

Ecosystem Services for Poverty Alleviation: Marine & Coastal Situational Analysis

Appendix 2

Western Indian Ocean Regional Assessment & Institutional Analysis

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1. INTRODUCTION

1.1 Coastal and marine ecosystems within the region

The East African marine ecoregion (EAME) lies within the latitudes of 2.15°N to 27.5°S and is generally defined as part of the Western Indian Ocean Tropical Bioregion (Gawler et al. 2000), with the southernmost areas becoming sub-tropical. Core countries in the EAME are Mozambique, Tanzania, and Kenya. The north-eastern coast of South Africa and southern Somalia are included in the region by some authors, but not by others. The “official” boundaries exclude South Africa and the WIO Island states - Madagascar, Mauritius, the Seychelles and the Comoros -, but these boundaries have been questioned for a variety of reasons (Kemp 2000). A more detailed scheme, based on hierarchical bioregionalisation, incorporates the area, including the islands, into the Western Indian Ocean province, of the Western Indo-Pacific realm, but divides it into nine different ecoregions (Spalding et al. 2007). However, for the purposes for this document, the broader classification will be adhered to and the islands will be included in discussions.

Estimates of the length of the coastline of the EAME vary according to the scale and method of measurement. For example, Mozambique’s coast is variously described as being 2700km long (Kemp 2000) or 6941km long (Taylor et al. 2003, UNEP 2004), some 2000km longer than one measurement of the coastal length of the entire EAME (EAMEP 2004). Similarly, Kenya’s coast is in the order of 600km (Twong’o and Sikoyo undated), or more than double that. Many of the ecosystems themselves are measured in km² and their measured extent may not depend directly on the coastline length. However coastal population density is often described as numbers of people per km, which clearly would affect perceptions of coastal population density if the length of coastline can differ by a factor almost three. As an example, there are 53, fishers.km⁻¹ of coastline in Mauritius according to one census (UNEP 2004). Clearly, it is important to have a common approach when discussing and comparing coastal population densities and distributions in the region.

Four separate coastal sub-regions, running from south to north in the region can be identified (Gawler et al. 2000, Kemp 2000): the Swamp Coast, entirely in Mozambique, the Parabolic Dune Coasts extending across southern Mozambique into South Africa as far south as Mlalazi, the Coral Coast, extending from northern Mozambique throughout Tanzania and southern and central Kenya and the Northern Monsoon Current Coast, in the extreme north of Kenya and southern Somalia (Kemp 2000, Gawler et al. 2000). Separate categories can be defined for offshore waters and ‘delta’ environments, including the Zambezi and Rufiji deltas in Mozambique and Tanzania respectively.

Despite these sub-divisions, the marine fauna of the EAME belong broadly to the Indo-West Pacific region. Prominent features of the marine and coastal ecosystems are typical of tropical biomes and include mangroves, seagrass meadows, and coral reefs, all highly productive systems. Estuaries and coastal forests are also important, especially in the northern provinces of Mozambique. Although not as diverse as marine fauna in the west Pacific, the WIO region, including the EAME is still globally recognized as an area of high marine biodiversity, in part due to high levels of endemism (Kemp 2000 and references therein). The Bazaruto Archipelago alone is reported to host 2000 species of fish and 220 coral species have been recorded in the region as a whole (Gawler et al. 2000).

Marine ecosystems in the region are shaped by several important oceanographic and geologic features. Along the coast of continental Africa a series of southward migrating eddies in the Mozambique Channel that contribute to the flow of the Agulhas Current. These strong current systems, are part of the reason that the ecosystems throughout the region are likely to have strong connectivity and therefore interdependence. The continental shelf is narrow throughout the continental EAME– no wider than 15km for most of the coastline’s length. One of the consequences of the narrow shelf is a restricted area of shallow water with higher productivity such as may be suitable for subsistence fishing with relatively simple equipment (Gawler et al. 2000). In combination with the absence of major upwelling areas, this partly accounts for the relatively low proportion of global industrial fisheries in the area (see van der Elst et al. 2005 for further discussion). One of the few areas where the shelf broadens is the Sofala bank opposite the Zambezi River, where a major prawn fishery occurs.

There are a number of sites in the area that are of global importance. These include World Heritage Sites, such as the atoll of Aldabra, the Greater St Lucia Wetlands Park and the old town of Zanzibar. Other sites deemed to be of global significance are the Rufiji and Zambezi deltas and the Lamu and Bazaruto archipelagos (WWF 2004). Several shallow plateaus, including the Amirantes and Mascarene plateaus are prominent oceanic features of the WIO.

The unifying feature of the Small Island Developing States (SIDS) of the WIO is the small ratio of land to oceanic area. In most cases, population levels are also low, although Mauritius is an exception, with the highest density in the region. One consequence of these ratios is that exploitation of marine resources contributes disproportionately to the economy. As an extreme example, fisheries resources in the Seychelles contribute 87% of export earnings and account for 14% of all employment (EAMEP 2005). Madagascar differs from the SIDS, having a large land area of over 581000km² and well-developed catchment areas as well as a population in the order of 30 times the size of the largest of the SIDS. In some respects Madagascar can be considered a 'micro-continent' (UNEP 2004). Nonetheless, it shares many hydrological, biogeographic and economic features with the SIDS (UNEP 2004). Despite its size and that more than 70% of employment is agriculture-related, fishing which accounts for only 14% of employment is the highest revenue earner (Taylor et al. 2003).

1.2 Poverty within coastal zones in the region

The complex nature of poverty is increasingly being recognised and the definition of poverty has undergone considerable revision from the standard income-related measures, such as the \$1 per day. Wider definitions of poverty include measures of well-being such as those used by the HDI (Human Development Index) and it is now widely acknowledged that aspects of poverty encompass a range of living conditions, including more difficult social relationships, inability to plan for the future, lack of real power in decision-making, lack of confidence, which makes poverty self-perpetuating in many instances (WRI et al. 2005) and vulnerability to shocks and extreme events. If freedom in a modern society is defined as the ability to participate meaningfully in decisions that affect one's life (Barbour 1980, UNEP 2006), then poverty, even in a democratic society, can be seen as diminishing freedom. However, even including such factors in definitions of poverty may overlook the importance of the relationship between welfare and the environment, with particular regard to the links between populations, consumption and the state of the natural resource base (Dasgupta 2001). If wealth is defined as the total bundle of social, natural and manufactured capital (Dasgupta and Mäler 2000, cited in Dasgupta 2001) then it is possible for people become poorer even as their incomes increase, if the natural resource base is being depleted.

This has particular resonance among the poor, who place high level of reliance on the natural environment (WRI et al. 2005). For many people, their livelihoods depend almost entirely on an array of ES and environmental goods. Using a variety of ES cushions people form the impact of environmental shocks, as they can move between economic activities – for example a change to harvesting forest or seafood products if crops fail. Yet, to raise themselves above the level of subsistence, it may be necessary for people to diversify their activities, and find more lucrative ways of exploiting natural resources (WRI 2005 and references therein). Indeed, while a diversity of activities may provide some security, Sachs (2005) argues that specialisation in one or a few activities, with associated division of labour is the best way to produce surplus goods and therefore income – providing there is a market for the goods. One example, albeit from outside the EAME region, is the transition of villagers in Laos from slash and burn agriculture to collecting and marketing bamboo and cardamom (Morris et al. 2002, cited in WRI et al. 2005). However, specialising in a single commodity may require capital, to which many people do not have access (WRI et al. 2005). Moreover, when specialisation depends on foreign markets, or foreign companies for employment, it can reduce security (Wilson et al. 2003), as with seaweed farming in northern Mozambique. To avoid this it would require that many different specialised activities be initiated simultaneously to create local markets (Schumacher 1973), although logistically this is difficult. The development of rural markets is seen as one of the major challenges facing rural development in Mozambique (Anon 2006).

While coastal poverty fits generally into the patterns of rural poverty, there are some distinguishing features. Many coastal resources are less dependent on short-term weather patterns than terrestrial resources, allowing more reliability, although the 'fugitive' nature of other marine resources, particularly

fish, adds a level of uncertainty to coastal livelihoods. The open-access nature of many coastal resources, while providing opportunities for people without property or capital, also opens the resource to unfettered competition or to expropriation for other uses, including tourism or conservation (Campbell et al. 2006). This may aggravate the historical trend of diminishing access to resources among the poor, as demand for them increases (UNEP 2006), even to the point of criminalizing coastal livelihoods, as when fishers resort to using illegal gear or fishing in protected areas (Campbell et al. 2006). In combination, these factors add to a complex and dynamic environment that requires a high level of adaptability among those who exploit it (Campbell et al. 2006).

By any definition, low state of development and associated poverty is widespread within the EAME. As of 2005, only Mauritius (HDI=65) and Seychelles (50) were placed in the High Human Development category (top 70 out of 177 nations). Tanzania (159) and Mozambique (172) were rated in the lowest 21 nations of HDI, with Kenya (148), South Africa (121), Comoros (134) and Madagascar (143) in the mid-range of HDI. While some countries of the EAME have improved their HDI status since the 1970-1980s, others have declined. Best relative overall increases were recorded for Comoros (16%), Mauritius (22%), Madagascar (32%) and Mozambique (27%). South Africa, Kenya and Tanzania reflected only small improvements, following considerable declines in HDI after peaking in the mid-1990s. Mozambique remains one of the least developed countries in the world, now 172nd, slightly up from 2002 when it was lowest in the world's..

Table 1: Selected indicators of development for EAME countries. (Source: UNDP <http://hdr.undp.org>)

Indicators	Year	Seyche	Mauriti	South	Comoro	Madaga	Kenya	Tanzani	Mozambi
		lles	us	Africa	s	scar		a	que
HDI Rank	2005	50	65	121	134	143	148	159	172
GDP per capita	2005	16,106	12,715	11,110	1,993	923 *	1,240	744	1,242
Human development index (HDI) trends	1975			0.65	..	0.407	0.466
	1980		0.662	0.67	0.483	0.444	0.514	..	0.304
	1985		0.692	0.699	0.5	0.44	0.534	..	0.291
	1990		0.728	0.731	0.506	0.45	0.556	0.421	0.317
	1995		0.751	0.745	0.521	0.463	0.544	0.419	0.335
	2000		0.781	0.707	0.54	0.493	0.529	0.433	0.375
	2005	0.843	0.804	0.674	0.561	0.533	0.521	0.467	0.384
Research and development expenditure (% of GDP)	2000-2005	0.1065	0.3547	0.7614	..	0.1198	0.5887
Gender-related development index (GDI) Rank	2005		62	106	115	121	126	137	149
HDI category (high, medium, low)		High	High	Medium	Medium	Medium	Medium	Low	Low

*A lower figure of \$309 is cited by Anon (2007).

