economic and policy indicators help with understanding and provide clear answers to questions about changes to the environment and sustainability (Pinter *et al.* 2004). Effective policy is achieved when policy makers are able to understand exactly what is happening and why it is happening. It is therefore important to focus on how the indicators are integrated into the processes of government and policy analyses (Pinter *et al.* 2004). In the case of maintaining or strengthening coastal values in the ASCLME region, the types of indicators that should be considered include:

- Pressure:
    - Overharvesting of resources – e.g. using indices such as Rapfish
    - Habitat loss – e.g. regular mapping of land cover

    - Overdevelopment for tourism, e.g. surveys that include measures of congestion and erosion of tourism attractions
    - Pollution events
    - Environmental flows – continuous monitoring of inflows into estuarine systems
    - Alien invasive organisms – regular surveys
    - Climate change – regular measures of physical parameters

- State:
    - Ecosystem health (similarity of ecosystem characteristics and functioning to natural state), using standard health indices.
    - Ecosystem services - stocks and flows (physical and monetary accounting)
    - Socio-economic status of coastal communities (population, household income, food security)

- Response:
    - Actions taken by state, NGOs and CBOs to strengthen natural resource management
        - Resources, plans, compliance etc

9 REFERENCES

Afonso, P.S. 2004. Review of the state of world marine capture fisheries management: Indian Ocean. Country review: Mozambique. Institute for fisheries research, Mozambique.

Agulhas and Somali Current Large Marine Ecosystems Project (ASCLME). 2009. Project website: www.asclme.org. Accessed April 2011.

Barbier, E.B. 1994. Valuing environmental functions: Tropical wetlands. Land Economics 70: 155-173.

Binns, T. & Nel, E. 2002. Tourism as a local development strategy in South Africa. *The Geographical Journal* **168:** 235–247.

Bourassa, A. 2009. Can the mining/metals sector contribute to sustainable development and poverty reduction? Presented at the Commodities and Development Conference, Geneva.

Branch GM, May J, Roberts B, Russell E, Clark BM. Case studies on the socio-economic characteristics and lifestyles of subsistence and informal fishers in South Africa. South African Journal of Marine Science 2002;24:439–62.

Britz, P. J., Lee, B. & Botes, L. 2009. AISA 2009 Aquaculture Benchmarking Survey: Primary Production and Markets. AISA report produced by Enviro-Fish Africa (Pty) Ltd. 117p.

Brown, K., Daw, T., Rosendo, S., Bunce, M. & Cherrett, N. 2008. Ecosystem Services for Poverty Alleviation: Marine & Coastal Situational Analysis Synthesis Report. University of East Anglia.

Chasomeris, M. G. 2005. South Africa's ports performance: policy, pricing and growth. Department of Economics and Finance, University of Kwa-Zulu Natal.

Clark, B. M., Hauck, M., Harris, J. M., Salo, K. & Russell, E. 2002. Identification of subsistence fishers, fishing areas, resource use and activities along the South African Coast. *South African Journal of Marine Science* **24**: 425–37.

Coastal Livelihoods Assessment (CLA) Report. 2010. Mozambique. ASCLME Programme Report.

Coastal Livelihoods Assessment (CLA) Report. 2010. South Africa. ASCLME Programme Report.

Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R.V., Paruelo, J., Raskin, R.G., Sutton, P. & van den Belt, M. 1997. The value of the world's ecosystem services and natural capital. Nature 387:253-259.

Department of Environmental Affairs and Tourism (DEAT). 2000. White Paper for Sustainable Coastal Development in South Africa. Coastal Management Policy Programme.

Department of Environmental Affairs and Tourism (DEAT). 2010. The Value of the Coast: Sustainable Coastal Livelihoods Programme.

Dicken, M. L. 2010. Socio-economic aspects of boat-based ecotourism during the sardine run within the Pondoland Marine Protected Area, South Africa. *African Journal of Marine Science* **32:** 405-411

Dicken, M. L. & Hosking, S. G. 2009. Socio-economic aspects of the tiger shark diving industry within the Aliwal Shoal Marine Protected Area, South Africa. *African Journal of Marine Science* **31**: 227–232.

