Agulhas And Somali Current Large Marine Ecosystems Project

Cost/Benefit Assessment of Marine and Coastal Resources in the Western Indian Ocean

Tanzania and Kenya

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DRAFT JULY 2011

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Executive Summary

1.0 Background

Coastal resources refer to the natural resources found in coastal areas, which is useful for human today or in the coming future, these include fish, shellfish, marine mammals, seabirds and other marine organisms (seaweed, coral reefs) land, forests, coastal waters and wetlands, sand minerals, among others (Walters, 1998; Jin, 2002). These resources are crucial and important and the benefits provided by them are both widely recognized but poorly understood by the majority (Daily, 1997). What is increasing clear in the literature, however, is that the natural ecosystems are under enormous pressure around the world due to the growing demands placed on them by economies (Pagiola et al 2004, Walters, 1998). The pressure into the natural ecosystem is coming mainly from the rapid human population growth and prosperity which translate into increasing conversion of natural ecosystems to agricultural, industrial and settlement. This population growth and prosperity not only that will also translate into increased demand for ecosystem goods and services such as fresh water, fiber, fertile soil but also will increase pressure on the capacity of natural ecosystem to assimilate our waste, including air and water pollution as well as solid waste. It is thus obvious that natural ecosystem and their goods and services play a crucial role in supporting the livelihoods of the people and national economies. Yet a report by the Millennium Ecosystem Assessment (2005) suggests that these ecosystems are deteriorating worldwide, and with them the capacity to support human well-being.

It is clearly evident therefore that natural ecosystems and the services they provide are valuable, but may be an important question that often asked is how valuable? This is an important question that needs an answer because other things are valuable as well. However, one of the arguments often cited as the major reasons for our failure to conserve natural ecosystems is that we do not realize how valuable they are. The farmers for example deciding whether to burn a hectare of forest to clear it for agriculture focus on the potential crop yields they may obtain, but pay little attention the many ecological services that would disappear. Likewise the minister of finance often base his/her budget decisions solely on the basis of indicators such as GDP, foreign exchange balances, and tax receipts, in which ecosystems services which appears might only be those with market prices for example timber, logs etc. Perversely, GDP often identifies activities that destroy ecosystems as benefits, for example, cutting forest for logs, increasing fishing intensity, clearing forest to increase agricultural lands, clearing forest to allow mining extraction etc. It is on the basis of these concerns that this study is conceived to value the ecosystem and the services they provide, this will increase our knowledge of the value of ecosystems for the informed policy decisions.
Maintaining ecosystem, whether through protected areas or through other means requires expenditure of resources, and there are often many competing claims on these resources. This will mean that devoting some resources to conservation of natural resources less will be available to address other pressing needs such as improving education, health or infrastructure. It is also true that conserving this natural ecosystem and the goods and services they provide may also involve foregoing certain uses of these ecosystems, and the benefits that would have been derived from those uses. It is obvious each sort of action taken on natural ecosystem will have implications on the other system. To assess the consequences of different course of action, it is not enough to know that ecosystems are valuable, we also need to know how valuable they are, and how that value is affected by different forms of management.

Asking how valuable is an ecosystems? Is also begs the question how valuable to whom? The benefits provided by a given ecosystems often fall unequally across different groups. Recent estimates of the economic value of the marketed and non-marketed ecosystem services of the coastal systems indicate a huge contribution to human welfare from the functions mentioned above plus raw materials, recreational and cultural services (Costanza, 1997). Thus this call for the need to strengthen the abilities of the country in implementing an ecosystem-based management approach (LME) so as to optimize and sustain the benefits for meeting Millennium Development Goals (MDGs) and the targets reached during the World Summit on Sustainable Development (WSSD).

2.0. Coastal and Marine Resources:

2.1 Coastal Ecosystems

Coastal ecosystems are valuable because people who are living both near coasts and those far away depend on them for a variety of reasons to support their well-being. Traditional coastal settlements are generally situated in relation to the availability of natural resources. Beaches resources provide suitable working places and landing sites. More recent developments are also located according to resources: Port facilities occupy natural harbors, tourist hotels are sited adjacent to beaches and coral reefs, and aquaculture sites are situated according to their various biophysical requirements, whereas industrial enterprises are more mobile. The following are some of the coastal resources which the study will look at them in more detail and quantify them where possible.

- Coastal Forests
- Coral Reefs
- Mangrove Forests
- Fish and fish Stocks
- Sea grass Beds
- Beaches

To help support decision making in the sustainable use and management of the resources in Tanzania, it is very important that the economic value of all ecosystem goods and services is recognized, and their contribution to sustainable economic welfare estimated. In this regard, the study will involve undertaking of economic valuation and cost benefit assessment of marine and coastal natural resources in the Tanzania and Kenya coastal land.

Society places values to the natural ecosystem and this value originates from different uses and services the coastal resources provide. Thus, the mainstream economic approach to valuation takes an instrumental approach-which is a usage based- and seeks to combine various components of value into an aggregate measure of resource value labeled total economic value (White, 1998). The figure below characterizes the Total Economic Value (TEV) of the coastal and marine resources. As the Figure summarize the TEV of a coastal resource is the sum of use and non-use values. However, identification is only the first step in assisting the public policy, and what is required is some means of quantifying each element in monetary terms.

2.2 Marine ecosystems

These are among the largest of Earth's aquatic ecosystems. They include oceans, salt marsh and intertidal ecology, estuaries and lagoons, mangroves and coral reefs, the deep sea and the sea floor. They can be contrasted with freshwater ecosystems, which have a lower salt content. Marine waters cover two-thirds of the surface of the Earth. Such places are considered ecosystems because the plant life supports the animal life and vice-versa. We follow here the Millennium Ecosystem Assessment's (MA) definition of ecosystems as dynamic complexes of plant, animal, and microorganism communities and the non-living environment, interacting as functional units. The MA classifies the services that ecosystems can provide into four broad categories: *provisioning services, regulating services, cultural services,* and *supporting services.* These categories illustrate the diverse ways in which ecosystems contribute to human welfare. Marine ecosystems are very important for the overall health of both marine and terrestrial environments. In addition, other marine ecosystems such as coral reefs provide food and shelter to the highest levels of marine diversity in the world. The diversity and productivity of marine ecosystems are also important to human survival and development of a nation through various sectoral linkages like fisheries, fuel/gas production, marine transportation, coastal mining and mariculture. Currently population pressure and human activities have become major threat of marine ecosystem. Therefore there is rise on concern on rehabilitation of marine environment for sustainable development. It was estimated that approximately 60% of the ecosystem services that support life on earth such as fresh water, capture fisheries, air and water regulation, and the regulation of regional climate, natural hazards and pests are being degraded or used unsustainably and harmful consequences of this degradation

could grow significantly worse in the next 50 years. (Millennium Ecosystem Assessment -2005). Therefore there is a challenge to meet an increasing demand of goods and services derived from marine ecosystem while conserving it for a sustainable use. Policies and strategies have been developed both at national and regional level to support in decision making on sustainable use and management of marine ecosystem.
The Agulhas and Somali Currents Large Marine Ecosystem (ASCLME) Project covers nine countries in the Western Indian Ocean region. ASCLME project aim at estimating economic values both use value and non-use values of all ecosystem goods and services and their contribution to sustainable economic development. Knowing economic values of marine ecosystem will enhance its inclusion in the national policy and governance and into a comprehensive Regional Strategic Action Programme (SAP). Then this study aim at assessing the costs and benefits of marine and coastal resources of Tanzania and Kenya. Having the correct information of economic value of ASCLME resources and their contribution will augment its sustainable use. In order to achieve this, in this study the followings have been done

(i) Measure the economic value of key ecosystem goods and services (fishing, fish farming, tourism, etc.) provided in Kenya and Tanzania.
(ii) Analyze the benefits accrued from resources and their contribution to income generation in these two countries.
(iii) Embark an economic risk assessment on marine and coastal resources in Kenya and Tanzania.
(iv) Provide economic analysis of major policy issues related to the coastal and marine ecosystem management in the two countries.

3.0 Objectives

The overall objective of the assignment is to promote sustainable use by identifying the contribution of coastal and marine ecosystem goods and services to the Tanzanian and Kenyan economy.

3.1. Specific tasks are

Undertake cost benefit assessment in Tanzania by:

1. Assessing the total economic value of marine and coastal resources and their contribution to the national economy of the respective countries;
2. Assessing the distribution of economic benefits among different stakeholders.
3. Assess the contribution of the marine and coastal resources towards poverty alleviation;
4. Using the results of the assessment, provide local resource managers with indicators and policy analyses about the economic impact of different governance options for sustainable use of these resources and the economic trade-offs among different uses of the marine ecosystem (e.g., tourism-fish farming, fishing tourism);
5. Increasing capacity for government and other stakeholders in Tanzania to use environmental economics effectively in their decision-making.
6. Compile the final report on Cost benefit Assessment of the marine and coastal resources of Tanzania and Kenya.

3.0 Methodology and Data

This assessment seeks to promote sustainable development in the coastal areas of by providing stakeholders with a powerful economic analysis for decision-making based on the economic value of the marine and coastal resources of Tanzania and Kenya coastal regions. To achieve this, the following will be undertaken in both countries:

- Collect, compile and measure the economic value of the key ecosystem goods and services (fishing, fish farming, tourism, etc.);
- Measure the incomes and other benefits generated by these goods and services and their distribution among stakeholders and between countries
- Undertake an economic risk assessment on marine and coastal resources in these countries
- The study will use the generated information to provide economic analyses of major policy issues related to the coastal and marine ecosystem management in Tanzania.

The major focus of this study will be on the valuation of the major ecosystem goods and services: fishing, fish farming, tourism, marine transport, coastal agriculture, coastal forestry and oil/gas/minerals and estimate:

1. value of ecosystem goods and services; and
2. Net benefits generated by these goods and service both regionally and nationally.
3. The approach will be mainly on the existing information. Further and as stated above, the assessment will utilize the data and information collected during the Coastal Livelihood Analysis as much as possible. This will include among others fishers, boats, gear of different types and so on.

Supplementary data may be collected to fill in the gaps. Such data include for example catch/volume of production of fishing, fish farming and tourism; data on prices, costs, discount rates, wages to fishers etc. The benefits to be analyzed here include total revenues, profits and wages made from each of these activities wherever possible.

The integration of policy analysis with economic valuation is essential to ensure that the project has an impact on stakeholders responsible for, and affected by, coastal and marine management, from government officials to the general public. In this study policy priorities will be identified where economic valuation can make the greatest contribution and develop indicators and analyses to support these priorities. For example, we will quantify the economic trade-offs among different uses of the marine ecosystem (e.g., tourism-fish farming-fishing), or the impact of promoting different segments of the tourism market.

3.1. Theoretical framework for economic valuation

Economists typically classify ecosystem goods and services according to how they are used. The main framework used is the Total Economic Value (TEV) approach (Pearce and Warford, 1993). The total economic value generally includes (i) direct use value; (ii) indirect use value; (iii) option value; and (iv) non-use value. The first three are generally referred to together as 'use value'.

3.1.1 Direct use values

Refer to ecosystem goods and services that are used directly by human beings. They include consumptive uses and non-consumptive uses such as recreational and cultural activities that do not require harvesting product.

3.1.2 Indirect use values

Are the values derived from ecosystem services that provide benefits outside the ecosystem itself. These services often affect activities that have directly measurable values, allowing their value to be estimated.

3.1.3 Option value

Values derived from preserving the option to use in the future ecosystem goods and services that may not be used at present, either by oneself (*option value*) or by others/heirs (*bequest value*).

3.1.4 Non-use values

Refer to the enjoyment people may experience simply by knowing that a resource exists even if they never expect to use that resource directly themselves. This kind of value is usually known as *existence value* (or, sometimes, *passive use value*).

Note: Direct use values correspond broadly to the MA's notion of provisioning and cultural services, while indirect use values correspond broadly to the MA's notion of regulating services. Existence value is part of cultural services.

Direct use values are easier to measure as it is simply using the market price of the product. Recreation is also relatively easy to value as the number of visits is directly observable. Measuring indirect use value is often considerably more difficult than measuring direct use values. While their contribution of ecosystem services to the production of marketed goods and services may be significant, it is often difficult to distinguish it from that of other marketed inputs to production. Moreover, many of these services often do not enter markets at all, so that their 'price' is also difficult to establish. Below we provide the classification of Economic Values provided by the Marine ecosystems.

Table: Classification of economic values provided by the marine ecosystems

Value components		Examples of benefits
Use value (UV)	Direct use value (DUV)	Tourism and recreational benefits, e.g. visits to the beach, swimming and sailing
		Marine resources with commercial value, e.g. fish, shellfish and molluscs
		Human health, e.g. prevention of skin allergies and gastrointestinal disorders
	Indirect use value (DUV)	Marine ecosystem and ecological functioning, e.g. climate regulation, protection of local marine living resources diversity
Non-use value (NUV)	Bequest Value (BV)	Legacy benefits, e.g. heritage of marine living resources for future generations
	Existence value (EV)	Existence benefits, e.g. knowledge guarantee that some marine living resources are not extinct

Source: van den Bergh et al. (2002)

3.2 Valuation techniques of ecosystem

A common feature of all methods of economic valuation of ecosystem services is that they are founded in the theoretical axioms and principles of welfare economics. Most valuation methods measure the demand for a good or service in monetary terms, that is, consumers' Willingness to Pay (WTP) for a particular benefit, or their Willingness to Accept (WTA) compensation for its loss (Hanneman, 1991; Shogren and Hayes, 1997).