There is not always a direct relationship between fiscal data and the HDI level, partly because income is not directly related to welfare. In the case of Mozambique there has been a period of considerable economic growth and an average per capita GDP in 2005 that was considerably higher than Madagascar's or Tanzania's yet both these countries attained considerably higher ranks than Mozambique on the HDI scale (Table 1). Similarly, Madagascar was ranked higher on the HDI than Kenya, where income is higher. In contrast, Tanzania, has seen little change in important indicators of poverty since 1988, including life expectancy and maternal mortality, despite consistent GDP growth in recent years (RAWG 2005). In spite of its persistently low rank, the absolute HDI value for Mozambique has risen consistently since 1985 and its research spending as a proportion of GDP is higher than that of the Seychelles (Table 1), both positive signs. Mozambique has seen poverty reduced by about 9 percentage points between 1996 and 2001 with the median income from agriculture increasing by about 27% (DNPO 2004). This increase is in contrast to a lower contribution to the GDP made by marine resources, especially the shrimp harvest which traditionally represented one of the country's most valuable sources of foreign exchange. From a previous high of nearly 40% the contribution to GDP by the

fisheries sector in 2003 stood at 4%, generating 28%-40% of foreign revenue for the country (FIGIS-FAO and NEPAD respectively)

Along with Mozambique, Tanzania is the only other EAME country that is rated as low in terms of human development (Table 1). Poverty in Tanzania reduced by only 3 percentage points between 1992 and 2002 (RAWG 2005), in part because inequality increased, implying that growth and poverty reduction were not proportional. Poverty decreased more in urban than in rural areas between 1991 and 2001 (IMF 2006), but overall did not reflect the growth in GDP during the period, affirming that growth and poverty reduction are not synonymous. The economy of Tanzania is still largely based on agriculture, which contributes 46% of GDP and occupies 70% of the population, including 80% of those classified as poor (IMF 2006). Nonetheless, the highest densities of poor people occur in urban areas. 18% of Tanzanians live below the food poverty line and 36% below the basic needs poverty line (IMF 2006). In contrast to Mozambique, Tanzania has made little progress in reducing child mortality (IMF 2006). The nutritional status of children, especially those under 5 is also poor, with over 40% suffering some deficiency.

Madagascar is one of the poorest countries in the region by income, with low GDP (Table 1) and 85% of the population living on less than \$2 per day as of 2005 (Anon 2007). Only Kenya and South Africa have shown recent declines in HDI values among the EAME countries, a possible sign of declining longevity due to HIV-AIDS.

There are strong variations in patterns of poverty within countries that are hidden by country level analyses. The development of tools such as GIS and satellite imaging has allowed the construction of poverty maps that allow intra-country analyses of indicators of poverty and welfare.

Throughout most of the region poverty is worse in rural than urban areas, although rates of urban poverty in Kenya are slightly higher than in rural areas (CIESIN 2006). However this figure may be influenced by the approach of using separate rural and urban poverty lines, rather than a single national poverty line (CIESIN 2006). In Kenya, Tanzania and Mozambique migration to coastal areas is likely to increase the proportion of the rural poor depending on coastal resources as this is seen as the "last resort" of employment and sustenance. This is illustrated by the expectation that the coastal population of the region will double by the year 2030 (EAMEP 2004). In general, remote, or sparsely populated areas tend to have higher levels of poverty than more central areas, as has been shown for Mozambique (CIESIN 2006), although the opposite is true of Madagascar, where the highest poverty levels are around the population centre of the central highlands (CIESIN 2006). Urban areas have higher levels of inequality than rural areas, even when the overall poverty level is lower (CIESIN 2006). In Mozambique, contrasting regional trends have been demonstrated for consumption-related vs non consumption-related measures of poverty, with the south of the country being poorest in terms of the former, but the north being poorer in terms of the latter. This has partly been attributed to climate related disasters which affected the south in recent years (Anon 2007). Overall, however, there seems to be a convergence in consumption-related measures among regions, but considerable differences remain within regions.

In Tanzania, there are variations even among coastal areas. As a whole, the coastal regions, comprising 15% of the country's land area, generates 33% of GDP. However the majority of this comes from Dar es Salaam and some of the other coastal regions are among the poorest in the country. Although agriculture accounts for the biggest portion of national GDP, it is less important to coastal communities than fisheries and other activities including tourism and trade in a variety of coastal products such as timber, lime and charcoal (UNEP 2001).

Kenya displays similar levels of geographical variation in poverty at provincial and district levels. The Coast province is the 2nd poorest in the country (IMF 2005) with 62% of residents living in poverty. However, there is a wide variation among districts, with poverty ranging from 13 to 90% across 140 locations. Key determinants of poverty include family size, educational level, agricultural production and gender (IMF 2005). Exogenous factors include poor access to infrastructure and markets, membership of a minority or other group that is discriminated against and residing in areas of poor environmental condition.

1.3 Gender and poverty

The importance of gender effects on poverty is widely acknowledged. In general, the trend in gender equality, measured by the Gender-related development index (GDI), correlates with the HDI in EAME countries (Table 1). However, gender related differences in poverty are often underestimated, partly because most surveys don't go beyond the household level, yet there may be intra-household aspects to poverty (Pontara 2001), for example when women do only subsistence work but earn no cash income, or when male children are given preference. Female headed households in Mozambique were found to be more vulnerable, even when no poorer than male headed households in consumption terms.

Cultures and traditions play a role in defining the gender aspects of poverty. A case study among the Makua people of Mozambique highlighted a number of ways in which traditions diminished economic opportunity for women. These included initiation ceremonies and perceptions that a woman was only 'complete' after having given birth to her first child. Lower mobility allied with the possibility of men working as migrant labourers to form new relationships can add to the poverty of women in rural areas (Pontara 2001, Campbell et al. 2006). Breakdown of social structures can also have negative effects, such as a reduction in the time between children, which adds to the burden of many women (e.g. Dasgupta 2001).

Gender related differences can also be seen as differences in indicators such as literacy rates. In Tanzania, for example, a district level analysis showed no district with higher literacy rates of women and in most districts, literacy among men was in the order of 20% higher than among women (RAWG 2005). In Mozambique, gender inequality has been described as an obstacle to growth and education among women is also much lower than among men. There are more women than men in the labour force, a fact that has been attributed to the longer period of education afforded to men (Anon 2006). Gender inequality is also acknowledged in Kenya, although analysis is hampered by the lack of gender-specific information and targets in many areas (IMF 2005). Madagascar has set as priority goals the elimination of traditional practices that discriminate against women and the establishment of government institutions to promote the participation of women in economic and civil activities (Anon 2007).

1.4 The problem of scale

Poverty rates are easier to calculate at national or regional scale than the financial and other needs for alleviating it. More difficult still is the securing of finance to alleviate poverty at large scales. Most of the examples of poverty alleviation or community management are at local levels – communities, villages or districts, the scales at which NGO's are also most effective (Campbell et al. 2006). In some cases, such local targeting of resources can be effective and minimise leakages (Ndeng'e et al.). However, while various models of sustainable coastal management are being implemented, their progress and successes to date have been described as 'puny compared to the forces driving coastal transformation' (Campbell et al. 2006). Often, setting up these schemes is itself a resource-intensive process and narrowly targeted delivery mechanisms frequently fail to address the underlying causes of poverty, which reduce the ability of the poor to access available services (Campbell et al. 2006). Many causes of poverty are more general, including factors of geography (access to markets and infrastructure such as health care, energy, sanitation and education), ecology (such as climate stress and the particular virulence of malaria in tropical Africa) and lack of capital to increase productivity, especially in the agricultural sector, resulting in what has been described as a 'poverty trap' that prevents the poorest of the world's population from improving their situation (Sachs 2005). It is possible to estimate the resources that are needed to mitigate these causes of poverty at national or larger scales, and in many cases it has been done in the form of PRSP's (poverty reduction strategy papers). In such cases, the main barrier is sustained financial backing and the will to provide it, since it is calculated that such backing could be given without exceeding the stated aid goal of 0.7% of GDP in wealthy nations (Sachs 2005). Alleviating the large scale causes of extreme poverty may be a prerequisite for expanding the delivery of more targeted programmes.

1.5 Social vulnerability in the Western Indian Ocean

Some people are highly vulnerable to changes in ecosystems and their services. Many of these people already experience stresses from environmental, socio-economic and health pressures which are further exacerbated by changes in ecosystems. The interaction between these changes and other on-going

stresses threaten the well-being of these people whilst many others benefit from human interactions with ecosystems. (Kasperson *et al.* 2006). At a global scale, many indicators for and definitions of vulnerability have been identified with topics like natural hazards and climate change, and food security receiving most of the attention (UNEP 1984, Watson *et al.* 1998, McCarthy *et al.* 2001, Pelling and Uitto 2001, Downing *et al.* 2002, IUCN 2003, Whittingham *et al.* 2003, Vincent 2004, Adger *et al.* 2005, CSAFSE and WFP 2005, Makoka and Kaplan 2005, Singh *et al.* 2006, UNEP 2006, Walmsley *et al.* 2006, WMO 2008).

There are a number of consistently emerging themes in terms of social vulnerability:

- The first is socio-economic and institutional differences, where linkages among livelihoods, development and environmental change are assessed using resilience and adaptive capacity as indicators. (Vincent 2004, Brooks *et al.* 2005).
- The second is the link between poverty and hazard vulnerability which are often closely related due to the lack of assets owned by the poor that would buffer them from environmental degradation and variability (Kasperson *et al.* 2006).
- The last theme is that of the interactions of environmental change and different stressors, e.g. economic, social, political and/or physical where major global trends in urbanization, economic development, HIV/AIDS and population growth affect vulnerability at both national and local scales. (Kasperson *et al.* 2006).

Approximately 41% of the global population lives in coastal areas with more than 85% of developed and developing countries and small island states having a high population concentration in coastal areas (Singh *et al.* 2006). Due to the degradation of most of the services derived from marine and coastal ecosystems, food security, increased health risks and income losses result in coastal communities becoming more vulnerable to natural and human-induced disasters (UNEP 2006). Vulnerability of a community depends on their exposure to ecosystem changes and their coping capacities. Vulnerable coastal countries in the Western Indian Ocean (WIO) include the Small Island Developing States (SIDS), Tanzania, Mozambique, and Kenya (Watson *et al.* 1998, UNEP 1984, McCarthy *et al.* 2001, Pelling and Uitto 2001, Whittingham *et al.* 2003, Allison and Seeley 2004, CSAFSE and WFP 2005, UNEP 2006) and within these countries certain groups of people are more vulnerable than others (see Table 2).

Table 2: Social vulnerability in the Western Indian Ocean identified in the literature.