Findlay, K. P. 1997. Attitudes and expenditures of whale watchers in Hermanus, South Africa. *South African Journal of Wildlife Research* **27**: 57–62.

Fletcher, W. J. 2005. The application of qualitative risk assessment methodology to prioritise issues for fisheries management. *ICES Journal of Marine Science* **62**: 1576-1587

Food and Agricultural Organisation (FAO). 2006. The state of the worlds fisheries and aquaculture. Electronic Publishing Policy and Support Branch, Communication Division. Report ISBN 978-92-5-105568-7.

Gittinger, J.P. 1982. Economic analysis of agricultural projects: 2nd edition. Baltimore, Maryland, USA: Johns Hopkins University Press.

GlobalData. 2010. Frontier exploration areas in Africa – analysis of upstream fiscal policies and exploration and development plans of key companies. Country Profile: Mozambique. GDGE0844ICR

Hara, M., Maharaj, I. & Pithers, L. 2003. Marine-based tourism in Gansbaai: a socio-economic study. Internal report, prepared for DEAT by the Programme for Land and Agrarian Studies, University of the Western Cape. Cape Town: Department of Environmental Affairs and Tourism.

Heileman, S., Lutjeharms, J. R. E. & Scott, L. E. P. 2009. A comprehensive overview of the Agulhas and Somali Coastal Current LMEs. *The UNEP Large Marine Ecosystem Report: A*

Perspective on Changing Conditions in LMEs of the World's Regional Seas ISBN 978-92-807-2773-9.

Jones, S. 2010. The economic contribution of tourism in Mozambique: Insights from a Social Accounting Matrix. *Development Southern Africa* **27**: 679 — 696

Kashorte, M. 2003. Moving subsistence fisheries to commercial fisheries in South Africa. The United Nations University Fisheries Training Programme. Marine and Coastal Management, Department of Environmental Affairs and Tourism.

Lamberth, S. J., Sauer, W. H. H., Mann, B. Q., Brouwer S. L., Clark, B. M. & Erasmus, C. 1997. The status of the South African beach-seine and gill-net fisheries. *South African Journal of Marine Science*. **18**: 195–202.

Lamberth, S. J. & Turpie, J. K. 2003. The Role of Estuaries in South African Fisheries: Economic Importance and Management Implications. *African Journal of Marine Science* **25**: 1, 131-157

Lizon, J. G. 2002. Rural livelihood dependence on wildlife resources in Gile District, Mozambique and policy implications. IFAD Workshop, Nairobi, Kenya.

Maher, J. 2004. Europa World Year Book. Taylor & Francis Group. pp 2980.

McGrath, M. D., Horner, C. C. M., Brouwer, S. L., Lamberth, S. J., Mann, B. Q., Sauer, W. H. H. & Erasmus, C.1997. An economic valuation of the South African linefishery. *South African Journal of Marine Science* **18**: 203–211.

Millennium Ecosystem Assessment. 2003. Ecosystems and Human Well-being. Washington : Island Press.

Muir, J., Davies, S., Bergh, P-E., Aurell, E., Gleinsvik, A. & Fjose, S. 2009. Identification of potential aquaculture and fish processing investment projects and partners in selected countries in Africa. NORAD Norwegian Development Assistance Agency, Nordenfjeldste Development Services (NFDS) and Econ.

Myeza, J., Mason, R. B. & Peddemors, V. M. 2010. Socio-economic implications of the KwaZulu-Natal sardine run for local indigenous communities. *African Journal of Marine Science* **32**: 399–404.

National Institute of Statistics Mozambique 2010. National Accounts of Mozambique. www.ine.gov.mz. Accessed April 2011

National Oceanic and Atmospheric Administration (NOAA). 2008. The ASCLME Region. www.noaa.gov. Accessed April 2011.

Omar, M. I. V. 2006. Overview of fisheries resources in Mozambique. Presented at the workshop on Fisheries and Aquaculture in Southern Africa: Development and Management, Namibia.