3.2.1 Reveled preference methods

It is meant to document actual behavior of individuals and as such considered more empirical than the hypothetical Stated Preference Methods. It focuses on choices people have made in order to estimate value.

(i) Production function (also known as 'change in productivity'): Trace impact of change in ecosystem services on produced goods.
(ii) Cost of illness, human capital: Trace impact of change in ecosystem services on morbidity and mortality.
(iii) Replacement cost (and variants, such as relocation cost): Use cost of replacing the lost good or service
(iv) Travel cost (TCM): Derive demand curve from data on actual travel costs. When using the travel cost method, researchers estimate the economic value of recreational sites by looking at the costs of the trips made by the visitors to these sites.
(v) Hedonic pricing: Extract effect of environmental factors on price of goods that include those factors. Hedonic price estimate economic value of clean air, researchers examine the analysis of house market prices and surrounding air characteristics.

3.2.2 Stated preference methods

(i) Contingent valuation: Ask respondents directly their WTP for a specified service.
(ii) Choice modeling: Ask respondents to choose their preferred option from a set of alternatives with particular attributes.

3.3 Benefits Transfer

Benefit transfer: Use results obtained in one context in a different context. Since contingent valuation is costly, complex and can only be done in a same place then benefit transfer can be used to transfer the value of ecosystem measured in one place of the world to another place basing on people's wealth. *Benefit transfer* is currently popularized and applicable for any of the ecosystem goods and services in question. Its popularity rise due to a low costs and less time consuming in valuation of most of the environmental goods and services. The idea underlying this method is to transfer the biodiversity benefit estimates from original CV studies to the policy site, where no original studies have been done but policy decisions need to be made. However, the validity and accuracy of the estimate results need to be improved.

This study will focus valuation basing on market prices and benefit transfer for non-marketed goods and services provided by ecosystem. The aggregation of goods price is given by their contribution to the gross domestic product (GDP). To calculate the benefit amount, an adjustment of sector GDP contribution is necessary by decreasing production value by the salaries and the other operating costs.

Bp' = Production Value – [Salaries] – [Other Operating Costs]

Due to income variation between one country and another then in doing benefit transfer we specifically use unit value transfer with income adjustment.

Adjusted benefit estimate Bp' at policy site: $Bp'=Bs\ (Yp/Ys)^{\beta}$

Bs primary benefit estimate (e.g. WTP) from study site, Ys, Yp income levels at the study and policy site, respectively β income elasticity of WTP for environmental good.

3.4 Coastal and marine resources and services

Basing on Millennium Ecosystem approach, then valuation of coastal and marine resources will be done basing on four categories which are

(i) Provisioning services; that can be either food or raw materials provision.
(ii) Regulating services; coastal and marine ecosystem can help in climatic regulation and disturbance prevention such as storm protection.
(iii) Cultural services; bequest and existence values of habitats and species.
(iv) Supporting services; nutrient cycling and biologically mediated habitat.

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. And all these values are expressed in US DOLLARS. The Figure 1 characterize the MA approach to Ecosystem Valuation.

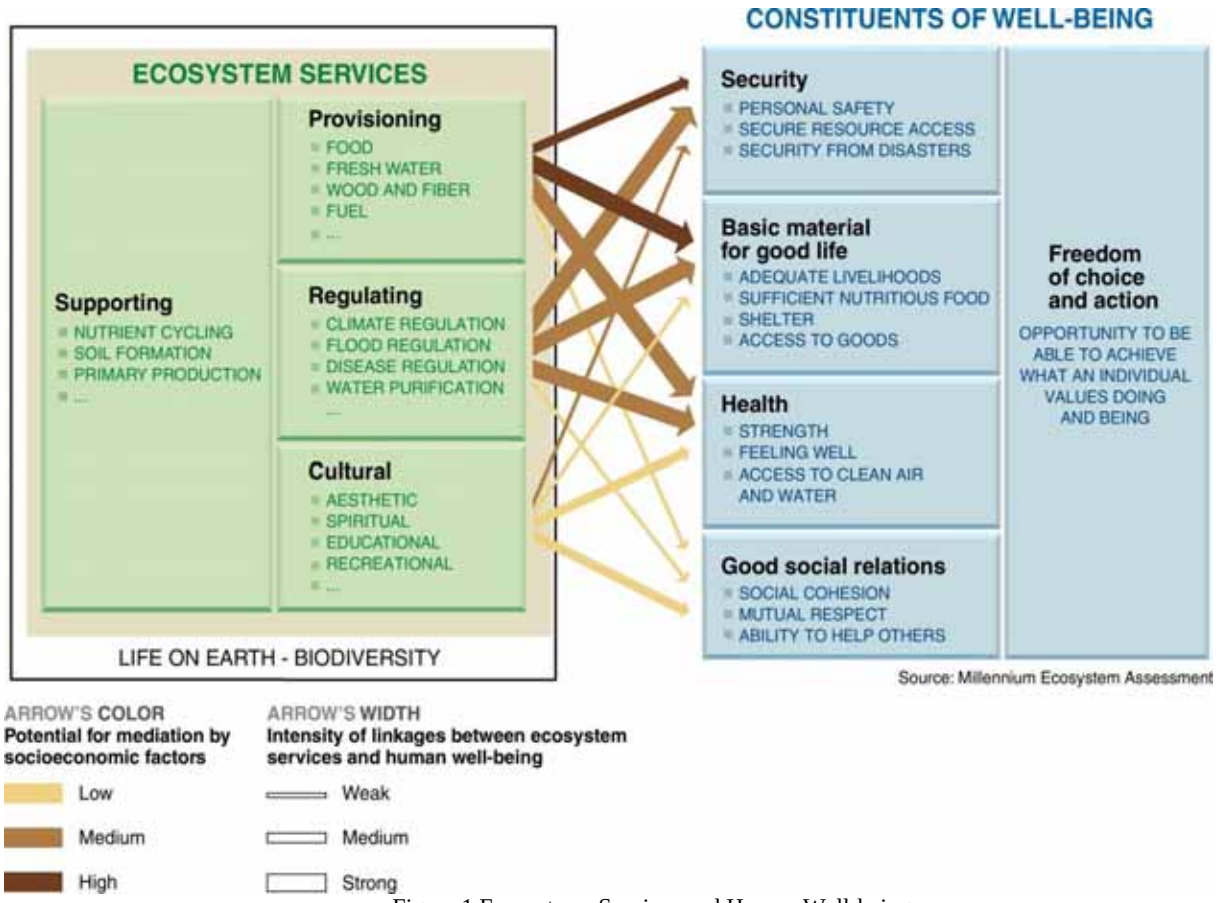

Figure 1 Ecosystems Services and Human Well-being

3.5 Cost-based Approaches

While the benefits from ecosystem can partly be captured through the market, the costs incurred on its cultivation, maintenance, restoration, depreciation and other miscellaneous costs to obtain the timber, non-timber ecosystem products, eco-tourism and other benefits are often not accounted for. In arriving at the monetary value of the ecosystems the important information is that restoration cost are incurred for reproducing the original level of benefits after development of projects like hydroelectricity, irrigation and others. In this report we have considered the fact that certain expenditures are required to prevent

degradation of the ecosystems is hydroelectricity and irrigation projects. Direct expenditure on development projects in ecosystem related services such as irrigation/electricity include land preparation, pitting, planting, watering, fencing, trenching, apart from purchase of seedlings, fertilizers, after care cost, etc. Apart from the direct costs, there are certain indirect costs that are required to be incurred in order to reap the larger benefits associated with ecosystems. Some of these costs would include infrastructure cost for promoting eco-tourism, markets for timber and NTFPs, etc.

The study specifically used cost-based approach technique to estimate the ecosystem services that can be captured in the economic contribution of ecosystem services such as watersheds. Formally, this approach can be described under the following sub components;

(i) replacement cost methods, which measure ecosystem values by estimating the cost of reproducing the original level of benefits with an alternative good or service;
(ii) preventive expenditure methods, which estimate the cost of preventing the degradation of the ecosystem; and
(iii) Opportunity cost approaches, which use estimated production costs of an alternative as a rough proxy for the value of non-market benefits of the ecosystem.

4.0 Study Area Resources

4.1 Tanzania

Tanzania is located on the east coast of Africa, bordering the Indian Ocean, and lies between Kenya to the north and Mozambique to the south. Its total area is 945,087 km2 and this includes the islands of Mafia, Pemba and Zanzibar. Water covers 59,050 km2 of this area and the coastline along the Indian Ocean is 1,424 km. The population of the country is 34 million (2002 census) with a growth rate of 2.6% (2002 est.). The current estimates suggest that the population has reached 41.9million (URT, 2010). The sex ratio is 0.99 male(s)/female (2002 est.). The economy is largely dependent on agriculture, which accounts for about 48% of the GDP, provides 85% of exports, and employs 80% of the work force. Industry is mainly limited to processing agricultural products and light consumer goods. Growth in 1991-2001 featured a pickup in industrial production and a substantial increase in output of minerals, led by gold. Natural gas exploration at Mnazi Bay and in the Rufiji Delta looks promising.

Tanzania is endowed with a scenic, diverse and resource rich coast area. This strip of land and water supports a diversity of important natural systems, including coral reefs, beaches, estuaries, sea grass beds and extensive mangrove stands. It is of crucial to the development of the county. The majority of the coastal communities rely on the coastal resources for their livelihood which is considered as the primary provider of the food and income. It is of immense strategic importance to many social and economic sectors such as shipping, fishing, tourism trade, agriculture, settlements and industrial developments. Of recent Tanzania coastal has experienced a significant increase in coastal tourism, mariculture development and natural gas exploitation. The Songo Songo gas field is preparing to come on line and contribute significantly to the nation's economy. This is just one of several potential gas and oil fields in Tanzania. Other explorations are ongoing in almost the entire coastal lands such as Mafia Island, Mkuranga and so on. Together with this is the significant increase in the demand of coastal land for biofuel production. All these are potential activities in the national economic development and, over time are likely to significantly contribute to gradual improvement of the quality of life of the coastal communities.

Livelihood opportunities for people living along the Tanzanian coastline are changing; coastal areas are experiencing rapidly expanding population, putting ever increasing pressure on limited resources. As farming employment option declines as a result of lack of financial assistance in the agricultural sector, more people are forced to depend on the easy and very common pool of coastal resources, such as; forests, fisheries, shore–land areas, swamps, mangroves and coral reefs which yield money more quickly as compared to the agricultural products. The productivity of these resources is in decline as the environmental carrying capacity decreases due to increased coastal pollution, depletion of fish stocks and coastal resources, extinction of water species and the change in water quality as well as its disruption (SCL Project 2000; Francis and Bryceson 2001).

These economic opportunities need to be developed for Tanzania as a nation and for her people. The coast's untapped potential must be harnessed, but it must be done with the appropriate safeguards that link growth to wise management. The pressures on these resources will grow and, like other countries faced with an expanding poor population, will likely collapse. People's quality of life, which inextricably tied to the resource base, will continue to decrease unless development moves hand in hand with local goals and aspirations.

Demersal fish species is the one dominate the marine catches with a total catch of 22,290tons and a total of 14,014tons of pelagic (fisheries Division, Ministry of Livestock Development and Fisheries, 1999). Main commercial marine species are sardine and anchovy, which together forms 30 - 50 percent of the total fish landing. Other fish species being landed include; Emperors/Scavenger, Snappers, Parrotfish, Carangidae, Rabbit fish, Tuna, Kingfish, Mackerel, Sharks, Rays, Lobster, shrimp Sardines and octopus. The main share of marine catches is landed by small-scale fishers using traditional fishing vessels including small purse-sein nets, gill nets of different sizes, hand lines, long lines and traps. There are about 500 out-board and less than 100 in-board engines. The engines are more often used by a few fishers and on fish collection boats, which are relatively larger than a common canoe. In overall the artisanal marine fishery sub-sector employs more than 29,754 full time fishers, using about 7,190 relatively small fishing canoes.

Tanzania's coastal and marine ecosystems cover the mainland coast, three major habitat islands (Pemba, Unguja, and Mafia) all of which are less than 100 km offshore, numerous small near-shore islands and islets and one oceanic island, Latham Island. The continental shelf, covering an estimated 17,500 – 17,900 km^2 (to 200 m depth) is generally narrow (narrowest point 2 km, widest 80 km), and drops sharply after 60 m depth (McClanahan 1988).

4.1.1 Coastal and island populations

There are five administrative regions situated along the Mainland coast: Tanga, Coast, Dar es Salaam, Lindi and Mtwara, with about 26 administrative districts. There are three major habitat Islands, namely Unguja, Pemba and Mafia. Unguja and Pemba makes up Zanzibar, which is part of the Union of Tanzania. The five coastal regions cover about 15 percent of the country's total land area and are home to approximately 25 percent of the country's population, contain 75 percent of the industries and includes Dar Es Salaam as the country's largest urban center. (URT 2002). The 13 coastal districts on the mainland are, from north to south, Muheza, Tanga, Pangani, Bagamoyo, Kinondoni, Ilala, Temeke, Mkuranga**,** Rufiji, Mafia, Kilwa, Lindi and Mtwara (Figure 2). The increase in population is also reflected in the increase in population density in the country. While the average population density was 14 persons per square kilometre in 1967; by 2002, it had increased to 39 persons per square kilometre (URT 2005). There is huge variation of population in the coastal regions, with the highest density registered in Dar es Salaam region of 1,745 persons/km^2 in contrast however; Lindi region is only 12 person/km^2. In most of the coastal districts, farming and fishing are the primary means of subsistence for the livelihoods of the poor communities.