Scale	Who is vulnerable?	Reference
Regional and national	Sub-Saharan African countries	12
	Developing countries	20
	Conflict countries	12
	Low GDP countries	6
Populations and groups	Coastal populations	1, 4, 7, 8, 9, 11, 17, 19, 20
	Rural & agricultural populations	20
	Minority groups and immigrants	16
	Refugees	7
	Small-holder producers	20
Communities, households and individuals	Asset-poor households	14
	Children (girls specifically) and the young	2, 4, 6, 7, 15, 16, 18
	Chronically ill, sick, HIV/AIDS infected individuals and households and high-altitude communities (lack of malaria immunity).	4, 7, 14, 15, 16, 17, 19
	Disabled	16
	Disadvantaged communities??	5
	Elderly and Elderly-headed households	4, 14, 15, 16, 18, 19
	Fishers and fishing communities (Especially small-scale fishers).	2, 10, 19
	Island communities	9, 20
	Isolated communities (especially isolated rural communities)	4, 20
	Malnourished individuals	17
	Orphans	14
	Poor or Indigent	2, 3, 4, 5, 6, 7, 11, 13, 15, 17, 18, 19, 20
	Rural communities	7, 12
	Women (Especially widows and pregnant women) and members of female-headed households	2, 6, 10, 14, 16, 19

These groups are vulnerable to a wide range of factors that include:

- Generation of primary income and food security through unstable or unsustainable livelihoods.
- Human mobility and migration increases exposure to disease such as HIV and concomitantly greater susceptibility to AIDS.
- Exposure to stochastic events and other large-scale climatic events exacerbated by climate change (sea-level rise, drought, floods, storm surges, cyclones, coastal erosion and desertification).
- Increased shortage of potable water.
- Gender inequalities.
- Infrastructure instability.

- Global economic instability, market dynamics and a lack of understanding of the market system.
- Unsustainable fisheries management.
- Over-dependence on rain-fed agriculture.
- War and conflict.
- A culture and sentiment condoning gender inequality.
- Population growth, competition for resources and likelihood of user conflict.
- Continued environmental degradation.
- Inadequate or lack of education.
- Inequitable land management and distribution.
- Archaic, insensitive or absent resource-use policies and legislation.

Vulnerability in the WIO appears to be increasing with the effects of climate change on the marine and coastal ecosystems on which the vulnerable population groups depend.

2. COASTAL AND MARINE ECOSYSTEM SERVICES WITHIN THE REGION

Ecosystem services (henceforth ES) are commonly divided into provisioning, regulating, supporting and cultural. Biodiversity is sometimes added as a separate category (e.g. UNEP 2006). However, these are somewhat loose categories. For example, what are categorised as provisioning services are often also referred to as environmental goods, with services being used more restrictively to refer to non-material benefits. The category of cultural benefits includes recreation, and protection, which are not cultural in the sense of belonging to the traditions of local communities. Knowledge and research probably fits best under this category, which differs from the other three in that it refers to social, rather than biophysical services of the environment.

Regardless of the above categories, ES can broadly be divided into fundamental and demand-driven services. Fundamental services, mostly those fitting into the regulatory and supporting categories, are those that are vital for the maintenance of ecosystem functioning and resilience (Holmlund and Hammer. 1999). Fundamental ES often do not have market or monetary values attached to them and may not even be perceived by most people, yet are vital to human existence. Demand-driven ES include most provisioning ES, as well as cultural. Although some of these are not vital for human life-support, they are usually more apparent and have market values attached. Yet the provision of these ES depends on the natural ecosystems and the fundamental ES provided by them (Holmlund and Hammer. 1999). Coastal ecosystems provide a range of ES in all the categories, summarised in Table 3.

Table 3: Typical ecosystem services in each of 5 categories

Biodiversity	Provisioning services	Regulating services	Supporting services	Cultural services
Genetic diversity	Food	Biological regulation	Nutrient Recycling	Recreation
Ecological redundancy	Timber & other building materials	Freshwater storage and retention	Biochemical	Religion and Tradition
Recreational amenity	Fuel	Hydrological balance		Aesthetic
	Medicines	Climate regulation		Research
	Craft materials	Human disease control		Transport
		Waste processing		
		Protection		
		Erosion control		

(Table adapted from UNEP 2006.)

An example of the ecosystem services of seagrasses and seagrass meadows

In a paper by Torre-Castro and Rönnbäck (2004), they clearly identify the link between humans and seagrasses. They identified a diversity of socio-ecological links that are important for the welfare of the local populations of a rural tropical economy in the East Coast of Zanzibar. In their study area (Chwaka village) fisheries and seaweed farming are the primary economic activities. In this setting seagrass

meadows provide ecological links to humans in the form of fishing grounds, sites for invertebrate collection, substrate for bait and seaweed, and finally seagrasses for medicinal use. The economic link resulting from the above is the finfish fishery, invertebrate collection and subsistence economy and food security. Finally, the existence of local ecological knowledge has been identified as an important input for the management of natural resources, and in this case seagrass meadows. Another social and cultural link between humans and seagrasses are the information services (current direction, measure of seasonality etc.), traditional (medicinal use) and religious beliefs (low-energy consuming trap fishery during Ramadhan) associated with this habitat.

Table 4: Summary of ecosystem goods and services associated with seagrasses in Chwaka village, Zanzibar, Tanzania, taken from Torre-Castro and Rönnbäck (2004).

Function of seagrasses/seagrass meadows	Provision of goods and services	Type of good and/or services	Associated seagrass species
Fishing grounds	Fish	Indirect good	All, but mainly those sub-tidal with more structural complexity: <i>Thalassodendron ciliatum</i> and <i>Enhalus acoroides</i>
	Invertebrates	Indirect good	Dense <i>Thalassia hemprichii</i> and <i>Cymodocea</i> spp. intertidal meadows
Bait collection grounds	Gozi for dema Macroalgae for dema Brittle stars for dema	Indirect goods	Dense <i>Thalassia hemprichii</i> and <i>Cymodocea</i> spp. intertidal meadows
Substrate for seaweed farming	Acts as fertilizer	Direct good	Dense <i>Thalassia hemprichii</i> and <i>Cymodocea</i> spp. intertidal meadows
	Fulfill the requirements of an ideal place for farming	Nutrient-related services Physical-structural services	
Fertilizer	Seagrass litter Natural on the beach Used in "shambas"	Direct good Nutrient related service	All
Medicines/traditional use	Seagrass roots and canopy	Direct good	<i>Enhalus acoroides</i> , <i>Thalassia hemprichii</i> , <i>Cymodocea</i> spp., <i>Halophila</i> spp., <i>Thalassodendron ciliatum</i>
Food	Seagrass plant	Direct good	<i>Halophila</i> spp.
Information indicator	Seagrass leaves	Information services	<i>Enhalus acoroides</i>
Provision of different values	Seagrass plant and meadows	Social and cultural services	All

It is clear from this study that seagrasses play an important role and that the community benefits from the presence of seagrasses which provides both goods and services and constitutes a prerequisite for securing continuous provision of protein and monetary income. However, in terms of long-term security of these services, a primary effect of increased global temperature will be the alteration of growth rates and other physiological functions of the plants themselves (Short and Neckels 1999). It is also expected that there would be a shift in the distribution of seagrasses as a result of temperature stress as well as a changes in the patterns of sexual reproduction. Furthermore, indirect temperature effects may include plant community changes as a result of increased eutrophication and changes in the frequency and intensity of extreme weather events. The direct effects of sea level rise on the coastal oceans will be to increase water depths, change tidal variation (both mean tide level and tidal prism), alter water movement, and increase seawater intrusion into estuaries and rivers. A major impact of all these changes on seagrasses and tidal freshwater plants will be a redistribution of existing habitats. Although these are considered potential impacts (Short and Neckles 1999), the implications for coastal communities with a

high reliance on seagrasses are clear. Continued exploitation of the goods and services provided by seagrasses and meadows may require greater mobility on the part of farmers and harvesters while in some cases alternative livelihood strategies will have to be found.

3. KEY ISSUES AND DRIVERS OF CHANGES TO ECOSYSTEMS AND THEIR SERVICES

It has become something of a truism that ecosystems and their associated ES have been, are being or are threatened by degradation due to overexploitation, pollution or destruction. At some level, all of society depends on the maintenance and continued functioning of ES, with a large proportion of the population globally and in the EAME dependent on natural resources for their livelihood. Yet it is the poorest members of societies, many of whom have subsistence lifestyles, who depend most directly on the environment and on natural capital. Degradation of ecosystems, even at local scales can be devastating to their livelihoods and well-being (WRI et al. 2005). The most pressing drivers of ES degradation are similar throughout the EAME region, although there may be variations in their relative severity and impact among countries or even areas within countries. SIDS are particularly vulnerable to effects of climate change and changes in water and rainfall patterns.

3.1 Regional and national Issues identified from the literature

An “issue” is defined here as any activity or action that has a direct or closely linked impact, either positive or negative on the condition of any regional ecosystem services. The purpose is to identify the recognisable issue relating to service provision rather than the drivers of issues e.g. government subsidies of coastal agriculture is not the issue but rather coastal land-use change brought on by slash and burn agriculture.

Because an “issues-based” approach is by definition concerned with the human dimension in the environment, most issues listed below should have at least one positive connotation albeit temporary or short-term. However, it will not be an issue unless the majority of the impacts are large scale, long-term and with serious implications for coastal livelihoods and human well-being.

Table 5. Regional and national issues relating to ecosystem services and the link to poverty.

No	Issues	Ecosystem links	Poverty links	Scale	References
1	<p>Habitat modification, land use change and land degradation caused by:</p> <ul style="list-style-type: none"> ● State subsidised deforestation (timber felling for domestic and commercial purposes) ● Large scale mechanised agriculture. ● Aquaculture (shrimp ponds and the subsequent loss of mangrove forests). ● Growing demand for forestry products (household cooking, fuelwood in the production of lime, salt and charcoal, construction, boat building, crafts and to clear land for agriculture). ● Housing and hotel development. ● Rural slash & burn agriculture. Inhaca Island, Kosi Bay, etc. ● Urbanisation 	<p>-ve: Impact on regulatory services i.e. loss of flood attenuation, reduced waste assimilation and processing function through the loss of mangroves and wetlands.</p> <p>-ve: Loss of provisional services such as reduction in water through the excessive abstraction from the water table as well as products from coastal forests such as wood and charcoal for energy. (Trade-off salt and lime production, and clearing for agriculture against forest degradation.)</p> <p>-ve: Increased siltation due to land-use change and lack of catchment management affect coral reefs.</p> <p>-ve: Reduction in capacity of mangroves to provide nursery and breeding ground habitat.</p> <p>-ve: Deforestation and habitat fragmentation (mainly through smallholder subsistence farming and mineral exploitation) equates to a loss of biodiversity, cause of coastal erosion, increasing severity and frequency of droughts and flooding, increasing levels of water pollution and desertification.</p> <p>-ve: Fragmented habitats have generally reduced resilience and resistance to perturbations.</p> <p>-ve: Growing risk of species extinction and loss of biodiversity.</p> <p>-ve: Increased soil erosion and concomitantly reduced agricultural productivity.</p>	<p>+ve: Increased area and potential for agriculture, mariculture.</p> <p>+ve: Provisioning of building material from stripping of forest mangroves etc.</p> <p>+ve: Short-term gain in revenue and energy requirement.</p> <p>+ve: Economic gain and livelihood options from unsustainable rain-fed agriculture on cleared soils with limited fertility, and harvesting of forestry products. Concomitant increases quality of life over short-term (food, medicine, housing, etc.).</p> <p>-ve: Loss of regulatory services increases vulnerability of poor living in low-lying coastal areas to stochastic events or extreme climate events such as flooding, landslides, drought, tsunami.</p> <p>-ve: Reduced nursery function of shrinking mangrove area causes reduced fish recruitment and ultimately less fish as an important source of protein for coastal communities. Reduced provisioning output from other degraded habitats such as coral reefs.</p> <p>-ve: Water quality and volumes reduces at the lower reaches of rivers and streams through unmanaged land-use changes higher up in catchments. Less water of lower quality available to people most reliant on this service. This in turn has effects on agricultural potential, food security, and human health,</p> <p>-ve: Increased scarcity and reduced access to traditional medicines as natural areas are converted. Greater susceptibility to illness, more income spent on pharmaceutical medication.</p> <p>-ve: As forests and mangroves reduce in size and distribution , members from poor households are required to spend more time and effort collecting wood for fuel, building etc.</p> <p>-ve: Degraded ecosystems have less value as tourists attractions, resulting in job losses, loss of future ecotourism opportunities and lost revenue (e.g. degradation of reefs impact negatively on diving industry).</p>	KE, TZ, MZ, SIDS	<p>UNEP 2006</p> <p>Kazungu et al 2001</p> <p>Wong et al 2005</p> <p>Emerton & Tessema 2001</p> <p>UNEP 2004</p> <p>Wagner et al (undated)</p> <p>Ngusaru 2000</p> <p>Enosse et al 2001</p> <p>DEWA AEO 2006</p> <p>IISD 2003</p> <p>UNEP (undated) - Assessing coastal vulnerability</p> <p>GEF & UNEP 2002</p> <p>GIWA 2004</p>