Pan African Research & Investment Services. 2010. A Framework/Model to Benchmark Tourism GDP in South Africa. Tourism South Africa: www.southafrica.net. Accessed April 2011

Pauly, D., Alder, J., Bakun, A., Heileman, S., Kock, K-H., Mace, P., Perrin, W., Stergiou, K., Sumaila, U. R., Vierros, M., Friere, K. & Sardovy, Y. 2005. Marine Fisheries Systems. In Ecosystems and Human Well-Being: Volume 1. Current State and Trends. Millenium Ecosystem Assessment.

Petro SA. 2011. http://www.petrosa.co.za Accessed May 2011

Pinter, L., Swanson, D. & Barr, J. 2004. Use of Indicators in Policy Analysis. Prepared for the World Bank Institute.

Richards Bay Minerals (RBM). 2011. http://www.rbm.co.za Accessed May 2011

Saket, M. & Matusse, R. V. 1994. Study for the determination of the rate of deforestation of the Mangrove vegetation in Mozambique; NDFW, MA, Forestry Department.

Sarmento, L. 2007. Mozambique: an analysis of government incentives for increasing the local economic impacts of tourism. In: Tourism and Development: agendas for action. SNV Netherlands Development Organization.

Sauer, W. H. H., Hecht, T. Britz, P. J. & Mather, D. 2003. An Economic and Sectoral Study of the South African Fishing Industry. Volume 2: Fishery profiles. Report prepared for Marine and Coastal Management by Rhodes University.

Soto, S. J. 2007. National assessment of coastal forest resources in Mozambique. A National review report to be used in the development of the WWF-EARPO Eastern Africa Coastal Forests Eco-region Programme.

South African Government. 2011. South Africa's Energy Supply. www.southafrica.info. Accessed May 2011.

Statistics South Africa. 2010a. Gross Domestic Product. Statistical Release P0441. www.statssa.gov.za

Statistics South Africa. 2010b. Environmental Economic Accounts: Fishery Accounts for South Africa: 1990-2008. www.statssa.gov.za

Suich, H. 2006. Economic valuation of natural resources in Mozambique. Report prepared for WWF Mozambique.

Tourism South Africa. 2010. 2009 Annual Tourism Report. South African Tourism Strategic Research Unit: www.southafrica.net.

Trade and Industry Chamber. 2007. Administered Prices Study on Economic Inputs: Ports Sector. Fund for Research into industrial development, growth and equity (FRIDGE).

Turpie, J. K., Barnes, J. & Wilson, G. 2011. Enhancing the value of protected areas of the Makgadigadi Wetland System through co-management and sustainable financing. Report submitted to the Botswana Department of Wildlife and National Parks

Turpie, J. K., Heydenrych, B. J. & Lamberth, S. J. 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**: 233–251.

Turpie, J.K., Smith, B., Emerton, L. & Barnes, J. 1999. Economic value of the Zambezi basin wetlands. Unpublished report to the IUCN.

Turpie, J.K., Savy, C., Clark, B. & Atkinson, L. 2005. Boat‐based whale watching in South Africa: an economic perspective. Report to DEAT: Marine and Coastal Management.

USAID 2010. Competitiveness of Mozambique's Fisheries Sector. Final Report.

Visser, I. 2004. Sector Report: Tourism. Mozambique Diagnostic Trade Integration Study Volume 2.

Vousden, D., Scott, L.E.P., Sauer, W., Bornman, T.G., Ngoile, M., Stapley, J. & Lutjeharms, J.R.E. 2008. Establishing a basis for ecosystem management in the western Indian Ocean. *South African Journal of Science* **104**: 417-420.

WIOLab. 2008. Transboundary Diagnostic Analysis of Land-based Sources and Activities in the Western Indian Ocean Region

World Travel and Tourism Council (WTTC) 2011. Travel and Tourism Economic Impact Report: Mozambique. www.wttc.org

World Travel and Tourism Council (WTTC) 2011. Travel and Tourism Economic Impact Report: South Africa. www.wttc.org