Figure 2 MARINE FISHERIES RESOURCES OF MAINLAND TANZANIA

4.2 Fisheries

Tanzania is endowed with both marine and inland fisheries. The marine water covers 64,000 square kilometres which includes the Indian Ocean and the Exclusive Economic Zone which covers 223,000 square kilometres. The fresh water includes the riparian shared waters of East African great lakes namely Lake Victoria, Tanganyika and Nyasa. The country has also other small natural lakes, man made lakes, river systems and many wetlands with fish potential. All these water cover 58,000 square kilometres. The country has coastline of about 800 km declared as its Exclusion Economic Zone but has not yet fully exploited. The Exclusive Economic Zone (EEZ) is estimated to be 223,000 km2 and the total coastline is 1,450 kilometers long. The present annual fish catch is about 350,000 metric tons (TAFIRI).

4.2.1 Artisanal Fisheries

The number of fishermen who are permanently employed is approximately 36,297 and many others obtain their livelihood from the sector by being employed in the fishing and fishery related activities. The artisanal fishermen produce about 95% of the total fish catch in the country; only 10% is derived from industrial fishing. The sector makes up 9.9% of fish export worth an estimated $12.4 Million per annum. While its contribution to GDP may appear marginal, (1.6 to 3.1%) the sector is a vital source of food security, employment and income for coastal communities, which subsequently stabilizes the five coastal regions which, when including all sectors, make up 32% of Tanzania's GDP.

The fisheries in the marine waters of Tanzania are highly diverse with different boat types and sizes using a variety of fishing gear types and sizes with different modes of propulsion from paddling, sailing to engines. These boats access different fishing grounds inhabited by different species and sizes of fish, and with differing production potentials resulting from varied historic levels of fishing intensity, and environmental conditions (Table 1).

Table 1 Fish species with their locations

Habitat	**Species**
Intertidal area and sandy beaches	herring, mackerel, and sardines, crabs, cuttle fish, octopus, squid, and a variety of bivalves, barracuda, sharks and rays
Coral reef	Groupers, snappers, mullet, long fin fishes, butterfly fish, parrotfish, surgeonfish, rabbit fish, groupers, and goatfish
Mangrove forests	Crabs, shrimps, milk fish, Shark, ray, skate, catfish
Seagrass beds	Parrot fish, Octopus,
Estuaries	Cat fish, milk fish, needle fish, groupers

Table 2 gives an overview of small scale fisheries statistics for 1995, 1998, 2001, 2007 and 2009 when frame surveys were conducted in marine waters. Fish catches decreased from 2001 to 2008, however, the trend increases by 2009. Trend in exported fish also suggesting a fluctuating behavior with the highest recorded in 1998. According to Fisheries Statistics of 2009, a total of 41,148.26 tons of fish and fishery products were exported to various countries outside the country. The 2007 survey shows that fisheries employ about 36,297 fishers from Tanzania mainland in various sectors such as fishermen, boat building and repair and marketing of fishery products. Various studies suggest that artisanal fisheries along the coast are values at more than US$ 23million per annum. This includes the kind of employment it generates, both direct and indirect, fishing, intertidal collecting and beach netting.

Table 2 **Fisheries statistics of inshore waters**

Details	Results					
Years	**1995**	**1998**	**2001**	**2005**	**2007**	**2009**
Number of Seaweed farmers	NA	NA	NA	NA	5,423	5,579
Number of Fishing vessels	3,768	5,157	4,927	7,190	7,342	7,664
Total number of fishers including foot fishers	13,822	20,625	19,071	29,754	36,247	36,321
Estimated weight of fish in m. tons	48,762	48,003	52,935	54,968.6	43,498 .50	52,231.97
Export (fish & fishery products) m.tons	1,557	4,057	2,142	2,250	2,820.83	1,710.24

4.2.2.1 Octopus fishery

Artisanal fishing for octopus is a highly important economic and subsistence activity for local coastal communities and is extensively practiced in Tanzania, Mozambique and Madagascar (Guard & Mgaya, 2002; Guard, 2003; Humber et al, 2006). Traditionally, harvesting of this marine resource is done by women in the intertidal areas for four to five days in each spring tide. In 1980s, in Kilwa district for example, octopus population was high and distributed all over Kilwa Kivinje and Masoko with the dominant species being *Octopus vulgaris*. Fishing without gear was the most common method to capture octopus by coastal women for local markets and domestic consumption. In the 1990s, the improved marketing conditions and the rising prices for octopus, forced the decline of the catches as it has attracted men into octopus collection both on intertidal flats and by free diving (Fisheries Division undated). Women are the one participating much in octopus fishery and they commonly capture octopus without gear. In 2007 the production of catch totaled to 57,045kg with the annual catch value of US$1.2million.

4.3 INDUSTRIAL FISHERIES

4.3.1 Territorial Waters

Commercial fisheries in Tanzania include fish fillets, prawns, lobsters, crabs, seashells, beche-der-mer, octopus, sardines, shrimp, fish maws, squids and aquarium fish. The total marine fisheries export value was about US$7,652,700 from Tanzania mainland (Jiddawi 1999b). Apart from that, about US$0.5 million were obtained in 2001 in government benefits from revenues from licenses and loyalties.

The industrial fisheries of Tanzania account for about 5 percent of total marine catches. The industry comprises of three vessels that trawl for shrimp and seining for sardine within economical exclusive zone of 220 000 nautical miles. Five penaeid species contribute to the Tanzanian shrimp fishery. The white prawn Penaeus indicus makes up to 66% of the catch, 18% are giant prawn Penaeus monodon and the tiger prawn Penaeus semisulcatus, 15% are brown shrimp Metapenaeus monoceros and the flower. The landings from the commercial trawlers reached about 500 tons (whole weight) in 1970, and then declined to about 200 tons when the joint venture company, New Mwananchi Ocean Products, was disbanded (Bwathondi and Mwaya 1984)**.** This sector is export oriented and export marine products such as tuna, shells, lobsters, crabs, squids, octopus, and aquarium fish. Shrimp production from the industrial fishing ranges between 1 000 tons to 1 500 tons per annum. Most of the shrimp being caught belong to the family penaeidea (including Peneaus indicus, Peneaus monodon and Penaeus semisulcatus). The fisheries are believed to have a total landed value of US$ 7million per annum.

Table 3 Trends of prawn fishery from 1995 to 2005

YEAR	NO.OF VESSELS DEPLOYED	NO. OF FISHING DAYS	PRAWN CATCHES (kg)	PRAWNS CATCH RATE (kg/day)
1995	18	2108	795,436	377.34
1996	12	1779	769,651	432.63
1997	16	2091	699,059	334.32
1998	17	2778	995,564	358.37
1999	17	2252	688,006	305.51
2000	20	3352	909,715	271.39
2001	21	3882	1,193,685	307.49
2002	23	2521	926,079	367.35
2003	25	3664	1,320,056	360.28
2004	25	3037	661,062	217.67
2005	17	1528	467,037	305.65
2006	13	1082	312076	288.43
2007	10	666	202455	304.00

4.3.2 Exclusive Economic Zone

The number of foreign vessels licensed to operate in the EEZ (Mainland and Zanzibar) has increased from less than ten in 1998 to more than 170 in 2004 corresponding to revenue of US$ 3.3 million. 99 percent of the decentralized revenue collection comes from fish levy, with 34 percent originating from marine Fisheries and 66 percent from freshwater Fisheries.

The total revenue collected by the Fisheries sector was close to Tsh.7 billion in 2002/2003 and close to Tsh.9.7 billion in 2003/04. Marine Fisheries in Tanzania are dealt with separately by the Fisheries Departments of Mainland Tanzania and Zanzibar. Therefore, marine Fisheries can in principle be divided into two Territorial Seas and two Exclusive Zones: The EEZ is emerging as an important revenue source for Tanzania and the sector itself. Table 16 below shows various marine Fisheries resources and their estimated value for Tanzania Mainland.

Table 4 Marine Fisheries Resources and their value (Base year 2000)

Fisheries	Type	Total Value in US$	Export value in US$	Remarks
Prawn	Industrial Artisanal	Estimated at 7million per year	5-6 million annually	13-21 trawlers all Tanzania flag. Closed season March-Nov
Artisanal	Artisanal reef and inshore, crustaceans	Estimated at 23.5 million per year	5.5 million	Up to 13,000 traditional fishing vessels
EEZ/Off-shore	Industrial –large pelagic	Unknown	1.9 million	Boats from far East and the EU. Most do not land in Tanzania and records are incomplete.

(Source: Fisheries Department)

There is scant information on the Exclusive Economic Zone (EEZ) Fisheries in the Tanzanian territorial seas. Of the approximately 25 industrial boats fishing the EEZ in any given season, only four land in Tanzania (Dar es Salaam) and the fishing states supply only limited information on the fish removal from EEZ and their value. Although the FD closely monitors these registered vessels, they only represent about one sixth of the entire fishing effort. It could be surmised from the figures that are available from the FD that the potential value of the fishery is about US$ 12 million per annum but this is not substantiated by scientific research.

In 2004 the fisheries recorded anomalous catches which occurred all over the western Indian Ocean, in particular a small area in eastern Africa. The fish caught were of large sizes (100-150 cm). The catch from the EEZ has been fluctuating in the range of 280,000-350,000 tones per year. In year 2003 catch was 400,000-450,000. The average catch over the last five years was 326,000 tons (Chopin 2005) Evidence suggests that 2004 was an anomalous year for tuna Fisheries with a significant shift in effort benefiting Tanzania as the fish moved into the EEZ.

Table 5 Estimated catches and Values from EEZ

	Estimated Catch	**Estimated Value of Catch**
Longliner		
Total Fleet	900-18,000 tons out of which 4,500-8,800 tons tuna and billfish	US$ 47.6-254.6 Million
Per vessel per year	70 tons tuna and billfish and 150 tons of other species	US$0.39-2.06 Million
Total Fleet	26,000-32,800 ton of tuna	US$ 27.6-85.6 Million
Per vessel per year	900-1,000 ton	US$ 0.67-2.09 Million

Source: Chopin, 2005) Based on average annual price for tuna for the ***Sashim*i** Market and canning

4.4 Revenue from Marine Fisheries

The greatest potential for increasing government revenue from fishery is in the licensing of vessels to fish in the EEZ. The FD started issuing licenses to foreign vessels in 1998, mainly to European tuna seiners and Asian long liners.

The license period ranges from a month to one year. The cost of a license depend on its duration, but the following general rules apply:

- The annual license fee is set at US$ 18,000-30,000;
- The registration fee is set at US$ 2,000;
- A license can be issued for a period of 1 month, 3 months, 6 months or one year; and
- Where the license period is less than one year, the license fee is pro-rated but the registration fee remains fixed at US$ 2,000.

Since licenses were introduced in 1998 the numbers of foreign vessels fishing Tuna and Tuna like big pelagis has risen rapidly. In 2004 the total number of registered vessels was 171 of which 41 were tuna seiners and 123 longliners. The mainland issued 85 licenses and Zanzibar 86 (mainly to longliners from the Far East). Increased control and compliance in 2004 have increased the number of licenses and reduced illegal fleets. In 2004 the total revenue from license fees that accrued to the Tanzanian FD was US$ 3.3 million (171 licenses @ US$18,000). This is not even reflecting the total amount that the government could earn. Expert's estimate that the real catch is most likely much higher than what has been assumed as a basis to set the license fees (between 200 and over 400 tons a day per boat). Notably, there is no catch based license or fee, and the vessels are allowed unlimited catch once they are in possession of a valid license. In addition, the Government earned US$ 300,000 in license fees from Tanzanian Flag Prawn Trawlers (there are 25 with a license fee of 16,000 US$).

Table 6 **Contribution of fish to household subsistence in coastal areas**

Activity		**Percentage of Households engaged in activity (Total Sample size 749)**
Marine Fauna	Fish	47.4
	Crustaceans	15.6
	Sea cucumbers	4.3
	Mollusks	2.4
Seaweed Farming		25.9
Farming –Various crops	Cassava	50.1

	Bananas	32.7
	Rice	27.5
Farming-Agroforestry	Coconuts	14.7
Livestock keeping	Poultry	12

Source: Ruitenbeek et al (2005)

While commercial Fisheries, in particular in the EEZ, represent potential for economic growth, the impact on poverty reduction depends crucially on how the license revenue earned by the Government is translated into benefits for local people. The effect of Fisheries Agreements on poverty reduction will depend on the creation of economic 'spin-offs' and associated development activities.