No	Issues	Ecosystem links	Poverty links	Scale	References
2	<p>Pollution and waste including increased sedimentation (land- and sea-based):</p> <ul style="list-style-type: none"> ● Pollution of water resources primarily due to improper disposal of solid wastes, industrial, agricultural and domestic waste water. ● Lack of integrated coastal management and the appropriate institutional arrangements to deal with pollution from a variety of activities. ● Lack of enforcement and mechanisms dealing with pollution. ● Inadequate waste-treatment infrastructure ● Unregulated industrial discharges, disposal of dredged material and solar salt production. ● Agricultural practices-intensive use of land, overuse of fertilisers to improve soil fertility and productivity and cultivation too close to river banks, incorrect ploughing and planting techniques. ● No or ineffective catchment management. ● Risk of oil spills due to the high oil tanker traffic from the Middle East. 	<p>-ve: Siltation of estuaries, mangroves and degradation of coral reefs.</p> <p>-ve: Eutrophication of estuarine and marine environments.</p> <p>-ve: Change in the species composition of receiving habitats (mangroves, coral, rocky as well as intertidal reefs).</p> <p>-ve: Predisposition of corals to disease, Crown-of-thorns starfish etc.</p> <p>-ve: Sand starvation of beaches due to reduced water flow in estuaries and increased rate of coastal erosion.</p> <p>-ve: Pollution of surface and coastal waters especially from urban areas, industry and agriculture.</p> <p>-ve: Accumulation of PCBs and heavy metals in fatty tissue of animals in the higher trophic levels and reduced egg shell thickness in seabirds.</p>	<p>+ve: No sewage handling infrastructure cost.</p> <p>-ve: Lack of access to clean water, air and soils increases risk and exposure to water borne disease (cholera, malaria, dysentery). The poor are left without alternatives to the direct and indirect ingestion of contaminants contained in untreated water, and air and animal tissues. The poor has limited access or opportunity for legal recourse. Produce from affected areas cannot be sold to other areas leading to loss of revenue for communities.</p> <p>-ve: Payment for clean or bottled water means less money for other necessities.</p> <p>-ve: Degradation of aesthetic character of the environment (coral reefs, beaches etc.) negatively affects tourist perception and numbers. Loss of income to community members employed in tourism sector as tourism potential reduces. Less cash injected in local economies and more reliance on natural resources. Overall reduction in the livelihood options.</p> <p>-ve: Reduced contribution of agriculture – both commercially and subsistence (through the loss of valuable top soil as well as soil fertility) towards the improvement of coastal livelihoods.</p> <p>-ve: Reduced productivity of marine and coastal ecosystems and the subsequent services that may be used. Especially the ‘knock-on’ effect through the reduction in provisioning stocks i.e. fish kills. Long-term and unabated pollution of habitats drastically reduce livelihood options for the poor.</p> <p>-ve: Change in natural resource communities necessitates change in usage patterns i.e. greater distance to unpolluted fishing grounds, reefs.</p>	KE, TZ, MZ, SIDs	Mpendazoe 2000 UNEP 2004 Ngusaru 2000 Enosse et al 2001 GEF & UNEP 2002 GIWA 2004

No	Issues	Ecosystem links	Poverty links	Scale	References
3	<p>Overexploitation of coastal and marine natural resources:</p> <ul style="list-style-type: none"> ● Increased fishing effort and destructive fishing techniques. ● Unsustainable harvesting of mangroves. ● Destruction of coral ecosystems by overfishing and small-mesh nets, ● Mining of coral rock for construction and lime, pollution and boat anchoring. ● Degradation of coral reefs due to inappropriate and unplanned tourism. 	<p>-ve: Threat to the integrity of MPAs as a result of a loss of biodiversity.</p> <p>-ve: Reduction in and collapse of fish stocks.</p> <p>-ve: Physical destruction of habitats and habitat complexity due to dynamite and poison fishing.</p> <p>-ve: Inability of fish stocks to recover from non-viable population sizes.</p> <p>-ve: Alteration in species composition (provisioning, regulating services).</p> <p>-ve: Disruption of food webs (regulating services).</p> <p>-ve: Destruction of mangrove habitat due to over-harvesting (see also Issue 1).</p>	<p>+ve: Short term benefits economy by providing employment opportunities, generating income, improving food security and increasing foreign exchange earning using their freedom of choice of harvesting techniques and limited enforcement.</p> <p>+ve: Maintenance of fishing as a cultural activity in poor coastal communities.</p> <p>-ve: Loss of employment in fisheries, a reduction in cash revenues from the sale of fish, increased food insecurity as stock becomes limiting. Direct dependence on provisioning ecosystem services increases vulnerability of the poor.</p> <p>-ve: Increased effort to maintain harvesting resources that provides minimum dietary requirements. Reduced health benefits derived from the nutritional value of fish.</p> <p>-ve:</p> <p>-ve: Unsustainable harvesting of mangroves are linked with land-use change and the associated negative poverty connotations i.e. increased vulnerability to flooding, reduced fish recruitment/reduced source of protein to coastal communities, loss of tourism potential and associated secondary benefits. etc.</p> <p>-ve: Reduction in fish catches is greater incentive for migration and in turn increased migration provides greater opportunity and thus susceptibility to diseases such as HIV/Aids by migrant fishers (mainly young men), fish traders, and fish processors (mainly woman).</p> <p>-ve: Declining fish stocks, catches and changes in social behaviour disrupt rural community living. Increasing social conflicts caused by unemployment and lack of artisanal fishing.</p> <p>-ve: Changing government policies to reduce fishing effort in response to declining stocks often affects “voiceless” poor first.</p>	KE, TZ, MZ, SIDs	Emerton & Tessema 2001 UNEP 2004 Kazungu 2001 Walmsley et al 2006 Ngusaru 2000 TCMP2001 Wells et al 2007

No	Issues	Ecosystem links	Poverty links	Scale	References
4	<p>Human migration to the coast and particularly urbanisation as a result of perceived improvement of livelihood options:</p> <ul style="list-style-type: none"> ● Large scale migration of rural peoples, increase potential to earn money but reduction in well-being should earnings not compensate for higher prices in urban environment. ● Rural-urban: due to lack of; communication and transport infrastructure, livelihood opportunity; poor performance of agriculture and fishing. ● Rural-rural: movement to remote areas, forest frontiers and coastal areas with greater land and resource availability. 	<p>-ve: Degradation of urban coastal provisioning, regulatory, cultural and supportive services due to pollution, land transformation and secondary impacts of increased demand for marine resources especially food.</p> <p>-ve: Heavy demand on existing and remaining urban services.</p> <p>+ve: Provisioning in rural areas (food from mangrove habitats etc.).</p> <p>-ve: Regulating services in urban areas i.e. greater demand on waste processing by mangroves, and waste assimilation in coastal and marine habitats.</p> <p>-ve: Provisioning in urban areas e.g. intensity of mangrove cutting dependent on ease of access and closeness to high-population density</p> <p>-ve: Degradation of habitats along migration routes and where migrants relocate.</p> <p>-ve: Loss of supporting (aesthetic and spiritual) services associated with natural landscapes as well as provisional services (medicinal values).</p>	<p>+ve: Potential increased employment but possibly decreased overall well-being.</p> <p>-ve: Reduced harvest yields for dependent coastal communities through a loss of/degradation of arable land.</p> <p>-ve: Increasing incidence of disease in urban areas.</p> <p>-ve: Increased mobility closely associated with prevalence and spread of infectious disease</p> <p>-ve: High-density populations in areas that only offers limited natural goods and services.</p> <p>-ve: Increasing scarcity of coastal and marine resources in urbanised areas.</p> <p>-ve: Restricted access to the coast for traditional users.</p> <p>-ve: Greater vulnerability when work takes people away from home (fewer social ties and lack of social cohesion increases likelihood of engaging in high-risk sexual behaviour).</p> <p>-ve: Loss of ecosystem services due to urban land use change increases exposure poverty risks described in Issue 1.</p>	KE, TZ, MZ	<p>Emerton & Tessema 2001 UNEP 2004 Kazungu 2001 WWF 2007 Wagner et al (undated) TCMP 2001 Enosse et al 2001 IISD 2003 UNEP (undated) – Coastal vulnerability GEF & UNEP 2002</p>