These are expected to be negligible as no fish is expected to be landed ashore and few supplies will be sourced from the country. It is for example unlikely that foreign vessels will employ Tanzanian nationals as crew in addition to what is stipulated in the Fisheries Agreements. If none such 'spin-off' effects are created, the net impact of commercial Fisheries on poverty reduction may be negative, provided that it competes with artisanal Fisheries over the same resource. The sector provides a potential source of direct and indirect employment if transhipment could be done in the country. At present Tanzania do have the requirement for licensed vessels to enter the Tanzanian ports or land part of their catch, also there is a provision that wherever there is transhipment, should be carried out in Tanzanian ports, but so far the requirement has not being rigorously enforced, as none of the vessel from the EEZ come to the Tanzanian port for inspection, thus making inspections particularly difficult to undertake and the threat of misreporting very high. This has denied the country substation benefits –this leads to a loss of secondary income –income from processing and re-export, port revenues, service revenues, transport and employment –which is both loss of value added income to the population, affecting their standard of living, and loss of tax revenue for the country. Thus this study could not establish the actual financial benefits which could be earned by the country if transhipment was done in the country, but is obvious is substantial amount. Tables 7 and 8 summarize some details of the gross rent earned form the tuna seiners and longliners

Table 7 Estimation of Gross resource Rent for Tuna Seiners

Gear type	Tuna seiner				
Fleet catch (t)	8,000	16,000	24,000	36,000	48,000
No. Vessels buying licenses	39	39	39	39	39
No. vessels fishing in the EEZ	39	39	39	39	39
Days spent in the EEZ	25	25	25	50	50
Nominal fishing effort	975	975	975	1950	1950
Vessel Catch per day (t)	8.2	16.4	24.6	18.5	24.6
License fee (US$/t/yr)	17,550	17,550	17,550	17,550	17,550
Registration fees (USD)	1,950	1,950	1,950	1,950	1,950
Compensation	0	0	0	0	0
License fee paid (US$)	760.500	760,500	760,500	760,500	760,500
Gross Fee per tonne (US$/t)	95,063	47,531	31,688	21,125	15,844
Revenue from Seining @ 910 (US$/t)	7,280,000	14,560,000	2,184,000	3,315,000	43,680,000
Revenue from seining @1040 (US$/t)	8,320,000	16,640,000	24,960,000	37,440,000	49,920,000
Revenue from seining @1,170 (US$/t)	9,360,000	18,720,000	28,080,000	42,120,000	56,160,000
license as % of value @ 1,040 (US$/t)	9.1%	4.6%	3.0%	2.0%	1.5%

Source: Chopin, 2005)

Interpretation: The gross resources rent ranges from 9.1 percent for 8,000t catch to 1.5 percent for 48,000 tons catch. The 5 percent gross resource rent is reached when the catch is limited to 14,300 tons.

It can also be reached by increasing the license fee to US$ 42,000 and allowing a total catch of 28,000 tons.

Table 8 Estimate of Gross Resources Rent for Longliners

Fleet catch	9225	18,450
No. vessels buying licenses	123	123
Days spent in the EEZ	50	100
Nominal fishing effort	6150	12,300
Vessel catch per day ton (tunas)	0.5	0.5
Vessel Catch per day ton (Others)	1.0	1.0
License fee (US$/tonne)	0	0
License fee (US$)	1,775	1,775
Registration fees (US$)	195	195
Compensation	0	0
License fee paid	2,878,200	2,878,200
Gross Fee per tonne (US$/tonne)	312	156
Revenue from fishing (@ 9,750 US$/t)	89,943,750	179,887,500
Revenue from Seining (@ 11,050 US$/t)	101,936,250	203,872,500
Revenue from seining @ 12,090 US$/t)	111,530,250	223,060,500
License as % of value (@ 9.750 US$/t)	2.8%	1.4%

Source: Chopin, 2005

Interpretation: To reach a 5 percent gross resource resnt, the catch would either have to be limited to 4000 tons or the license fee increased to US$ 42,000 allowing a total catch of 9000 tons.

4.5 Occurrence of non-traditional fish: The Coelacanth

The history of Coelacanths in Tanzania started in September 2003, when a single fish was caught off the coast of Songa Mnara near Kilwa by deep-set gillnets. Since then more than 35 captures of Coelacanths have been reported by rural fishers in the fishing villages of Kigombe, Mwarongo and Mwambani, South of Tanga, Mtwara, Lindi and Dar es Salaam using deep-set shark gill nets (locally called Jarife) (NEMC 2010). The unprecedented catches of coelacanths in Tanzania especially in Kigombe in Tanga have called for urgent measures to stop catches of this highly endangered species, both from within Tanzania, including calls by the President of the United Republic of Tanzania, His Excellency the President Jakaya Mrisho Kikwete, local conservation agencies, and from the international communities. Coelacanths are rare and endangered species and there is a need for a national conservation strategy to protect the population of this fish and its habitat.

4.6 Mammals

Whales, dolphins, dugongs and porpoises are some of the marine animals which frequently occur in the marine coastal waters of Tanzania. Eight species of dolphins have been observed in various places including the Rufiji delta, Mtwara, Tanga, Saadan, Lathan Island, Menai bay, Nungwi and Matemwe. Humpback Whales have also been observed near the coast of Tanga and Mnazi Bay.

4.6.1 Dugongs

Until recently, dugongs were thought to have already disappeared from northern Tanzania (their former stronghold), their presence in the south was unknown and the entire Tanzania coast was highlighted as a priority area for research (Marshall *et al.* 2001). The first documented photographic records were of 3 animals netted by local fishermen from Mafia Island in 1930 (Dollman 1933)**.** Ray (1968) identified Rufiji and Kilwa as the last remaining refuges for dugongs along the Tanzania coast.

Prior to the mid-1970s, dugongs were both abundant and widely distributed along the Tanzania coast. At this time they were actively hunted in some areas using deliberately fashioned "dugong nets" and

occasionally dynamite. Over the past 25-30 years dugong numbers have declined dramatically and sightings are now rare. Interviews with fishermen during the 2003 survey, yielded just 38 reported sightings since the start of 2000 (31 incidental captures and 7 live). Small resident populations are reported to exist in just two remaining areas: the Rufiji-Kilwa-Mafia area and at Moa in Tanga region, near the Kenyan border. That dugongs do still occur in Tanzania waters was confirmed on 14 January 2004 when a dugong drowned in a gillnet off the Rufiji Delta was handed over to government officials on Mafia Island. In Rufiji-Kilwa, dugongs were reported to move into channels of the Rufiji delta, possibly to calf, during the southeast monsoon from May-August when sea temperatures are lower. During the inter-monsoon months (October and November) when the sea is calm and the water clear, dugongs can sometimes be seen in the shallow bays and sea grass beds in the southern part of the delta reference?.

4.5.2 Marine Turtles

Five species of marine turtles occur in Tanzania's waters. These are the green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), loggerhead (*Caretta caretta*), olive ridley (*Lepidochelys olivacea*) and leatherback *(Dermochelys coriacea)* turtles. The first studies on the status, distribution, uses of and threats to turtles in Tanzania were conducted by Frazier (1976, 1980). However, it was not until the early 1990s that more widespread efforts to conserve turtles were made, and only more recently in some areas such as Mafia, Pemba, Unguja, Saadani, Temeke and Mtwara, that more comprehensive, longer-term surveys have been conducted.

The most important nesting sites in Tanzania are Misali Island, off Pemba, and Mafia Island. On Misali Island, 42 hawksbill nests were recorded between 1998 and 2002, peaking during the month of March, while on Mafia Island, 30 hawksbill nests were recorded between 2001 and 2008, of which 16 were laid on Shungi-mbili Island in the North West and 14 on the east coast at Juani and Kungwi. The main nesting season is during the northeast monsoon between December and April. Although no animals bearing tags from other countries of the region have been recorded, the hawksbill is a migratory species so it is probable that Tanzania harbours both residents and migrants (Muir 2005).

Tanzania harbours extensive seagrass beds and coral reefs which can support considerable numbers of turtles (Howell and Mbindo 1996). The extensive seagrass beds off the southern Rufiji Delta (Kichinja Mbuzi and Toshi) including Mohoro Bay (Fungu ya Kasa) are reported by local residents to be important feeding grounds for green turtles. On Mafia Island, immature and adult green and hawksbill turtles are seen regularly by recreational divers in Chole Bay and along the east coast of Juani Island where seagrass and corals occur. Off Ras Kisimani on the west coast of Mafia, green turtles have been observed digging pits in the sand at a depth of 10-15 meters where they appear to nest (Muir 2005). These areas are within the boundaries of Mafia Island Marine Park.

In Mtwara, records of turtle sightings from dive surveys and questionnaire surveys indicate that important turtle foraging habitats exist in Mnazi Bay and off Msimbati (Guard 1998, Muir 2003). In Zanzibar, green and hawksbill turtles are regularly sighted by divers at Nungwi and the coral reefs around Mnemba Island. The main turtle developmental habitat, where small and immature green and hawksbill turtles concentrate, is Uroa in the Central District of Unguja. The area comprises of seagrasses, corals and algae and, as late as 1996, was unprotected. The reefs off Zanzibar are also reported to be important feeding grounds for loggerhead and leatherback turtles (Khatib *et al.* 1996).

4.5.3 Birds

The avifauna of Tanzania includes a total of 1108 species, of which 23 are endemic, 4 have been introduced by humans, and 43 are rare or accidental. There are 36 species which are globally threatened. A wide variety of coastal birds and seabirds are found particularly in mangrove forests, intertidal flats and on rocky cliffs. Waders and shorebirds visit United Republic of Tanzania in large numbers each year between August and May to feed, particularly on intertidal flats at low tides. 10 Important Bird Areas (IBAs) have been designated by Birdlife International along the coast of Tanzania (CLS 2010).

4.6 Coastal Agriculture and Forestry

Mangrove forests in Tanzania occupy about 225,000 ha which is about 0.3% of the forest cover in the country (Mariki, 2000). Of these, the Rufiji Delta, located about 150 km south of Dar es Salaam, contains the largest continuous block of mangrove forest in East Africa, comprising some 53,000 hectares. This delta also supports the most important fishery in Tanzania's coastline, accounting for about 80% of all shrimp catches in the country. The Delta is home to about 41,000 people, many of whom are small farmers and traditional fishers. Up to the mid 1990s, exploitation of mangroves for poles (for construction) and bark (for tannin extraction) for export was common in the region (Mainoya, et al, 1995). Significant income in foreign exchange encouraged the exploitation of mangroves. For instance in 1979 Tanzania earned 4 million Shillings in foreign exchange after selling 30,000 scores of mangrove poles (Havnevik, 1980 in Mainoya, et al, 1995). A more recent study on mangrove exploitation in the Rufiji Delta has revealed uncontrolled harvesting of mangroves logs and poles that are cut for commercial and domestic use within and outside the areas. This is vivid at the following places Kikale, Konde, Chaka Nganuni A & B, Kifuruni and Mnyali areas (TCMP/STWG, 2003).

4.6.1 Coastal Agriculture

Agriculture and forestry is the country's leading sector, employing 82% of the population, contributing 45% of GDP and 60% of total export earnings. The sector employs three million people, with forestry alone accounting for 4% of GDP, making up 10% of foreign exchange earnings equal to 14 million USD annually. Subsistence farming is, however, the most dominant form of income generation in the coastal zone, thus, any increases in unemployment are expected to place further strain on the region's natural resources. Fuelwood also accounts for more than 92% of the country's energy use, also placing extensive strain on the country's coastal forests.

Coastal agriculture in Tanzania is similar to agriculture in other areas of the country. It is rain-fed and dominated by smallholder farmers typically cultivating farms with an average size of between 1 and 3 ha. The main food crops produced include cassava and maize; rice is also cultivated in river valleys and flood plains**.** Cash crops include sisal, coconut, cashew, cardamom, cotton, fruits and horticulture. Women constitute the bulk of the agricultural labour force, while practices such as slash and burn have resulted in soil erosion and subsequent sedimentation of coastal waters (Wio-Lab 2008).

4.6.2 Mariculture

Mariculture is clearly a vibrant sector in the Tanzanian economy, with finfish, seaweed and mudcrab being farmed in all coastal regions, and pearls and prawns also being farmed in Mafia and Tanga,. Regulation and infrastructure development has lagged behind in this sector, however, high quality seawater, large numbers of candidate species and existing research and support capacity highlight the untapped potential in the sector.

4.7 Coastal Forestry

Forests in Tanzania, including Coastal Forests, have been protected by the Forestry and Beekeeping Division of Government, through a network of Forest Reserves. In the definition of coastal forests adopted, do not include mangrove forests. The Coastal Forests of Eastern Africa, of which 40 percent is in Tanzania (WWF, 2009), epitomize the difficulties of maintaining biodiversity values in the tropics, in that they show virtually all of the conservation problems faced by conservation planners and protected area managers. The main features of the coastal forest is that they are small, and highly fragmented, consisting of many (over 150) separate forest patches, most of which are less than 500 ha in size, and few of this forest are protected by government agencies. More recent studies by Burgess and Clarke (2008) using remote sensing technology indicated that in 1980 the coastal forests of Tanzania covered an area of 617,562ha.

In order to provide functional values of ecosystems in the coastal resources, this report estimate the role of the ecosystems of the coastal resource in the global carbon cycle and their value in terms of hydrological cycle. Given the complexities in arriving at money value of this sort of ecosystem values, attempts have been very successful in using loss in economic activity avoided by conserving the resource as proxy values. In the case of the global carbon cycle, avoidance of the impact of future climate change through the build-up of atmospheric greenhouse gases; and watershed protection, the offsite and onsite costs of soil erosion, which inevitably occurs when forests are lost in critical upland areas, are used as proxies.

In terms of carbon, the study estimates the carbon sequestration benefits of ecosystem conservation in the basin based on the local and international parameters existing. It will be recalled that in order to estimate the carbon storage in forests, and hence the fluxes involved in the loss of forests, several methods are available, such as extrapolation from experimental plots and modeling from inventory data. Using inventory data, it is possible to estimate the above and below ground biomass of regional areas (see Brown and Lugo, 1992; Fearnside et al., 1993).

In addition to the high biodiversity values of the coastal forests, they are also important because of their many and varied uses to people. Coastal forests are used as a source of medicinal plants, fuel wood, building materials, food and they help to maintain a regular water supply for towns and villages. They play an important role in reducing soil erosion, maintaining ecological cycles and micro-climates and carbon sequestration. Several studies now exist attempting to put a money value on carbon sequestration services of the forests. The findings show that the value of avoiding the carbon fluxes associated with changing land use range from $650 to $3400 per tone (equivalent to $20 to $100 per ha per year), depending on the forest type and the subsequent land use (Brown and Lugo, 1992; Fearnside et al., 1993). For the purpose of this study again we adopt the conservative estimates by taking the average values, which will imply US$60 per ha per year. Hence with a total area of 617,562ha of coastal forest, this will translate into US$ 37,053,714 per annum as the economic and social value of the coastal ecosystem in terms of avoiding carbon fluxes associated with changes in land use. This figure is arrived by taking into account commercial products such as timber, beeswax, honey, fuelwood, poles, charcoal, wattle-bark, wild fruits etc.

4.8 Existence Values

Existence value derives from the knowledge of a resource's continued existence, independent of any use. There are several plausible underlying motivations for existence value which have been widely covered in social science literature (Randall and Stoll, 1983 for example). From the methodological standpoint, measurement of existence value is perhaps the least tractable and most contentious aspect of natural resource valuation. The available developed country evidence (summarized in Pearce, 1993), suggests that non users have typically indicated values in the range US$1.2 - 64 per annum per person for wild species, while per annum WTP for scenic and wilderness areas range between US$9 and $107. To estimate this value for forests in our study area, we used data from a synthesis of global economic values of forest ecosystems. This synthesis indicates considerable variability in estimates of existence value for various forest regions, which is associated with differences in both methodology and attributes of the forests that were valued. We chose to be conservative and therefore selected a value of US$5/ha per annum for household WTP for the existence of forests in the area, a value based on debt-for-nature swaps for all tropical forests. We assume that the forests in our region are representative of tropical forests in general, and that they would qualify for additionality based on rapid conversion rates outside protected areas. On the basis of this evidence, indicative per hectare values would appear to be in the range (0.03 - 10.4 US$ ha-1). Multiplying the upper bound of that range over the extent Coastal forests (approximately 617,562 hectares) provides a conservative estimate of US$ 6,422,643.

4.9 Mangrove Forests

Coastal mangrove forests cover a total area of about 115,500 ha. The mangrove ecosystem is rich in molluscs, several species of which are gathered by women and provide an important source of protein in

the local diet, while commercial fisheries are also directly dependent on the mangrove ecosystem. It is estimated that over 150,000 people in Tanzania earn their living directly from mangrove resources. Mangrove exploitation for poles for construction and bark (for tannin extraction), both for export, was common in Tanzania up to the mid-1990s (Wio-Lab 2008).

Coastal communities use mangroves to supply local needs for fuelwood, charcoal making, fences, house construction, boat building, fish traps, fish stakes and for medicines. Overall, it is estimated that over 150,000 people make their living directly from mangrove resources in Tanzania (Saada 2005). The largest mangrove forest within URT as well as in Eastern Africa is in the Rufiji Delta, which also receives sediment load from the river. Commercial fisheries of crabs, prawn and fish are directly dependent on the mangrove ecosystems thus the two main prawn fishing grounds are areas adjacent to the Rufiji Delta and Bagamoyo. Likewise the fishing for crab is an important activity in the Pangani river mangroves. The potential catch of the large mangrove crab (Scylla serrata) was estimated to be 5 – 10 tonnes wet wt/month in Pangani and in 1989 the price of the crab was TShs. 75/Kg (Semesi and Mzava 1991). Today the price of the crab is ranges from 2500-6000/kg. Thus increasing even further the existence value of the mangroves forest. The direct value of the mangrove habitat which includes values for the fuelwood, timber and poles and wood products, the animals and birds and the honey it provides, was estimated to be US$ 0.9 million per year (Turpie 2000).

4.10 Coral reefs

Coral reefs support one of the most productive and diverse marine ecosystems in Tanzania waters and, with their associated habitats support a variety of marine species. Over 500 species of commercially important fish and other invertebrates are commonly found here. It is estimated that 95% of artisanal fishing, which employs over 50,000 full time fishermen, is carried out on coral reefs and that they support over 70% of the artisanal fish production in Tanzania (Saada 2005). It is estimated that a sustainable yield harvest of 15 tons of fish can be obtained per km^2 of coralline areas in depth of less than 30 m (Munro and Williams 1985). Thus with 3,580km2 it would suggest that about 340 tons are harvested annual from the coral reefs. With approximately US$ 1000 per tons this will translate into US$ 340,000 per annum.

4.11 Seagrass Beds

Seagrass beds are highly productive and serve many ecological functions. Seagrasses form dense beds that cover large areas of sandy or muddy coastal bottom, from the mid tide mark to a depth of 20m or more. Twelve of 50 species of seagrass that are found worldwide occur in the URT (*Cymodocea rotunda, C. serrulata, Cymodocea sp., Enhalus acoroides, Halodule wrightii, H. uninervis, Halophila minor, H. ovalis, H. stipulacea, Syringodium isoetifolium, Thalassodendron ciliutum* and *Thalassia hemprichii)* (Whitney *et al.* 2003). The most dominant species are *T. ciliutum, T. hemprichii* and *S. Isoetifolium* (Francis *et al*.2001). Usually several seagrass species occur together in mixed vegetation that forms extensive meadows. Their importance results from their ecological interactions with other ecosystems in the marine environment, especially mangroves and coral reefs, and in their wide range of physical functions (Saada 2005). Sea grasses are associated with nitrogen fixing microorganisms and support complex food webs through dead and living biomass and thus among other services, they provide breeding, nursery and feeding areas for a number of invertebrates and vertebrate species including commercially important species of finfish and shellfish (Wells *et* al. 2004). Moreover, seagrass roots filter and bind sediments and thus prevent sedimentation over coral reefs hence protecting the shoreline from erosion (Saada 2005). Recent studies of dugong's distribution and migrations along the Tanzania coast show that they are associated with areas of extensive seagrass beds particularly the Rufiji delta, Mafia Kilwa areas which have a viable population in the country (CLS 2010).

Table 2 Valuation of Ecosystem Goods and Services in Tanzania

Coral Reefs		Mangroves		Coastal Forests		Total
Area(km2)	Value (Million US$)	Area(km2)	Value (Million US$)	Area(km2)	Value (Million US$)	Value (Million US$)
3,580	2,175	1,250	1,249	700	141	3,565

Source: Wio-Lab 2008

4.12 Tourism

The sandy beaches have become centers of tourist activities more in recent years. Many tourist hotels have mushroomed along the cost (Zanzibar and Mainland) and more are being built. In other areas not yet exploited, such as Bagamoyo, the potential exists for expanding the tourist attractions into the mangrove reserves south of Mlingotini to Changwehela. These reserves are bound by excellent sandy beaches and a large lagoon with wide areas of mud flats. Suitable camping sites are found both within and near the border of the mangroves. Since they are easily accessible and within an easy drive from both Bagamoyo and Dar es Salaam city they are excellent sites for educational and eco-tourism. Tourist activities are important for the national economy as it is a major source of foreign exchange and is becoming increasingly important. Reef based tourism is becoming an increasingly important economic activity on the coast of Tanzania mainland, Unguja, Pemba and Mafia. Associated with this are coral and shell jewelry, tourism curios, and marine ornamentals. Collection and export of coral reef animals creates jobs and income for the coastal communities. Between 1992 and 1999 the number of tourists increased three fold, illustrating the growing exposure of the country to foreigners as well as the increasing percentage of foreign exchange contribution to the country's GDP from Tourism.

Currently, coastal tourism is said to be rather undeveloped along the mainland coast and near shore islands. This is largely due to inadequate infrastructure along the coast, as well as government and investor focus on wildlife tourism in the Northern circuit and Zanzibar. Capacity constraints and poor infrastructure and service connections in the mainland have challenged the existing tourist potential for the coastal region despite its several attractions such as the unexploited beautiful beaches and diverse marine life and features. Most of the rural coast is thus almost unexploited. Potential areas include Mnazi Bay in Mtwara and Pangani area. A number of hoteliers have shown interest in investing in such areas (CTWG, 2002). Existing coastal tourist hotels are concentrated in Dar es Salaam and Bagamoyo and mainly cater for conference and business tourists as well as resident (weekend) tourists. These are medium sized hotels having between 40-70 rooms. Small clusters of hotels can be found in Pangani,

Tourism in Tanzania plays a vital role in the country's economic development. It is one of the major sources of foreign exchange. The sector accounts for 17.2% of the GDP and nearly 25% of total export earnings. It directly supports an estimated 288,700 jobs[i] (TTB, 2008). Foreign exchange receipts from tourism grew from US$259.44 million in 1995 to $1,269.68 million in 2008. Tourist arrivals have shown a steady increase from 295,312 in 1995 to 770,376 in 2008 (MNRT, 2008). USA, UK, Italy, Canada, Australia, Netherlands, Sweden, France, South Africa, India and China, remain to be the major tourist source markets for Tanzania.

At a macro level tourism has been consistently contributing to employment and GDP and hence positively affecting the macroeconomic conditions of the country. The GDP contribution averaged an impressive 15 percent a year from an average growth of international tourism arrivals of 6.8 percent during this period. At the same period for every 1 percent increase in tourist arrivals the GDP grew by an average of 2.2 percent (Scott, 2009). At the micro level the importance of tourism to the Tanzanian tourism industry is reflected within various planning and policy documents. The Rural Development Strategy identifies tourism as a key tool in rural poverty alleviation, advocating that "the rural economy is linked to the new engines of economic growth, particularly tourism," in order to stimulate "pro-poor growth".

List of standard accommodation facilities are presented in the table belowIn addition to these clusters of hotels and guesthouses in urban areas, a number of smaller hotels and guesthouses are scattered along the coast, primarily in and around Pangani, Kilwa and on Mafia Island. Local guesthouses are scattered throughout the rest of the coast, including Muheza, Mkuranga, Rufiji and Lindi. At Lindi one luxury beach hotel is operational.

Table 1: Distribution of Coastal Accommodation Facilities

Region	Number of Rooms		Number of Beds		Number of Staff		No. of Establishments	
	2006	2009	2006	2009	2006	2009	2006	2009
Dar es Salaam	4,412	6,123	5,873	9,230	3,852	5,282	107	170
Coast	568	1,341	866	1,446	687	970	18	40
Tanga	449		730		300		39	39
TOTAL	**5,429**	**7,464**	**7,469**	**10,676**	**4,839**	**6,252**	**164**	**249**

4.12 Ports and Coastal Transport

4.12.1 Ports and Harbours

Port activity in Tanzania is one of the country's economic strongholds, command significant amounts of bulk cargo for the country and its neighbours. At the l cal level, the country's ports also offer sizeable employment opportunities. Tanzania has four major harbours, Dar es Salaam, Mtwara, Tanga and Zanzibar. The mainland ports are under the Tanzania Harbours Authority (THA). THA had 3163 permanent employees in 2003, a reduction from the 9349 employees in 2002. Despite the yearly reduction of staff, the activities of the port and harbour are still a dependable source of employment for local populations since they offer casual labour opportunities and subsidiary jobs such as food vending during periods of peak activities. The intake of casual labourers ranges from 20 to 250 people a day earning an income of TShs 2500 a day and 5000 on weekends (on average US $ 2.5 - 5). Currently the port has 8 deep-water berths for general cargo, 3 berths for container vessels, eight anchorages, a grain terminal, an oil jetty and offshore mooring for super tankers.

Dar es Salaam is the largest seaport in Tanzania followed by Tanga and Zanzibar, handling cargo going to land locked neighbouring countries (namely Burundi, Rwanda, Uganda, Malawi and Zambia). Tanga is the second largest seaport with a handling capacity of 500,000 tons of cargo a year and has experienced a tremendous growth in traffic in recent years. It handled more than twice the traffic in 2003 to 2006 as compared to in 1999 to 2001. The port is handling mostly cargo in the form of copper concentrates from the Kahama mines, bulk wheat for Pembe Flour Mills, Tanga Cement, Tanga Fish fillets/octopus and hide and skins from Moshi. Sisal and coffee are also exported to European and Asian markets. There are container handling and cold storage facilities as well. Other coastal regions with harbours include Lindi, Mtwara and Coast (Mafia). The new initiative of the Mtwara corridor is likely to make Mtwara more active in handling cargos of the Southern African countries. Fishing harbours however is are missing in all the coastal regions. This is important as it helps handle large fishing vessels especially those operating in the EEZ.

4.12.2 Airports

Apart from Julius Nyerere International airport which is in Dar es Salaam, Zanzibar airport is the second largest international airport in the coastal zone, handling both local and international flights. Tanga city also has airport facilities capable of handling small passenger planes. It is situated 4 km from the City Centre along the Tanga/Dar es Salaam Arusha road. Small aircraft are also used in charter flights to and from Dar es Salaam, Zanzibar, Pemba, Mombasa, Kilimanjaro and Arusha ferrying passengers and their

luggage. Other coastal regions also have airports to cater for domestic transport. These include the Mafia Airport in Pwani Region, Lindi and Mtwara Airports which are popular for the domestic flights. In addition there are small airstrips which cater for private needs such as the air strip in the Selous game reserve for those visiting the area, Utete air strip, Pangani-Ushongo air Strip and Mnazi Bay air strip. All these are important infrastructure which provides a good reflection of the growth of the economy and investment into the region.

4.13 Energy

All coastal regions, like other settlements in Tanzania, depend on different sources of energy, such as electricity, kerosene, charcoal, firewood and solar. The main source of power for lighting, business and industry is electricity, which is generated, transmitted and supplied by a sole utility agent; Tanzania Electric Supply Company Limited (TANESCO). All coastal regions and districts are connected to the national grid. Residents commonly use kerosene, firewood and charcoal for cooking and lighting.