No	Issues	Ecosystem links	Poverty links	Scale	References
5	<p>Governance vs. government and the increasing role of social organisation in all forms of sustainable development.</p> <ul style="list-style-type: none"> ● Decision making procedures, the promotion of individual agendas i.e. tourism/industrial developments. ● Non-transparent management of common property/privatisation of resources. ● Lack of capacity within county councils to carry out effective developmental planning i.e. sewage, road and rail infrastructure. ● Disruptions caused by civil unrest and the resultant displacement of people 	<p>Greater environmental sensitivity and awareness of coastal communities involved in cooperative governance can contribute to improved management of coastal ecosystems and their services. However, in some case, traditional “top-down” management is required by the elected custodians i.e. government, in order to safeguard resources and ecosystem services for the benefit of all citizens.</p>	<p>-ve: Impact on livelihoods through the loss of these services associated with natural landscapes. -ve: Loss of access to ES services, negative impact on livelihoods – disproportionately amongst the poor. -ve impacts on health through spread of water borne diseases -ve: Loss of potential to derive all services provided by coastal and marine habitats. -ve: Increasing distrust of government intervention. -ve: Breakdown of relationships between poor communities, decision makers and government officials. -ve: Marginalisation of the poor due to political agendas. -ve: Inability of the government to recognize critical custodianship role that include the responsibility to ensure sustainable use of natural resources through management. The beneficiaries of good governance are firstly coastal communities and then all citizens.</p>	TZ	UNEP 2004 Emerton & Tessema 2001
6	<p>Extensive and intensive tourism activities and construction of associated facilities.</p> <ul style="list-style-type: none"> ● Growth in the coastal property market associated with the tourism potential of an area. ● Construction of tourism infrastructure. ● Migration to the coast due to the perceived livelihood options offered by coastal tourism. ● Siting of tourism ventures heavily dependant on services and state of ecosystems. 	<p>-ve: Direct threat to marine and coastal habitats through change in land use. -ve: Habitat destruction during construction -ve: Coral habitat destruction due to unmanaged diving and trampling. -ve: Excessive extraction of fresh water from natural reservoirs to supply tourism needs (pools, washing, gardens etc.) and regulating of waste processing (sewage, garbage) -ve: Demand for beach front property and resultant change in land-use. -ve: Greater demand on ecosystem services relating to waste treatment and pollution assimilation. -ve: Intrusion of human species into an environment and species assemblage not familiar with their presence.</p>	<p>+ve: Increased economic growth and employment rates contributes to improved livelihoods. -ve: Loss of access to provisional services, specifically that of fishing and harvesting of coastal and marine resources. +ve: Increased direct employment opportunity through the establishment of supporting services – a multiplier effect throughout the local economy -ve: Dependency on tourist sentiment and associated tourism activities. -ve: Tourism revenues not captured locally (leakage). -ve: Increase in local prices for land, foodstuffs and other necessities. -ve: Conflict between local communities and tourism ventures. -ve: Decreased access to natural resources due to exclusivity of tourism and associated supporting services and residential development. -ve: Degraded ecosystems provide less services to tourism industry as well as to local communities.</p>	KE, TZ, SIDs	Kazungu et al 2001 Wagner et al (undated) TCMP 2001 GIWA 2004

No	Issues	Ecosystem links	Poverty links	Scale	References
7	<p>Global climate change may be responsible for changes in rainfall patterns, an increased occurrence and severity of storms, and rising sea levels.</p>	<p>-ve: Impact on provisioning services i.e. agriculture as well as regulating services of human disease control, contamination of water table due to sea level rise, -ve: Coastal flooding -ve: Coastal erosion. -ve: Reduction productivity of habitats due to climate change impacts e.g. coral bleaching -ve: Reduction in agricultural provisioning potential due to climate variability -ve: Reduction in provisioning of freshwater and regulating service of maintaining a hydrological balance. -ve: Increased atmospheric CO2 concentrations will decrease coral growth and disrupt fisheries and climatic patterns.</p>	<p>-ve: Output capacity of provisioning services reduced, -ve: Reduced income and negative impact on livelihoods. -ve: Increase in outbreaks of diseases malaria and increasing susceptibility to disease. -ve: Coral bleaching – reduced output in terms of services associated with coral reefs (tourism desirability). -ve: Loss of homes due to sea-level rise. -ve: Greater vulnerability to stochastic climate events and associated effects i.e coastal erosion, habitat destruction. -ve: Increasing distance to travel obtain sources of freshwater. -ve: Reduced agricultural output and food security. -ve: Reduced income due to mariculture seaweed die-offs probably caused by rising average water temperature -ve: Increased incidence of heat stress, air pollution, asthma, vector, water, tick and food borne disease (WWF 2006) -ve: Higher food and other commodity production costs due to water scarcity (desalination plants, transport of water and loss of production by industries). -ve: The majority of industries and human population live close to the coast where sea level rise will cause land loss, beach erosion and loss of infrastructure. This will in turn lead to loss of employment (especially in the tourism sector) and property and large human displacements. -ve: Structural damage and loss of lives caused by severe storms, especially the poor living in low-lying areas. -ve: Loss of traditional burial sites and memorial grounds. -ve: Loss of biodiversity critical to community support. -ve: Conflicts between user-groups over water use.</p>	KE, TZ, SIDS	<p>UNEP 2006 IMF 2007 Kazungu et al 2001 Ngusaru 2000 TCMP 2001 WWF 2006 GIWA 2004</p>
(8)	<p>Low coastal agriculture productivity due to:</p> <ul style="list-style-type: none"> ● Lack of appropriate technologies and skill. ● Inappropriate sited mariculture and aquaculture facilities. ● High dependence on water resources. ● Extensive use of pesticides and fertilisers ● Habitat modification 	<p>-ve: Algal blooms and reduced fish catches related to high use of fertilisers. -ve: Siltation and destruction of coral reefs caused by forest clearing for agriculture. -ve: Continuous cultivation without the provision of fallow fields have led to soil impoverishment and soil erosion. -ve: Possible pollution of groundwater by agricultural run-off, but no data are available. -ve: Pollution of freshwater supply by pesticides and fertilisers. -ve: Reservoirs and dams build for irrigation negatively affects productivity of floodplains</p>	<p>-ve: Increased dependence on coastal agriculture -ve: Mariculture seaweed die-offs due to rising average water temperature increases vulnerability. -ve; Distance and access to markets and lack of negotiating skill. -ve: Woman primary participants and hence vulnerable to gender inequalities brought about by the absence of male support, and disease +ve: Short term: Agriculture provide employment and an important economic sector, particularly for Mauritius, Madagascar and Comoros. -ve: Modification of stream flow for irrigation negatively impacts water availability to the tourist sector, especially in the</p>	TZ, SIDs	<p>Wagner et al (undated) GIWA 2004</p>

No	Issues	Ecosystem links	Poverty links	Scale	References
		and functioning of lakes.	rural areas of Mauritius and Madagascar as well as other industries		
(9)	Environmental issues related to aquaculture and mariculture , such as benthic enrichment, hypoxic water conditions and habitat modification of coastal wetlands and mangroves.	<ul style="list-style-type: none"> -ve: Regulating services provides habitats suitable for mariculture. -ve: Uncertain and negative impacts on receiving habitats. -ve: Loss of coastal wetlands and mangroves used for aquaculture purposes. Coastal wetlands and mangroves are used as nursery grounds by natural shrimp populations and has significantly reduced the replenishment of these populations -ve: Coastal erosion due to habitat modification, level of destruction is undocumented 	<ul style="list-style-type: none"> +ve: Viable option for income generation but needs to be planned from culture (infrastructure, technical expertise etc.) to products (markets, demand etc.) for communities to benefit while remaining economically viable. +ve: Short term: Economic benefits and employment opportunities. -ve: Maricultured seaweed die-offs due to rising average water temperature increases vulnerability. -ve; Distance and access to markets and lack of negotiating skill. -ve: Woman primary participants and hence vulnerable to gender inequalities brought about by the absence of male support, and disease. -ve: Long-term unsustainability of aquaculture industry could lead to job losses and increase poverty. 	TZ, SIDs	Wagner et al (undated) GIWA 2004
(10)	Establishment of protected areas .	<ul style="list-style-type: none"> +ve: Protection of habitats. +ve: Opportunity for tourism and recreation revenue. +ve: Increased provisioning services outside protected areas caused by a spill-over effect. +ve: Productivity of provisioning services increased – recovery of threatened species due to the proclamations of sanctuaries/no take zones 	<ul style="list-style-type: none"> +ve: Enhance the productivity of ecosystems services, improved species diversity and catch rates. +ve: Direct source of revenue generation, especially through tourism. +ve: Improvement of livelihoods due to MPA related enterprises i.e. building boardwalks in mangrove forests. -ve: Distances to travel to collect fuelwood from non-protected areas -ve: Distances to travel to non-protected fishing grounds -ve: Destruction of crops by wildlife from protected areas -ve: Reduction of land by proclamation of protected areas. -ve: Negative perception of conservation measures compounds a culture of unsustainable environmental practices. -ve: Loss of customary conservation practices, reduced environmental education and awareness levels. -ve: Displacement of fishers in regions of MPA establishment-inability to use marine resources for livelihoods. -ve: Lack of capacity to manage MPAs cause distrust in the concept of protected areas as only those willing to bend the rules will benefit. 	TZ, MZ	Ngusaru 2000 TCMP 2001 Wells et al 2007 GEF & UNEP 2002

3.1.1 Human population growth and movement in coastal areas

This is one of the root drivers of other causes that lead to local environmental degradation. As with the world at large (e.g. Wilson et al. 2002), population growth is generally higher at the coast than in East Africa as a whole due to migration from inland areas, although this does not hold true everywhere. Large inland lakes (as in Tanzania and Kenya) as well as strong inland industrial centres (as in South Africa's gold mines) are equally important factors in human demography. In Tanzania, coastal areas excluding Dar es Salaam have lower population growth than the country as a whole, although there is large variation among districts. A lower proportion of the population ($\approx 25\%$) in Tanzania lives near the coast than in other EAME countries. All the countries in this region are experiencing declines in population growth rates in excess of 20%, with South Africa calculated to have a 95% reduction in population growth rate from 2.1% to 0.1% (UNEP 2006). These reductions are significant and largely attributable to HIV&AIDS. Population growth in Mauritius is also low at 0.8%, attributable largely to its improved economic conditions and human development index over the years (UNEP 2006). Urbanization has also been a major factor with a near doubling in all countries over the past 30 years. This trend is projected to continue over the next decade, resulting in an anticipated decrease in rural population numbers. Nevertheless, the growth of coastal populations throughout the region is still expected to increase in the foreseeable future, especially in the large coastal urban centres of Maputo, Dar es Salaam, Mombasa and Zanzibar. Increased and shifting human populations have been described as the biggest threat to the natural resources in the EAME region (Sosovele 2000).

An important aspect of coastal population growth is migration, either because perceived employment opportunities are greater at the coast, where most of the region's industrial and tourism infrastructure is concentrated, or because in times of drought or crop failure, the coast is seen as a last-resort resource. In some cases, such as the Lamu-Kiunga area of Kenya, migration has been increased by deliberate policies of resettling people (WWF 2001). The most severe case of deliberate re-settlement to the coast took place in Somalia during the Soviet era when, during drought condition, nomadic herdsmen were resettled along the coast in very large numbers and engaged in industrial fishing ventures. Although many later returned to the rangelands, those that remain today have taken to artisanal fishing.