Currently gas is being exploited and already in use in Dar es Salaam and part of Mtwara and Lindi regions. Gas is currently being converted to electricity and has been connected to the national grid, thus supplementing hydropower. Songo Songo gas field is a large scale offshore gas extraction, and an extensive pipeline sustain that to deliver the product to Dar es Salaam has been constructed. Already because of this, the southern coastal regions especially Mtwara has attracted a number of big investments especially in Cement industry and fertilizer plants. Gas reserve in Mnazi Bay is also currently exploited thought still in small scale. Supplying power mainly to southern regions of Mtwara and Lindi. It is obvious that the gas exploitation is generating huge direct revenue to the government as employment as well. It was however, not possible to exactly quantify the financial gain from the gas exploitation. No existing study which has so far explore this issue.

4.14 Coastal Mining

Tanzania has a large and growing mining industry exporting $995,000,000 worth of minerals in 2008. Tanzania is Africa's third largest gold producer exporting gold valued at $932,000,000 in 2008. The Williamson diamond mine in Tanzania produced 134,000 carats of diamonds in 2008. Tanzania is also the world's sole source of the gemstone tanzanite and is a producer of other precious stones, notably sapphire and garnet. The sector contributes nearly 4% to GDP, it formally employs 8,000 people and also makes up an extensive 42.9% of total foreign exchange earnings. An estimated 500,000 artisanal miners are also active throughout the sector. The majority of precious metal mining takes place inland; however, the coastal zone does have mining operations focused on cement, coral and lime, with both lime and cement being produced for export throughout East Africa.

Tanzania has a substantial cement industry and produced 1.76 Mta of cement in 2008. Expansion of the cement industry since 2008 has Tanzania producing over 3Mta in 2010 with new plants coming on line in 2011. In 2007 the mining sector contributed 3.7% of the gross domestic product. This contribution has been attributed to both large scale mining operations as well as medium- and small–scale mining activities. However, medium- and small scale mining has been an important contributor to local economies, providing a means whereby large numbers of people can complement income derived from other primary activities, such as subsistence or seasonal agriculture.

4.15 Coastal Resources and Poverty Alleviation

Fisheries dependent communities have been mentioned to be economically better off than purely agricultural dependent livelihood earners as earlier discussed (DFID undated). Yet determination of profit margins for fishers and related activities requires complex analysis involving many variables and assumptions. This is complicated by the different gear types used, the use or non-use of boats, whether or not boats use are motorised. Whereas men go out to fish in boats, women mostly glean the intertidal

areas for gastropods, bivalves and sea cucumbers (Jiddawi 2000). There is no periodic survey programme for management of fisheries households and therefore no official information of fishers' income other than data collected in the preparation of the Fisheries Master Plan Project. Survey outcome showed that the income of fishers is approximately US $ 1 per day, which exceeds the national average, with incomes of up to Tshs 120,00o/= per month for a boat owner with a circle net in the marine waters being categorised as one of the highest income generating groups engaged in fishing activities (Tables 9 & 10). There is a distinct difference in income between boats with and without engines, though both practice the same fishing methods. Obviously fishers without boats earn little, basically for home consumption.

Table 9: Macro Economic Index for fisheries Sector

Item	1996	1997	1998	1999	2000
Fisheries GDP (US$ 1,000)	-	165,232	189,787	211,704	
Fisheries GDP/Total GDP (%)	-	3.0	2.9	2.9	
Employment (full-time fishers	75,621	-	-	78,682	
Fisheries Exports (Million US$	61.8	70.1	72.5	61.8	75.6
Fish Export/Total Exports (%)			12.3	11.4	11.4

Source: Tanzania Fisheries Master Plan 2002

Table 10: Comparison in monthly Incomes and Profits per sales among different fishing methods for Marine fishers

Fishing method	Night purse seine with engine	Circle net with engine	Gill net without engine
Income for crew (Tshs)	46,940	21,250	28,250
Income for a boat owner (Tshs)	120,483	191,389	39,750
Profit per sale (%)	5.2	18.2	18.9

Source: MNRT/JICA 2002

5.0 Study Area

5.1 Kenya

The State of Kenya has a total land area coverage of about 583, 000 km2 with a coastline of about 650km which borders with Somalia in the North and with Tanzania in the South. The coastal land area is about 32,447km2 and lies in a semi arid zone (Ruwa et al 2003). Her oceanward boundary extends to the 200 nautical mile Exclusive Economic Zone limit in accordance with the UN Law of the Sea (UNCLOS) proclamation and has further applied to extend to 350 nautical mile limit for exploitation of bottom ocean bed resources. The additional application 150 nautical mile gives Kenya an extra 103,000 km2 making the new total ocean area upto 350 nautical mile, 245,000 sq km which makes about 42% of her total of land area which makes Kenya a significant maritime country. With a total national population of about 40 million people and a total land area of 583,000 km2, Kenya has national population density of about 69 people per km2 (UNESCO 2010). The coastal area with about 2.5 million people has a higher density of 77 per km2 Most of the population is further concentrated in areas which are virtually all located along the coastline. In urban district of Mombasa which covers 282km2 has a population density of 3190 people per km2. At national level the coastal area is food –deficient and is the second poorest of Kenya's eight provinces.

The fishery sub-sector is an important contributor to the GDP and provides livelihoods to many coastal and inland lake residents. In 2007, the average fish production was 156,000 metric tons, with inland fisheries contributing up to 95 percent of the total, followed by marine fisheries (4%) and aquaculture (1%). Development options in the sub-sector include: promotion of aquaculture, coastal fisheries, value addition and the sound management of Kenya‟s 200 nautical miles Exclusive Economic Zone (EEZ) where high value commercial fisheries are exploited by Distant Water Fishing Nations (DWFN). Kenya has four marine parks and six marine reserves that incorporate important marine habitats including coral reefs, seagrass beds and mangrove forests. Decentralization of management to the local level, which is insufficiently equipped to address multiple issues, and balancing the needs of a healthy ecosystem with the needs of communities living adjacent to the parks are two of the challenges the sub-sector faces.

Figure 3 Marine and terrestrial parks and reserves at the Kenya coast (Source: KMFRI GIS Coastal Resource Database).

The Coast province covers an area of 83,603 km² and, according to the 1999 census, has a population of 2,487,264, with about 62 percent of the coastal population living below the poverty line, making this the second poorest of Kenya"s eight provinces. Kenya's coastline is approximately 600 km long, extending

from the border with Somalia at Ishakani in the north (Longitude 1°41‟S) to the border with Tanzania at Vanga in the south (Longitude 4°40‟S). The Coast Province is comprised of seven districts namely Kwale, Taita Taveta, Mombasa, Kilifi, Malindi, Lamu and Tana River. The Coastal region extends 150 km inland from the seafront, covering an area of 67,500 km2 and constituting about 11.5 percent of the total area of the Republic of Kenya. A fringing coral reef runs parallel to the coastline, from Vanga to Malindi Bay. Other unique features include: a) the Lamu archipelago with its extensive mangrove forests and cultural sites; b) Mombasa Island; c) the southern complex of Gazi Bay; d) Chale Island; e) Funzi Bay and Wasini Island; f) the Tana and Sabaki Rivers that drain into the Indian Ocean. Kenya has about 500 km2 of mangrove forest, a vital part of the coastal ecosystem and one that provides economic development, environmental services and social and cultural values.

The fisheries sector plays an important role in the Kenyan national economy. The sub sector has been contributing around 0.5% to GDP yearly. This figure may be higher if value addition of the various stages of the supply chain is considered and post-harvest losses are minimized. The sub-sector supports about 80,000 fishers directly and about 800,000 individuals (processors, traders and other service providers) indirectly.

Fishery production in Kenya comes from two broad sectors. These are aquaculture and capture fisheries, which are further, divided into marine and freshwater. Capture fisheries accounts for the bulk of the national nominal production contributing about 96% during the year under review. The Kenya fisheries sub-sector has the potential to significantly contribute to the national economy through employment creation, foreign exchange earnings, poverty reduction and food security support but this potential is yet to be realized particularly in our Exclusive Economic Zone (EEZ).

The Coast Province is characterized by four topographical zones (NEMA 2001):

- the coastal plains, which stretch from the sea level to 30m a.s.l.,
- the foot plateau, which stretches from 60m to 140m a.s.l,
- the Coastal range, particularly around Kilifi creek, and
- The Nyika plateau, rising up to 150m a.s.l.

5.2 Coastal and Marine Resources

5.2.1 Fisheries

In the marine waters, fishing is done at five levels namely artisanal, sport fishing, shallow water shrimp trawling, long liners and purse seiners. The fishers use artisanal fishing methods and gears to capture a variety of species which include fin fishes (pelagic such as king fish, barracuda, mullets, queen fish and dermersals e.g. rabbit fish, snapper, rock cod, scavenger etc), crustaceans (prawns, lobsters, crabs etc), and Cephalopods (squids, octopus etc). Other marine fisheries activities are culture fisheries which is quite minimal and aquarium fishery. The later contribute a great deal to the export of aquarium fish (ASCLIME Report 2010).

The Territorial Waters Act of 1972 revised in 1977 defines Kenya territorial waters as 12 nautical miles from the base line (1982 United Nations Law of the Sea Convention). The Kenyan coastline is mostly characterized by a fringing coral reef that runs parallel to the coast line stretch and cannot be trawled. The marine environment is characterized by warm tropical conditions varying at the surface between 25°C and 31°C during the year, stable salinity regimes, and moderately high nutrient levels from terrestrial runoff. The semi-diurnal tidal regime varies from 1.5 to 4 metres amplitude from neap to spring tides.

5.2.2 Artisanal Fisheries

In the year 2007, the marine artisanal fish production was 7,467 metric tons with an ex-vessel value of Ksh.610, 865,000. This was a slight increase both in quantity (7.3%) and value (23.1%) when compared

to the previous year. Total artisanal marine fish production represented approximately 5.5% of the country's total annual production in 2007. Just like in the previous years, most of the catches in 2007 were landed in the south and north districts of Lamu and Kwale. Kwale district contributed 2,236 metric tons (30%) of the total artisanal production followed by Lamu with 1,977 mt (26%), Malindi 1,292 mt (17%), Mombasa 934 mt (13%), Kilifi 826 mt (11%) and finally by Tana River district which contributed only 203 metric tons (3%).

Despite the fact that there has been fluctuating trend in the fish landings from artisanal fishery the value of the fish catch has maintained an increasing trend over the years, possibly due to inflationary pressure. In 2007, Demersal fish species category dominated the marine artisanal fish landings by contributing 47.0% of the landings while pelagic fish category contributed 27.4 %, the sharks, rays and sardines category made up 10.7% of the landings, crustaceans 8.3% and mollusks 6.6%, figures 9 and 10. The Artisanal fishing subsector has created direct employment to the tune of activities during 10,276 fishers by 2007, of which 9,601 were boat fishers and 675 foot fishers (ASCLIME Report 2010). The fishers mainly use motorized boats, paddles, sails as a mean of propulsion. The most common fishing gears used were gillnets, traditional traps, seine nets (which include beach, prawn and reef seines), long line hooks, hand lines and traps among others.

During the year 2007, a total of 8,736 metric tons of assorted fish species valued at US$ 11,511,969 (Ksh.736,766,000)[1] to the fishers were landed. This production reflected an increase of 17.0 % from last year's production. These were landed from 141 landing sites distributed all along the whole stretch of the Kenyan Coastline. Fish landings from artisanal fishery have been experienced boom and burst over the years despite the fact that value wise it has been increasing, mainly due to inflationary pressure. Pelegic fisheries for the past three years (i.e. 2006-2008) generated an approximate value of US$ 2,369,934 per annum (See Table 11).

Table 11 **Marine Fish Landings by Species, Weight and Value 2006 to 2008 (Pelegics)**

	2006			**2007**			**2008**		
	M. tons	**000 Kshs**	**US$**	**M. tons**	**000 Kshs**	**US$**	**M.Tons**	**000 Kshs**	US$
PELAGICS									
Cavalla jacks	157	9,431	147,359	176	12,125	186,538	219	15,014	230,985
Mullets	221	12,147	189,797	201	15,423	237,277	236	15,274	234,985
Littla mackerels	145	9,078	141,844	197	14,513	223,277	212	16,853	259,277
Barracudas	246	14,968	233,875	248	18,017	277,185	325	25,988	399,815
Milk fish	55	3,379	52,797	64	3,876	59,631	91	6,929	106,600
King fish	81	7,052	110,188	111	9,553	146,969	77	7,276	111,938
Queen fish	54	2,937	45,891	57	3,435	52,846	85	5,640	86,769
Sail fish	148	9,501	148,453	83	6,261	96,323	105	9,609	147,831
Bonitos/Tunas	233	14,706	229,781	185	14,096	216,862	320	23,229	357,369
Dolphins	11	694	10,844	21	1,466	22,554	28	2,674	41,138
Mixed Pelagics	336	19,851	310,172	436	29,572	454,954	539	39,670	610,308
Not Acc. For	253	15,562	243,156	267	19,251	296,169	335	25,223	388,046
TOTAL	**1,940**	**119,306**	1,864,156	**2,046**	**147,588**	2,270,585	**2,572**	**193,379**	2,975,062

[1] US$ 1 was traded at approximately 64 in 2007

In 2008, Demersal fish species category dominated the marine artisanal fish landings by contributing 46.8% of the landings while pelagic fish category contributed 29.4 %, the sharks, rays and sardines category made up 10.2% of the landings, crustaceans 6.6% and mollusks 6.8%. The aggregated fish production from the marine and coastal fisheries has remained fairly constant. There has been fluctuation in production quantities when analyzed at district level but generally the trend and order of contribution has remained very similar. In this case Kwale continued to be the leading district, followed by Lamu, Malindi, Mombasa, Kilifi and Tana Delta respectively as shown in figures 9 and 10.