3.1.1.1 *Ecosystem services affected and links to poverty*

Population growth and migration increases demand on all ES. Family farms or plots may be inadequate as the family grows in size, resulting in a drop in per capita production, or forcing some members of the family to seek employment elsewhere driving migration (Sachs 2005, Oglethorpe et al. 2007). Growing populations need more space for residence, more infrastructure, use more water and other resources. Migration may exacerbate user conflicts over resources and land tenure and add pressure on infrastructure provision, beyond expectation. New migrants to an area may be unaware of customs, traditional management systems or taboos on using some resources. For example, the demise of a colony of sooty terns in northern Mozambique has been partly attributed to the collection of eggs by migrants to the area (Kemp 2000). Yet, scientifically-based egg harvesting of the same species in Seychelles is known to be sustainable and generate valuable income for artisanal fishers. Similarly, the depletion of some fisheries resources in Zanzibar, notably octopus, has also been attributed to increased fishing by fishers from the mainland who have access to motor boats. A traditional closed season for octopus is known to protect the resource during its growth phase, a fact that is not a custom of the migrant fishers (Saleh Yahyah *pers com*). However, migrants may also bring new knowledge and skills and diversify economic activities (Oglethorpe et al. 2007).

3.1.1.2 *Trade-offs and policy*

Although population is considered a driver of many environmental changes, it is often not considered as an issue in and of itself. For example, EAMEP (2004) expects the coastal population of the EAME region to double by 2030, and that everyone should be accommodated within any sustainable plan, while Sosovele (2000) argues that "increasing numbers alone do not pose major threats. It is how the resources are used and distributed that really constitutes the main problem". Although the relationships between numbers of people, consumption patterns and ecological impact are not clear (Agardy et al. 2005), this is probably not a tenable argument for the medium and long term. While absolute population densities may not be high in most of the EAME countries, the level of direct dependence on natural resources may already be unsustainable and the rates of population growth in most of the countries will stretch the abilities of governments provide or improve vital services. Ecosystem management and even restoration, along with improved technologies, discussed in other sections of this document can certainly

enhance levels of production, but limits will eventually be reached if they have not already been. The idea of 'sustainable use for everyone' has been referred to as a placebo and an 'absurd notion' by Jackson (1997), who contends that many marine and coastal ecosystems were depleted long before modern monitoring or baseline studies began and that even well-managed reefs systems are being stretched beyond the point of sustainability. It is well established that fertility rates decrease with increased income, employment opportunities and education among women in particular and with decreases in infant mortality rates (Dasgupta 2001, Sachs 2005, among others) and these goals should be pursued within the region. Demographic and economic trends in Mauritius demonstrate this well. Madagascar, among the EAME nations also recognises this explicitly (Anon 2007) and reducing family size is one of its priority health care goals. However, it is notable that these trends are not always consistent, especially at local levels and that a variety of interactions between poverty, population and resource degradation have been elucidated; nor is it always clear which of the factors are causative in population growth and which just correlative (Dasgupta 2001).

Migration to coastal areas could probably be reduced if more attention was paid to rural development as a whole. In particular, poor access to arable land is seen to be a driver of people to the coast. Improving productivity in rural areas, access to water, electricity, health benefits and crucially, markets would all form part of such a policy (e.g Enosse et al. 2001, Anon 2001). Madagascar demonstrates progress here with cooperative mechanisation as part of a strategy to increase small scale agricultural productivity.

The introduction of low-cost, simple technologies to improve productivity is also important (Enosse et al. 2001). This was recognised by Schumacher (1973) who wrote that what is needed are methods and technologies that are cheap enough so that they are accessible to virtually everyone and suitable for small-scale application.

3.1.2 Loss of biodiversity

Conservation of biodiversity underpins all aspects of the maintenance of ES. The EAME and the WIO ocean in general, is an area of high diversity of both marine and terrestrial biota. Fishing pressure and climate-induced bleaching of corals have already had considerable effects on marine systems in the area (van der Elst *et al* 2005). Large areas of seagrass meadows have been lost or damaged and populations of some key species are severely threatened, including flagship species such as the dugong and several turtle species. Countries throughout the region have made commitments to biodiversity conservation, including a plan to increase the size of protected areas in Madagascar from 1.7 to 6m hectares, 10% of the land area (Anon 2001).

3.1.2.1 Ecosystem services affected and links to poverty

Although the links are not always obvious, biodiversity provides a range of ES services. Some of those most commonly referred to are the potential for pharmaceutical and medical products and the importance of biodiversity for recreation, aesthetic, cultural and research purposes. Yet species and populations all play important ecological roles and the effect of removing any one of them can cascade through the system impairing its function and capacity to provide ES. Links within and between ecosystems, resilience and resistance to disturbances, maintenance of trophic webs, regulation of sediment properties and carbon flows are just some of the ES provided by biodiversity (e.g. Holmlund et al. 1999, Luck et al. 2003) The importance of diversity *per se* has been slow to be acknowledged, but was recognised by the millennium assessment: "...the available evidence clearly points to the key importance of the maintenance of the genetic, species, and landscape diversity of ecosystems in order to preserve the ecosystem services they provide...." (Díaz et al. 2005). The effects of biodiversity loss have been demonstrated on some Tanzanian and Kenyan reefs, where overfishing of predators of herbivores, especially triggerfish, has caused increases in fleshy algae and sea urchin abundance, which in turn negatively affects populations of other herbivorous fishes (McClanahan et al. 1999, McClanahan 2006). Other predators of sea urchins, including some wrasses and emperor fish seem less effective at controlling urchin populations at these sites. It is instructive to consider an extreme example of such overfishing from the Caribbean, where the decline of biodiversity similarly reduced the functional redundancy among herbivores, until control of algal growth was dependent almost entirely on sea urchin populations. When these collapsed due to disease outbreaks, uncontrolled algal growth led to many of the reefs becoming algal dominated rather than coral dominated, possibly irreversibly (Jackson 1997, Jackson et al. 2001 and references therein). Simplified ecosystems may still provide a level of provisioning services, but the products are often of diminished value and the ecosystem is much less resilient to further degradation.

There is a considerable body of local knowledge and tradition that should be considered in the planning of conservation measures. In Kenya, cultural beliefs and rituals are associated with particular sacred sites along the coast, as is the practice of appeasing and requesting favours from the spirits that inhabit them. At certain times of the year, sacred sites at sea were avoided for fear of upsetting the spirits. Other sacred sites associated with unusual phenomena or danger, were avoided throughout the year (McClanahan et al. 1998, cited in Whittingham et al. 2003). Such practices not only have cultural value but may contribute to resource management in the area, effectively acting as no-take zones.

Recognition of the importance of ecosystem effects was strengthened by the development of an ecosystem approach to fisheries (EAF) management (FAO 2003), where overfishing, sustainable use, modifications of ecosystems, economic losses, conflicts and food security are all incorporated in an overall management approach.

3.1.2.2 State of knowledge of this issue and evidence of thresholds

Knowledge of biodiversity in the EAME region varies among families of flora and fauna as well as geographically. In general, more is known about biodiversity within MPA's than outside them although most biodiversity continues to reside outside protected areas. More is known about species than about their ecology and interactions, yet features such as trophic webs and ecological redundancy may be as important in maintaining ecosystem functions as the number of species themselves and more research is needed to understand the relationship between different components of biodiversity and ES (Di'az et al. 2005). Globally, more is known about the status of species than about trends, and more is known of terrestrial than marine diversity. Much of the research on coral reefs in the region is concentrated on highly visible or commercially valuable species, such as corals and fish, leaving a host of others relatively unknown. Few phyla or species groups in the region have been comprehensively described, with data on species in deep water and sub-tidal soft sediments being particularly sparse (e.g. Kemp 2000). In the EAME there has been a rush to try to manage natural resources and biodiversity without adequate knowledge about species and their distributions, hindering effective management and conservation (Kemp 2000) and funding for basic research needs to be increased.

3.1.2.3 Trade-offs

Conservation measures to protect biodiversity may have the effect of shifting the benefits of biodiversity away from local consumers to wider society when their activities are restricted or banned in certain areas. It has been argued (Gutman 2007) that conservation still depends on large amounts of natural resources and few people managing them and that a more labour-intensive conservation model is needed, a view that is echoed by Campbell et al. (2006) who note that the practice of pro-poor conservation lags considerably behind the theory. Such strategies would reduce the perceived trade-offs between livelihoods and conservation. There are also trade-offs between protection of biodiversity and other activities such as mining and even tourism, insofar as tourism infrastructure intrudes on natural habitats. Uncontrolled tourism, including SCUBA diving can easily exceed the carrying capacity of the environment, resulting in severe damage to coral reefs (e.g. Enosse et al. 2001). A case study in Kisite, Kenya (Emerton and Tessema 2001) showed that conservation effectiveness was hampered by the inequitable distribution of benefits. Much of the revenue from a protected area went to the general government treasury, leaving the management of the park under-funded, a point also made by McClanahan et al. (2005) for Kenya as a whole. The benefits of improved resources, and tourism employment were seen as inadequate compensation for the loss of access to fishing grounds by the local population, leading to hostility towards the park. Surveys around a number of parks in Zanzibar revealed a range of attitudes towards the parks, but also that poverty was one of the reasons that led people to infringe the park regulations (Tobey and Torell 2006).

Trade-offs can be reduced if the benefit of conservation to local communities is increased. In this light, Gutman (2007) called for the re-invention of conservation as a labour-intensive enterprise, rather than the current paradigm of 'mostly parks'. Effective zonation of protected areas for different levels of use can also help reduce the effect of trade-offs. A WWF run project at Menai Bay, Zanzibar, which involved 17 villages in the establishment of a conservation area has resulted in decreased dynamite fishing, increased catches in the bay and direct financial benefit to local communities from entrance fees paid by tourists (Gawler et al. 2000), demonstrating the importance of retaining benefits of conservation at local scales.

3.1.3 Over-exploitation and destructive harvesting of living resources

Marine and coastal systems are extensively used for provisioning services. In the marine realm this is primarily for food, although coral skeletons for building, shells for curios and various products deemed to have medicinal value are also collected. Marine species are proving to be important sources of bio-products. Coastal areas, including intertidal rocky and muddy areas, mangroves and estuaries are also used extensively for provisioning services. In addition to food, these areas provide timber for fuel and building, fibres for weaving and roofing, medicinal plants and animals, amongst others.

Demand for these products is fuelled by a combination of population growth and increasing markets, especially as tourism develops. In the EAME, fishing is primarily artisanal, with as many as 3 million people dependent on fisheries for their livelihood (van der Elst et al. 2005 and references therein). Many of the fisheries in the region are already over or fully exploited (van der Elst et al. 2005), particularly the inshore fisheries that are accessible to artisanal and small-scale fishers, with reef fish at some sites declining by 40% in the last two decades (EAMEP 2004). However, there is some scope for increased production in the offshore fisheries of Kenya (small pelagic) and Madagascar (small pelagic and demersal) (EAMEP 2005). In many cases poor handling and preservation of the catch lowers overall value and thus decreases the benefits that can accrue to the fishers and their communities. Technical support and intervention could ameliorate this problem. In most of the EAME countries, local participation in large-scale industrial fisheries is limited. Patterns of exploitation differ within the region. For example, bycatch is considered a serious problem in the Comoros, but not at all in the Seychelles (UNEP 2004), while in Tanzania there has been a movement to remove turtle excluding devices from prawn-trawl nets because they also exclude bycatch species, such as sharks that are considered valuable (UNEP 2004).

Mangroves are over-exploited in some areas, but not throughout the range. In Mozambique, overall reduction of mangrove area is low, although in some locales, such as Maputo Bay it is a serious problem, estimated at 8% per year (Taylor et al. 2003). Overexploitation of living marine resources is exacerbated by destructive harvesting methods, including dynamite fishing, indiscriminate bottom trawling and the use of nets with small mesh.

3.1.3.1 *Ecosystem services affected and links to poverty*

The most direct effects of resource over-exploitation on ES is depletion of the resource stock itself, with obvious consequences for continued supply. In the case of fisheries, this might induce a switch to smaller size-classes or less valuable but disturbance-tolerant species, resulting in diminishing income and possible loss of nutritional value or to more destructive fishing practices (McClanahan et al. 2008). Similarly, overexploitation of mangroves may result in a drop in quality of the available wood, such as straight poles suitable for building, which affects the income of collectors. However, while the loss of direct provisioning services is the most obvious, there is a range of subsidiary effects to resource overexploitation. Species and populations play a valuable role in maintaining ecosystem functions. Loss or even depletion of species can lead directly to the loss of regulatory or supporting services offered by ecosystems. Overfishing of triggerfish in the EAME region can lead to uncontrolled sea urchin population growth (Kemp 2000 and references therein) and possible damage to the reef through grazing pressure. In the Caribbean, sea urchins became the major grazers after herbivorous fish stocks were depleted. When sea urchins suffered major disease-related mortality, many of the reefs were overgrown by algae, resulting in a 'phase shift' that persists today. In such circumstances, many of the functions of a reef are lost, including provisioning and recreational amenity.

3.1.3.2 *State of knowledge of this issue and evidence of thresholds*

Globally, vast resources are committed to assessing the state of marine resource stocks. Even within the EAME region, there is a considerable body of knowledge. Nonetheless, considerable gaps remain. More is known about large-scale industrial fisheries than about small-scale and artisanal fisheries, aided by multilateral bodies such as the Indian Ocean Tuna Commission (IOTC). Even so, stock status and maximum sustainable yields of some important resource species has not been determined, including swordfish and some tuna species (EAMEP 2005) and this is aggravated by likely under-reporting of catches by artisanal fisheries (van der Elst et al. 2005), which are not adequately supported by scientific knowledge, with only 27% of fisheries being managed on a scientific basis, only 14% having formal management plans and 76% needing further research (see also www.wiofish.org). Of the stock assessments that have been conducted, only that for the Mozambican industrial prawn fishery was considered adequate (van der Elst et al. 2005). Capacity to accurately monitor catches is inadequate in some countries. Trends in Catch per unit effort (CPUE) are not available for large parts of the region, making trends in landings difficult to interpret (van der Elst et al. 2005). Ecologically, much remains to be

known, including migration of populations and connectivity between them in much of the area, links with habitat and ecosystem functioning, especially for reef species. More research is needed on the effects of MPA's, especially in light of at least one study which showed that, in contrast to temperate areas, MPA's in tropical regions have failed to produce benefits for adjoining areas (Hodgeson 1998, cited in Gawler et al. 2000), although conservation of a coral reef area at Menai, Zanzibar has resulted in increased catches (Gawler et al. 2000). More detailed studies have shown that while only a few species demonstrate large spill-over effects into areas outside MPA's, these may be the species that are favoured by fishers, meaning that catches may show relatively large increases. The three main groups of fish to move from the Mombasa Marine National Park were surgeonfish, emperors and rabbitfish, which collectively represented 60% of the catch to local fishers, but only a small proportion of the species diversity (McClanahan 2006). Benefits of protected areas depend on a host of factors, including the length of time that protection measures have been in place (McClanahan 2006).

There is a dearth of knowledge on the links between resource depletion and other ecosystem services in quantitative terms and between the depletion of different resources, such as mangroves and fish, although at least one estimate exists (Moberg and Rönnbäck 2003) that 1km² of mangroves equates to 90-280 tons fish production per year. Even then however, the condition, species composition and density of the mangroves may well influence the figure. Knowledge of carrying capacity and limits of use for resources other than fisheries are often not well defined in quantitative terms.

From the human perspective, considerable knowledge in trends of dependence on marine resources, contribution to nutritional requirements, and access to resources has been accumulated in most areas of the region. Factors that influence behaviours, such as non-compliance with regulations or sustainable fishing practices are proving to be complex and multi-faceted. It has been demonstrated in Kenya that people with at least secondary education are more likely to respond positively to protective measures, especially the institution of closed areas (McClanahan et al. 2005). There was more positive response to restrictions on some types of gear. However, even when the benefit of regulations is widely perceived, compliance may still be low if there are barriers to the use of approved methods or areas. These may include higher expenses, for example to reach alternative fishing areas or to switch from spearfishing to other methods of harvesting.

3.1.3.3 *Trade-offs related to this issue*

There are a number of trade-offs that determine the patterns of resource exploitation. One of them is temporal - running down resources now in the hope of replacing or substituting them in the future. However, this is largely a false trade-off, because even in the short term, using resources within their limits assures their productivity, while long-term substitutability is uncertain. Relying on mariculture involves other trade-offs and to date most mariculture is concentrated on high value species for sale rather than for food security and local consumption. Moreover, depletion of living resources due to over-exploitation also degrades a range of non-resource ES, many of which are not substitutable (Moberg and Rönnbäck 2003) and can only be restored at great expense and effort, if at all.

The second possible trade-off, relating mostly to larger-scale resource exploitation – industrial fisheries – is that of local food sufficiency vs foreign exchange, either through the licensing of foreign vessels or the export of fisheries products, much of which ends up in the general fiscus, through exporting products or licensing. In many cases this involves trade-offs that occur outside the region, such as fishing subsidies to protect employment in other countries. These trade-offs need to be minimised by strengthening agreements with other countries, as is already happening in the EAME (EAMEP 2005) and by increasing the capacity to process seafood products within EAME countries, adding value to them and providing additional employment opportunities.

Often there is a strong incentive to take up activities that earn cash income, while requiring little in the way of start-up capital or other inputs. In the EAME region, a fishery for sea cucumbers, for export to the Asian market has resulted in depletion of stocks, as fishers progressed from hand collection on the intertidal flats to deeper waters, using more sophisticated equipment, including boats and SCUBA gear (Whittingham et al. 2003 and references therein).

There is also a trade-off between fishing and some types of tourism, where tourism is based on wildlife viewing or activities such as SCUBA diving (Pauly et al. 2005). It has been shown that specific attributes of coral reefs are important to divers' willingness to pay, with species diversity of fish and corals as valued attributes, along with visibility (Wielgus et al. 2003). However, it is also arguable that as some forms of

tourism decline due to a drop in environmental quality, others take their place. For example, diving tourism could be replaced by tourism based on other watersports or just the advantages of a good climate, especially during the northern hemisphere winter, while divers, or those tourists to whom biodiversity is important, would move on to other destinations. Both tourism and foreign exchange-directed fisheries can also be seen as at trade off between the welfare of local fishers and broader society.

3.1.4 Land use and habitat destruction

There is increasing demand for land for agriculture, tourist and urban infrastructure, industry and conservation, among others, resulting in the conversion of large tracts of land. Poor catchment management, deforestation and farming practices inland and at the coast, including slash and burn agriculture, can severely disturb coastal ecosystems through changes in freshwater flow, sediment load reaching the coast and nutrient inputs. While some of these activities may increase the flow to coastal areas, the building of large dams for water storage or hydroelectric power generation conversely starve the coast of sediments, resulting in coastal erosion, as has happened in Kenya's Tana Basin (UNEP 2006). These effects are magnified by the degradation of coastal environments, due to development, sand-winning mangrove removal among others. The combination of a degraded environment and increased inputs can result in the disruption of a range of regulatory, provisioning supporting ES. Artisanal mining is a problem in some areas, as mercury and other chemicals are washed into rivers.

Clearing of mangroves continues to be a problem. Although not on the scale that occurs in some other regions, the development of aquaculture, particularly of shrimp, and salt production are growing threats. In Tanzania and Kenya, plans for large prawn farms have been abandoned due to public protests and a poor business model. In Kenya salt production has caused seepage of saline water that has killed mangrove. Mangroves and other wetlands are reclaimed for roads and tourist development, especially in the Seychelles where the generally steep topography of the granitic islands means that flat land is at a premium (Gawler et al. 2000), while many of the wetlands in Mauritius have been reclaimed for residential developments. Sediment runoff is a problem, particularly in Madagascar where some mangrove stands have been affected by their roots being smothered (Taylor et al. 2003).

Tourism and associated developments are often touted as one of the potential engines of growth and poverty alleviation in the area. Yet tourism development is often poorly planned or ill-considered. Plans to develop a huge tourist resort on the island of Unguja that would have included several hotels and a golf course (Sosovele 2000) were shelved after protests. In Momabasa, Kenya the number of hotels trebled from 8-25 within 2 decades, outstripping the demand for accommodation and posing a potential threat to the environment (Taylor et al. 2003), especially the uninterrupted ribbon development north and south of Mombasa. Much of the tourism in the region is nature-based, which usually places limits on the number of tourists that can be accommodated. When this number is exceeded, it can lead to degradation of the environment and of the amenity itself. By the very nature of the industry, tourism developments often occur in or near areas of ecological importance, leading to infrastructure development in potentially fragile environments. In Mozambique, many tourists from South Africa arrive by car, bringing most or all of their equipment and supplies with them. A large proportion drive 4x4 vehicles, posing threats to beaches and other coastal environments. Mozambique benefits little from this type of tourism, which has long been a concern along the country's southern coast (Fennessy and van der Elst; Sosovele 2000).

3.1.4.1 Ecosystem services affected and links to poverty

Poor land use results in the loss of many of the regulating services provided by mangroves, including flood and erosion control, nutrient recycling, waste absorption and filtering and provisioning, most notably through the loss of nursery areas for fish, but also of mangrove-dwelling invertebrate and fish species. This can have severe economic effects, especially in areas such as the Zambezi delta, where mangroves systems are the preferred nursery for shrimp that comprise an important fishery (Taylor et al. 2003). The reduction of runoff to rivers, through excessive water abstraction or damming upstream can reduce the amount of potable water available in coastal areas and severely affect the dynamics of estuaries. The latter effects are most pronounced in relatively small estuaries. Deforestation and habitat fragmentation (mainly through smallholder subsistence farming and mineral exploitation) causes loss of biodiversity, and reduces access to a range of forest products. Erosion causes loss of topsoil reducing agricultural productivity and increases the probability and severity of floods. Among the indirect effects is an increase in vulnerability among people who resort to harvesting wild products when agricultural crops are poor or

fail altogether (e.g WRI et al. 2005). The important function of coastal protection is compromised when mangroves, coral reefs or sandy beaches are damaged or lost.