Table 12 **Marine Fish Landings by Species, Weight and Value 2006 to 2008-Demersal**

SPECIES	2006			2007			2008		
	M. tons	000 Kshs	US$	M. tons	000 Kshs	US$	M. tons	000 Kshs	US$
DEMERSAL									
Rabbit fish	412	22,570	352,656	420	27,702	426,185	484	34,546	531,477
Scarvenger	477	25,185	393,516	431	27,586	424,400	499	33,769	519,523
Snapper	193	11,045	172,578	220	14,485	222,846	244	19,326	297,323
Parrot fish	217	8,815	137,734	259	14,169	217,985	315	18,303	281,585
Surgeon fish	34	1,467	22,922	55	4,258	65,508	75	4,618	71,046
Unicorn fish	31	1,487	23,234	55	3,397	52,262	107	6,655	102,385
Grunter	88	5,554	86,781	94	7,171	110,323	135	9,909	152,446
Pouter	138	6,924	108,188	128	8,428	129,662	127	9,046	139,169
Black skin	127	6,448	100,750	153	9,268	142,585	179	11,813	181,738
Goat fishr	73	4,375	68,359	87	6,305	97,000	98	7,463	114,815
Steaker	25	1,705	26,641	27	1,807	27,800	56	3,642	56,031
Rock cod	99	6,323	98,797	108	7,464	114,831	127	9,069	139,523
Cat fish	85	4,426	69,156	83	4,598	70,738	74	4,978	76,585
Mixed dermasal	955	39,937	624,016	929	53,700	826,154	1,039	65,201	1,003,092
Not Acc. for	444	21,940	342,813	458	28,551	439,246	533	35,750	550,000
TOTAL	**3,398**	**168,201**	**2,628,141**	**3,508**	**218,888**	**3,367,508**	**4,092**	**274,088**	**4,216,738**

As shown in Table 12 over the past three years (i.e. 2006-2008) the Demersal fisheries has generated catch valued US$ 1,408,113per year.

The 2007 frame survey indicated that Artisanal fishing activities were undertaken by 12,077 fishers, of which 9,541 were boat fishers and 2,536 were foot fishers (Marine waters fisheries Frame Survey 2008 report). The latter category of fishers mainly target lobsters and other reef fishes since they can walk or dive deep into the water and use hooked sticks as their main type of fishing gear. The number of fishing crafts which were used during the period under review was 2,687, of which 312 were motorized, 1,021 used paddles, 1,227 used sails while 137 used pole/pondo as a means of propulsion.

Dugout canoes were the most widely used fishing craft owing to its simplicity and low cost of manufacturing and maintenance constituting 53% of all the crafts. These were followed by: Sesse with flat one flat end (23%), Hori (10%), Sesse pointed at both ends (7%), and the Dau (7%).

5.2.3 Commercial fishery

The 200 nautical mile EEZ is believed to have vast fishery resources that are under-exploited. The Zone is mainly exploited by foreign flagged vessels due to lack of appropriate fishing vessels, fishing gears and safety gear to venture into the open waters among the local fishermen. With an estimated potential of between 150,000 to 300,000 metric tons per year, Kenyan EEZ is currently being exploited by Distant Water Fishing Nations (DWFN) whose main target are Tuna and Tuna like species. A significant amount of Tuna and Tuna like species is landed by the foreign vessels which is either processed in to Tuna loins or transshipped at the port of Mombasa but there is no define data on total catch from Kenya's EEZ. It is believed that more than that could be caught in the EEZ; however, due the poor Monitoring Control and Surveillance (MCS) system their activities are not fully monitored. During the year 2007 a total of 33 purse seiners and around 30 long liners operated in our EEZ under Kenyan licenses. From available records, these foreign vessels transhipped a total of 16,564 metric tons of Tune and Tuna like species through port of Mombasa during the year. Basing on the average price in the world Market of 100US$ per ton, this would translate into a total of USD 1,7million per year.

The offshore fish stocks are relatively under-exploited, with the main benefits from these resources (mostly tuna-like species) going to the DWFN that contribute little to the Kenyan economy, apart from licensing fees that are in all likelihood disproportionate to the value of the resource extracted. Even though there is incomplete information about stocks, there is a strong indication of good potential to increase the fishing capacity in offshore marine waters, while fishing effort in the inshore coast should decrease. Enhancing data collection systems, particularly in the offshore zone would help develop marine fisheries. This can be done by making it compulsory for fishing vessels to provide data on catches as a condition for obtaining a license.

The annual license fees per foreign PS cost US$ 30,000. The LL licenses can be monthly (US$ 5,000), quarterly (US$ 7,000) or annual (US$ 12,000). Charge rates for national vessels amount to about US$ 1,300, but this sum is currently under review. The offshore fishing operations in 2005, 2006 and 2007 in Kenya‟s EEZ involved an average of DWFN vessels, 37 PS and 30 LL. All were foreign vessels licensed by the GoK. The 125 number of licensed vessels (mainly PS) has increased steadily since 2003, when the Government took a keen interest in illegal fishing and occasionally used the Kenya Navy to patrol the EEZ. The increase in number of vessels applying for EEZ licenses can be also attributed to the recent efforts through the SADC-EU MCS Program for the emerging management of the EEZ fishery. The annual average revenue earned by the GoK from EEZ licenses during the period 2005 to 2007 was around US$ 1 million.

5.2.4 Sport fishing

Sport fishing as a recreational activity has been taking place along the Kenyan Coast within the confines of various registered clubs and at times on individual basis. Sport fishing activities do takes place as far as 15 nautical miles along the entire coastline. It is reported that in the year 2007 there were 48 sport-fishing clubs under the umbrella of the Kenya Association of Sea Anglers. Sport fishing is seasonal with the low season occurring between May and September and peak season in October to March. Targeted species are mainly billfishes especially sailfish, swordfishes, the marlins, sharks and some tunas. The popular sport fishing areas are Malindi, Watamu and Shimoni. The sport fishing clubs do keep records on catches and in 2007 a total 95,287 Kgs of the above named species were landed and recorded by the clubs.

5.2.5 Aquarium Fishery

Ornamental fish from the country are exported and have a very small local market. Some of the most exported species include: surgeonfish, angelfish, blennies, butterfly fish and wrasses. In the year 2007, Kenya exported over 184,314 pieces of live aquarium fish worth slightly over US$ 153,642 (Kshs 11.6 million). There are 8 aquarium dealers along the Kenyan coast.

5.2.6 Exports of Fish and Fishery Products

A total of 1,718.19 metric tons of fish and fishery products value at US$ 3,925,828, (Kshs. 296,400,000) were exports from the country to different destination in 2007. The exports mainly comprised Octopus, Shark fins, Sword fish, Prawns, Lobsters, and Crabs. During the same period Kenya exported 184,314 pieces of live aquarium fish worth slightly over US$181,250 (11.6 million Kenya shillings).

It is worth noting that the figures on Tuna loins which were semi processed at the port of Mombasa are not included in this years' bulletin since it has not been clear on "who owns" the tuna loins. During the 2007 review a total of 16,564 metric tons of tuna were trans-shipped through the port of Mombasa. With approximately US$ 600 per ton, this will translate into about US$ 9.9 million. Table 9 provides the summary of fish and fishery product exported during the year 2008.

Table 13 **Exports of Fish and Fishery Products 2008**

Commodity	**Quantity (M. tons)**	**Value ('000 Kshs)**	**US$**
Sword fish	159	15,800,000	210,667
Sharks	462	20146000	268,613
Shark fins	34	1,204,000	16,053
Big eye	14	969000	12,920
Cullte fish	1	277000	3,693
Lobsters	47	44,711,000	596,147
Octopus	487	106,340,000	1,417,867
Live Lobsters	8	3,844,000	51,253
Live Crabs	45	4,869,000	64,920
Prawns	68	20,144,000	268,587
Fish oil	2	58000	773
TOTAL	1327	218,362,000	2,911,493
Tuna loins	15,069	677,749,000	9,036,653
Grand total	**16,396**	**896,111,000**	11,948,147

5.3 Coastal Ecosystem Services

5.3.1 Coastal Forest

Coastal forests in Kenya are estimated to cover a surface area of about 660 km2, however, the majority of them are now degraded. According to White (1983) in Wio-Lab (2008), Kenya's coastal forests fall

within the northern range of the broad Zanzibar-Inhambane Regional Mosaic, an extensive biogeographical unit stretching from the southern tip of Somalia to the southern coast of Mozambique. Due to its plant endemism, this northern area has more recently been re-classified as the Swahilian Regional Centre of Endemism and the vegetation types are mostly semi-evergreen or evergreen undifferentiated dry forest. Examples of coastal forests in Kenya include Arabuko-Sokoke, Tiwi and Diani Forests. Despite the fact that Kenya has lost almost 90% of her forest resources, the remaining coastal forests are still unique in their totality as a biodiversity priority site in the world (LS 2010). The species diversity is of high value to the communities that live adjacent to these forests and to the world community as a whole (UNDP Kenya 2010).

Several types of coastal forests occur in Kenya: Woodland; coastal evergreen bushland; Coastal palm stands (Bennun & Njoroge, 1999). By the early 1990s, there were about 107 forest patches in the Coastal Forest Mosaic in Kenya covering an area of 660 km2 (Burgess et al. 2000). Mean patch size in Kenya was 6.7km2 with modal patch-size classes ranging 0 – 1 km2. The two largest coastal forests are Arabuko-Sokoke, (minimum area 370 km2; Shimba Hills, (minimum area 63 km2) (WWF-EARPO 2002). There is some uncertainty with these numbers since available information is somewhat out of date and the current situation is, again, far more likely to have deteriorated than improved (Burgess et al 2000). The area of the forests ranges from three-hectare patches to large tracts such as Arabuko Sokoke covering 37,000 ha. Other large forests such as Marafa Brachystegia and Boni/Dodori have neither been demarcated nor surveyed, hence the figures cited above are approximations.

5.3.2 Main goods and services from main forest blocks

Virtually all coastal forests in Kenya have globally unique biodiversity values and most contain at least one endemic species (Burgess & Clarke 2000) and all deserve some form of recognition and protection. The high levels of poverty in the region means that the population is highly dependent on forests resources for their daily needs (food, medicines, and general livelihoods), which may be destructive to the environment. Agriculture and pastoralism are the major livelihood source for most people at the coast. This sector, however, is characterized by inappropriate land use practices resulting in degradation and loss of land productivity leading to widespread encroachment on public land to grow more food and extract resources from the forests in means and rates that are not sustainable.

5.3.2.1 Local values

The Coastal Forests are used for many purposes in addition to timber production. Burgess and Muir (1994) assessed main local uses: pole collection; pitsawing; religious (spiritual) sanctity and ceremonies; gathering of medicinal plants; and clearance of forests to grow crops (agriculture); collection of edible plants and honey; mining and building hotels mainly for tourism. Coastal forests provide a source of building wood and charcoal energy (90% rural house-hold energy and 85% of urban household consumption) to the growing towns of Malindi, Watamu, Kilifi and Mombasa. Coastal Forests are the major known reliable source of pole wood (best poles from mangrove) used by local people for construction purposes. Pole cutting is concentrated in areas closest to human populations (Hall and Rodgers, 1986). Like many other places, coastal forests in Kenya provide a main source of medicine (70-80 %) for the poor local populations (Kokwaro 1976; Mogaka 1992). Edible mushrooms are widely collected from coastal forests. Household incomes in Arabuko-Sokoke Forest have been transformed through modernized and coordinated extraction and marketing of coastal forests products e.g. in 2001, the communities around Arabuko-Sokoke Forest earned around US$37,000 from guiding, bee-keeping and butterfly farming. The honey business is limited by problems of scale, technical skills and processing.

Bush meat is another valuable use of coastal forests by the poor local people who can hardly afford to buy livestock and chicken meats from the near-by towns. *Brachystagia huilliensis* “Muhugu” (from Arabuko-Sokoke Forest) and Mpingo are major sources of carving material, though harvested illegally. Among many values, Mangroves are used as building materials for boats: *Sonneraia alba* is used for ribs of boats while *Heretiera littoralis* is used for boats though it is very scarce in Kenya-- large trunks of *Avicennia marina are used to make dugout canoes.* Ironically, of the total number of mangroves poles sold in Mombasa (from 6,500 score (bad year) to 14,000 scores (good year) some are exported to Middle

East countries. A total of 3,262,000 poles (equivalent to a volume of 24,262 m3) are estimated to be consumed annually in house building (Wass, 1995).

Hotels and Villas consume larger sizes of poles than traditional house construction (Gachanja and Violet, 2001). Other coastal forests uses and values (especially mangrove) include: high quality mangrove honey (available at Malindi, Kipepeo in Arabuko-Sokoke Forest and Nature Kenya office in Nairobi); poles for fishing traps; Fishing net floats; Tannin for fishnets and leather industries; Fisheries (Fish use mangrove areas and creeks as shelter, feeding and nursery grounds); Oysters (Oysters fix themselves on mangroves predominantly *Sonneratia alba* and *Rhizophora mucranat;* Chale Island mangroves are the only mangroves used as Kayas. Many of the cooking utensils and handles of tools used in villages are made from hardwood that often come from forests (Lagerstedt, 1994). Some of the plant species within the coastal forests could represent important genotypes of commercial crops. The most important of these may be *Coffea spp*., some of these are caffeine-free varieties not yet exploited for these properties. In many coastal forests, the wild animals are hunted to provide meat for local populations. For, example, around 60% of households living adjacent to the Arabuko Sokoke Forest, hunt these regularly, and in 1991 about 350kg meat/km2 forest was harvested, with an estimated value of KShs 1,306,000 per annum (c.$35,000) (FitzGibbon *et al.,* 1995). In the Arabuko Sokoke Forest, 30-40% of people collect wild honey from the forest (Mogaka, 1992). Coastal forests are major sources of water that sustains the local people and wildlife.

Woodcarving industry at the coast has a big potential in generation of wealth and employment. Currently it generates between US $ 20 - 25 million annually in export revenues. Its characterized by carved bowls, rhinoceri and giraffe's products. Main species being exploited at the coast are *Brachylaena huillensis* (Mhugu, Muhuhu or Mahogany mainly from Arabuko Sokoke Forest) and *Combretum schumanii* (Mkongolo). Main wood carving species, *Dalbergia melanoxylon* (African black wood - Mpingo) has been depleted from source areas mainly in Ukambani. There are few commercial exotic plantations for production of timber at the coast compared to other regions, however, the available few are important at the national level as they provide raw materials for construction and should be targeted for improved management and production.

5.3.2.2 National level values

Due to their proximity to Mombasa and Malindi, coastal forests are important tourist destination areas. Tourism development is well established in two of these forests, Shimba Hills and Arabuko Sokoke forest reserves. In the two, roads, foot trails, camp-sites, car-parks, gates and signs facilities are available though improvement is needed. Revenue is mainly collected for entrance and use of other facilities. Watamu Marine Reserve and Mida-creek board walk (constructed by A Rocha Kenya) is another tourist destination area with benefits flowing to local people.

Some of the coastal forest are being developed for ecotourism, e.g. in Arabuko Sokoke (through Birdlife International—EU Funding and Nature Kenya—USAID Funding) walking nature trails have been cleared to attract tourism providing; opportunity to walk; scenery attractions; bird watching; mammals viewing; and butterfly exhibit. In many of the coastal forests there is growing potential for ecotourism indicating good potential for both specialist and non-specialist forest tourism. Mangrove forests offer tourist attraction especially where there is bird life and mammal life like Ramisi in South Coast, Tana River, Gazi, Mida Creek and Kipini where birdlife, mollusks and crustacea and crocodiles are abundant.

The coastal forests are rich in minerals (mainly titanium and lead) making mining to be a value not only to local people but also to the national economy. Silica sand for glass manufacture was formerly mined in Arabuko-Sokoke Forest. The old sand quarries have since become a distinctive biodiversity site within the forest, especially for frogs and birds but they remain devoid of valuable natural vegetation cover (Matiku *et al* 1998). Extensive salt works have been established at various sites (e.g. at Ngomeni, Gongoni and Kurawa), where they have been responsible for local destruction of mangrove forests. Limestone deposits are abundant along the coast forming a 4-8 km band, parallel to the coast and about 70m thick from

across the Kenya-Tanzanian border north to Malindi. All along the coast, coral limestone is quarried as building blocks, but there is local variation in limestone quality, affecting its potential use. In Tiwi on the south Kenyan coast it is used for lime manufacture. In the Bamburi area just north of Mombasa, limestone is quarried on a large scale for cement manufacture by a subsidiary of La Farge, a French-based multinational. This site at Bamburi has become famous for its ecological restoration of quarries and has potential for eco-tourism.

5.4 Biodiversity Value

The coastal forests of eastern Africa are recognised as an area of global importance for their concentration of narrowly endemic plants and animals (Statterfield *et al.,* 1998; Olson and Dinerstein 1998; Mittermeier *et al*., 1998). Half of Kenya's threatened woody plants occur in Coastal forests (Wass, 1995). These Coastal forests, combined with Taita Hills complex and the mountains east of the Rift Valley, account for almost all the rare forest biodiversity in Kenya, with a few other rare species scattered across the large blocks of montane forests. Overall, of the forest-dependent and nationally threatened species in Kenya's forests, about 50% of the plants, 60% of the birds and 65% of the mammals are found in the Coastal forests, which show the national, regional and global importance of this region despite its relatively small forest cover.

The Kenya coastal forests are part of the EACF hotspots. Conservation International ranks it 11th in species endemism and BirdLife International ranks it as one of the most globally important Endemic Bird Areas (Bennun & Njoroge, 1999). It is ranked by WWF as among the top 200 out of the worlds 850 ecoregions that are most important for global biodiversity conservation. The region contains many strictly endemic species, comprising 1,366 known endemic plants and 100 endemic animals, and shares many species with the adjacent Eastern Arc mountain ecoregion that is also of global biodiversity significance. In the whole EACF ecoregion, there are more than 4,500 plant species in 1050 plant genera with around 3,000 animal species in 750 genera (WWF-US 2003). The Kenyan Coastal forests have more than 554 strictly endemic plants (40% of the total) and 53 strictly endemic animals. According to Burgers and Clark (2000) and CEPF (2003), the area is considered to be a major global conservation priority because of the high endemism and severe degree of threat. It has a high congruence for plants and vertebrates, and ranks first for densities of endemic plants and vertebrates out of the 25 most important global biodiversity hotspots. This is because of the number of endemic plant and vertebrate species per unit area (Myers *et al*, 2000).

5.5 Mangroves Forest

Other key production sectors in the coastal zone are mangroves, coral reefs and sea grass beds. The area of mangroves in Kenya is estimated at 52,980ha, spread over 18 forest formations along the coast. Lamu District, with 34,000 ha of mangroves, contains the largest mangrove area. All the nine mangrove species recorded in the Western Indian Ocean region occur in Kenya with the two species of Rhizophora and Ceriops being dominant and accounting for 70 percent of total mangroves (Republic of Kenya 2007).

Mangrove forests are an important habitat for a variety of terrestrial and aquatic plants and animals. Terrestrial fauna include many species of birds, reptiles including crocodiles, mammals (pigs and monkeys) and insects; while terrestrial flora mainly comprises fungi, lichens and mistletoes. At the Tana River near Kipini as well as at the Ramisi River, the animal life is abundant when compared to other mangrove areas in Kenya. Very large crocodiles are very evident here as are herds of hippopotamus. Other smaller mammals found in the mangroves of Kenya are baboons, duikers, rodents and fruit bats. Bird life is rich and most varied in most mangrove forests but especially so in Mida creek. Aquatic flora and fauna are much more diverse. Many (possibly up to 90%) of the species found in the mangrove forests are known to spend their entire life, or at-least a major part of their life cycle in these areas. These species include a number of prawns (*Penaeus indicus, P. monodon, P. semisulcatus, Matapenaeus monoceros*); crabs (*Scylla serrata, Uca spp., Sesarma spp.*and *Birgus latro*); mollusca (oysters such as *Brachydontes spp.* and *Crassostrea cucullata*; and cockles, Donax spp.).

5.6 Sea grass Beds

Approximately 12 species of sea grasses have been reported on the Kenyan Coast with some of the most common species being Thalassodendon ciliatum, Halodule wrightii and Halophla minor (Republic of Kenya 2007). Sea grass beds cover a surface are of about 33.6 km2, with the most important sites in the region lying between Lamu and Kiunga. In the north of Kenya (Kiunga Marine Reserve), 11 species were identified in estuary, bay and reef habitats. In Diane-Chale lagoon for instance, preliminary studies indicate that T. ciliatum beds experienced a loss of more than 50 percent of cover. These degraded sites were also found to have a density of the sea urchin Tripneustes gratilla of more than 37 individuals/m2, while healthy sites had a density of only 4 individuals/m2 (Wio-Lab 2008). It is estimated that the sea grass beds valued at US$ 65million. Table 14 summarize the ecosystem values in Kenya's coastal zone.

Table 14 **Valuation of Ecosystem Goods and Services in Kenya**

Coral Reefs		**Mangroves**		**Coastal Forests**		**Sea Grass Beds**		**Total**
Area (km^2)	Value (Million US$)	Area (km^2)	Value (Million US$)	Area (km^2)	Value (Million US$)	Area (km^2)	Value (Million US$)	Value (Million US$)
630	383	500	500	660	133	34	65	1,079

Source: Wio-Lab 2008

5.6 Coastal Agriculture

National records classify 87% of coastal land as agricultural, with 70% of the labour force in the area engaged in this activity (GOK 1996 in Mwaguni & Munga, 2003). Demands to maximise food production have encouraged farming activities in this area to adopt irrigation schemes. The sector supply about 70% of raw materials for domestic agro-industry and making up 80% of total export earnings and 45% of government revenue, agriculture and forestry is clearly the most dominant sector in the Kenyan economy. Agricultural activity in the coastal zone is also significant, producing food and non-food products for both subsistence and commerce, with cashews, bixa, sisal, as well as fruits and vegetables, all being produced for export.

Estimates suggests that about 62% of coastal residents live below the poverty line, the over-exploitation of natural resources has inevitably become a problem. Depletion of coastal and mangrove forests, as well as the destruction of sea grass beds, threaten vital ecosystems which, in the long run, will worsen poverty levels along the coast. The sector is important for coastal livelihoods, particularly evident with the government's Integrated Coastal Zone Policy, as well the creation of a coastal unit within the National Environment Management Authority, both of which are promoting the protection of coastal resources and the empowerment of local communities. Similarly, the government's Integrated Coastal Zone Management scheme has placed emphasis the provision of alternative income generating activities, which could potentially reduce over-exploitation in the sector.

5.7 Tourism Sector

The tourist industry in Kenya is promoted as a destination for sun, sand and safari, and is one of the highest foreign exchange earners, only surpassed by tea and coffee. Europe is the main source continent for Kenyan tourism, accounting for 69.3 percent of the market share. Indeed, in the early 1990's the industry surpassed the traditional cash crops of tea and coffee, contributing 22 % to foreign exchange earnings and 12.5 % of the GDP, taking into account all linkages with the sector (CLS 2010). The sector makes up 4% of total employment in the country, providing nearly 483,000 jobs in 2008, and contributes 18% to total foreign exchange earnings, between 52% and 68% of which is derived from coastal tourism

activity. The sector has also been strong in recent years, with arrivals increasing from 814,000 in 1990 to over 2 million in 2007 and revenue increasing from US$864 million (Kshs56.2 billion) to US$ 1 billion (Kshs65.4 billion) between 2006 and 2007, representing an 11.6% growth rate. Taking 60% of these revenues as due to Coastal tourism will imply that Coastal Tourism generated a total amount of about US$ 518Million and US$ 604 million. Coastal tourism is conducted with a mass orientation and strong cultural component. The primary attractions are the warm climate, the beautiful coastal scenery and clean sandy beaches. Thus, tourism infrastructure and related facilities have mushroomed along the beach areas.

The coastal area generates the highest number of bed occupancies in Kenya with an average of 55% of total bed nights in Kenya. In 2006 for example, the coastal province of Kenya accounted for 3,420,300 bed nights (57%) of bed nights compared with 1,204, 000 (20%) bed-nights for Nairobi. The average length of stay for a visitor in the country in 2005 was 14 days with 6.8 million overnight stays. The Coast also has the highest number of tourism enterprises in Kenya accounting for close to 50% of hotels and 43% of tour operators (See Table 15). The sector is also a major source of Government Revenue in the form of taxes, duties, licence fees and entry fees.

Table 15 **Table showing contribution of Coast province in bed occupancy**

Zone	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Coastal Beach	1,505.3	1,625.2	2,065.2	1,438.2	2,171.8	1,269.6	1,883.5
Other	109.1	73.9	85.8	136.1	108.2	36.5	29.4
Coastal Hinterland	43.9	48.7	76.3	56.6	44.9	60.9	52.9
Total occupied in Kenya	2,813.0	2,951.0	3,687.8	2,764.10	3,479.4	2,605.9	3,791.5
Coast Province contribution	58.9%	59.2%	60.4%	59%	67.6%	52.4%	52%

Source: CBS: Economic Survey 2005 in (CLS 2010)

In the major tourist centers various facilities and services have also mushroomed to meet the demands of the tourist industry. Such services include tour operators, banking and recreation services. Indeed, the rapid growth of Ukunda near Diani Resort, Malindi and Watamu are directly attributed to the development of tourist facilities. In Malindi and Watamu the main activity driving the local economy is tourism, which accounts for approximately 60 % of business. The tourism industry also supports local livelihoods and economy through the provision of employment, and also through provision of services and the supply of commodities such as agricultural products, seafood and building materials.

5.8 Harbours and Ports

Port activity, damming of rivers and agricultural production along the costal zone of Kenya are high. The port of Mombasa, Kenya's largest port provides one of the country's economic strongholds, maintaining maritime trade, commerce and harbour activities. Other ports are generally smaller, mainly serving fishing boats and some small craft transporting consumer goods. These include Lamu (which has also historical significance in maritime trade), Malindi, Kipini, Kilifi, Mtwapa, Gazi and Shimoni. Developments at the Mombasa port have a longterm outlook /perspective in order to extend facilities for oil reception and the container terminal, indicating extensive use of land (Hoyle, 2000).

5.9 Coastal mining

Other coastal mineral resources of minor local importance include barites, galena, iron ore, gypsum and rubies. However all of these may be dwarfed by the development of titanium mining in Kenya. There are vast titanium reserves in the Magarini Sands belt, which stretches from Shimoni in the south coast to Mambrui in the north. Titanium has traditionally been used to make a white pigment for paint, plastic and paper, but is increasingly in demand for applications in the armaments and space industries. Since 1995,

a Canadian-based company (Tiomin Resources Inc.) has been negotiating an agreement with the Kenyan government to mine titanium. Tiomin hopes to start its activities in the Kwale District and expects to generate around $47 million in annual cash flow. Noteworthy, mining is a desired evil and must be properly managed to ensure that other coastal forest values e.g. timber, energy, pole wood, medicine, biodiversity, tourism, ecotourism, carbon sinks, water catchment etc are not compromised.

6.0 Conclusions and Recommendations

ACKNOWLEGDEMENTS

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