Tourism can lead to over-exploitation of water and other provisioning resources, often for luxury items like swimming pools or golf courses. An extreme example from outside the EAME is the Maldives, where over extraction of ground-water has resulted in salinisation of water supplies and land subsidence. Sewage from tourist facilities in the Seychelles is often pumped directly to the sea while many stands of mangroves there have been cleared for tourist development, although the Seychelles has better treatment facilities for solid waste than the other SIDS in the area.

Tourism can cause the alienation of land from local communities, or limit their use of previously common resources. In some cases, tourism can add to pressure on natural resources. For example, on Bazaruto, Mozambique, most of the employment in the tourist industry is taken up by people from the mainland (Enosse et al. 2001). As a result the new infrastructure is unlikely to draw local people away from artisanal resource exploitation. Similarly, on the Zanzibar island of Unguje, high-class tourism developments on the southeast coast have resulted in the displacement of women from accessing nearshore areas for seaweed cultivation and reef gleaning, which was thought to spoil the area for tourists, although legally locals cannot be prevented from these activities (Wallevik and Jiddawi 1999, cited in Whittingham et al. 2003).

Culture and peoples' pride in it may benefit from tourism (Yunis 2004), but can also be degraded as the drive to provide commercially attractive services, including art, overrides tradition. In some areas, tourist facilities, such as night-clubs refuse to admit local patrons, causing resentment towards the tourist industry. Tourism is subject to the vagaries of fashion, international markets and politics, potentially resulting in underused and over-capitalised infrastructure as tourists move on to newer destinations. The decline of the Kenyan tourist industry (Akama 1999) provides an example. The current rise in fuel prices may well affect tourism in the EAME, especially as EAME countries are generally 'long-haul' destinations for foreign tourists. It has been postulated that tourism is bound for eventual decline and possible collapse unless thorough, long-term strategies are firmly in place (References in Akama 1999), yet this is seldom the case in EAME countries. The world tourism organisation (WTO) has outlined principles of sustainable tourism and begun a programme 'Sustainable Tourism as an Effective Tool for Eliminating Poverty (ST-EP)' (Yunis 2004).

3.1.4.2 State of knowledge and thresholds

As with many other issues, the nature of changes is better known than their quantitative effect, thresholds or limiting factors. However, there is considerable knowledge, if properly applied about minimising the effects of many forms of land use. Mapping of land use and its changes and satellite images are useful tools in land management and ICZM.

3.1.4.3 Trade-offs

The trade-offs in different land-use choices are among the most stark of all facing the EAME region today. Any land use has an opportunity cost for any other potential uses and there are immense demands from many sectors of society. The need for increased agricultural productivity needs to be balanced with the need for conservation, maintenance of water quality, etc. The main challenges in land use vary between countries. For example, in Mauritius, up to 50% of wetlands have been converted to tourist developments in some parts of the island and there is enormous pressure for land to provide for residential and business development (UNEP 2006b).

It is almost impossible to avoid trade-offs around land use options. The provision of infrastructure, increases in energy supply, increasing the proportion of arable land under irrigation, meeting the demands of industry, agriculture and mariculture and residential and tourism facilities are all necessary, but all place conflicting demands on land use. In some cases, altering natural habitats seems inevitable. For example, there is broad acknowledgement that the agricultural sector needs to become more productive and this will inevitably mean higher inputs of fertilisers and probably more irrigation. The African Development Bank has recently assigned a sum of US\$ 1 billion to improving agriculture on the continent. Industrialisation and the associated improvement of roads are needed throughout much of the region. Madagascar has prioritised building roads and 'a green revolution' approach to agriculture and rural development that would include the establishment of agri-business centres (Anon. 2007). Intense mining activity is also part of Madagascar's economic strategy. In Mozambique, it is acknowledged that the pace of rural development is directly related to the investment in increasing capacity and productivity

and the infrastructure to support these goals has been prioritised (Anon 2006). Such investments are likely to affect patterns of land use, especially in terms of agricultural inputs.

However many other changes in land use turn out to be counter-productive. Shrimp farming has been estimated to yield far lower economic returns than intact mangroves (Levy et al. 2005) and has the potential to impoverish communities via a number of different pathways (Lebel et al. 2002, cited in Agardy et al. 2005). Shrimp ponds in mangrove areas tend to have limited productive life-spans and after their abandonment the area often remains as a salt barren, with little regeneration of mangroves.

There are ways to reduce the effect of necessary trade-offs in land use. Zonation of areas for multiple use may maintain vital ecosystem functions (Agardy et al. 2005). Improved methods and technologies, such as conservation tillage in agriculture are being more widely practiced. New agroforestry techniques have been used to increase production and these can include the use of nitrogen fixing plants in depleted soils. Cuba, rated by the WWF as the only country to be 'sustainably developing' achieved this largely by restructuring its agriculture sector to be less resource intensive after the collapse of the Soviet Union led to severe shortage of fuel, fertilisers and pesticides. There is considerable potential to reduce waste of agricultural and other economic activities. To some extent this occurs in integrated aquaculture projects, where, for example, fish, molluscs and seaweed are cultured together. Terrestrially, techniques are being developed by the ZERI (zero emissions research and initiatives, www.zeri.org) organisation to generate added value from by-products that would normally be discarded as waste. For example, in an experimental brewery in Tsumeb, Namibia, spent grains from the brewing process are used to grow mushrooms, before being used to feed livestock. The waste from livestock is flushed into a digester, using wastewater from the brewery, producing methane that generates energy and nutrients that are used to grow algae that are in turn fed to fish in an integrated aquaculture system. Whether such projects can be scaled up or repeated at national levels is yet to be discovered, considering that the start-up costs are probably high. There is also scope for ecological restoration and rehabilitation, although these are often expensive and the results uncertain. Adger et al. (2006) have described many attempts at reef restoration as 'well-intentioned but misguided'. Nonetheless, there are areas, such as wetlands and forests, where much can be achieved by restoration and rehabilitation.

3.1.5 Pollution

Industrial pollution is a less severe threat in the EAME than in many other areas of the world. However, there is extensive organic pollution, especially from untreated sewage and to a lesser extent from agro chemicals. Often these wastes are discharged to the environment with little or no processing (Kemp 2000, UNEP 2004). Sewage discharges in the main coastal cities of Maputo, Dar es Salaam and Mombasa are mostly directly into nearby bays or estuaries, creating environmental and human health hazards. Port-based activities, including ship repairs and TBT painting add to the toxic load. Increasingly the discharge of ballast water from ships is recognised as a significant polluting factor with risks of introducing invasive species. There is also always the danger of oil spills, although with one or two exceptions, these have so far been limited mainly to small spills in harbours. Oil spills in the port of Mombasa have affected mangrove forests in the area. Beaches, and other intertidal areas, as well as estuaries are particularly vulnerable to oil spills. Disposal of solid wastes has been rated as one of the most critical problems for island states. Only the Seychelles and Madagascar have facilities for processing of solid waste, although disposal remains a problem even there (UNEP 2004). Pollution from the vapour trails of aircraft being recognised as a major cause of climate change, which must be considered in the light of the expanding tourist industry in the region. A form of pollution that is often understated is that of smoke from indoor cooking and heating, which may affect up to 75% of those living in absolute poverty in the region (WRI et al. 2005).

Pollution in the Western Indian Ocean

Table 6: Land-based activities and sources of pollution in the Western Indian Ocean (Mmochi and Francis, 2003).

Land-based activities and sources of pollution	Link to ecosystem service and poverty
Lack of infrastructure and treatment facilities for large quantities of domestic sewage generated by	Greater reliance on ecosystem services to process waste products. Simultaneously, ecosystems in urbanised areas are under increasing pressure due to rural-urban migration, increased population densities and rapid land-use

expanding coastal urban populations	change. The environment in developing countries are required to play multiple roles in providing goods such as clean water and air, substrate for agriculture and other natural resource harvesting while also transporting and “treating” waste. The poor has greatest reliance on goods directly and untreated from the environment. Reduced quality of goods required for basic human survival has direct and costly impact on peoples health and well-being.
Increasing number of visiting tourists	Immediate need for high-quality products such as clean water (potable and for recreational use e.g. swimming pools, water sports) while simultaneously generating disproportionate amounts of waste.
Siltation related to agricultural activities	Siltation and sediment transport has potential to negatively affect productivity of habitats such as mangroves, coral reefs and intertidal rocky shores. These provide direct provisioning ecosystem services and thus the livelihoods of people reliant on these resources are more vulnerable. This is an integrated coastal area issue that has origins inland extending to entire catchments. The link between terrestrial ecosystem services and their management is apparent.
Dumping of solid domestic waste	Both aesthetic and ecological effects are evident. Coastal tourist destinations must comply to minimum environmental standards (e.g. Blue Flag beaches) to attract tourists. Tourism is a sector that could contribute to providing greater livelihood opportunity to coastal communities and the poor. Sustained and long-term tourism strategies depend partly on the quality of the environment to provide these opportunities. Solid waste can negatively affect functioning and productivity of habitats e.g. fishing line and solid waste fouling of coral reefs.
Enactment and implementation of laws and policies relating to waste disposal and quality of effluents Initiation of monitoring programmes	Policy required to ensure a reasonably clean and productive environment which in turn provides ecosystem services. Pollution and associated issues requires legislations and management intervention to regulate the impact on the environment. This is an overriding concern that, once addressed, could positively influence the health and well-being of the poor.

Priorities for action and strategies

- Scales of coastal habitat degradation due to either physical effects or chemical pollution.
- Development of long-term water quality and pollution monitoring programmes.
- The extent and epidemiology of microbial contamination of groundwater from on-site sewage disposal.
- The extent of saline intrusion in groundwater as a result of increased extraction (urban, tourism) as well as sea-level rise.
- Chemical and physical effects on coastal habitats of releasing large volumes of untreated domestic effluent into near shore coastal waters.
- Degradation of coastal habitats, particularly coral reefs, from siltation associate with soil erosion.
- Sedimentological impacts of land use (land clearance, deforestation, industrial and tourism developments, mining) change.

Regional capacity needs

- National pollution monitoring programmes that includes coastal contaminant surveys in order to identify priority pollutants, potential pollutant hotspots and major land-based sources of pollution.
- National and accredited laboratories that can analyse water samples as well as collect and analysis marine benthic samples.
- Procurement of suitable instruments and the expertise to maintain and repair such instruments.

3.1.5.1 Ecosystem services affected and links to poverty

Organic pollution has particularly severe effects on coral reefs, causing eutrophication and predisposing corals to disease and other infestations. In extreme cases, entire reefs can undergo phase shifts and become algal dominated systems, with the loss of all provisioning and regulating services, as well as loss of tourist and recreational amenities. A number of marine and coastal species, including turtles and

seabirds, are vulnerable to choking when they try to eat items of litter, such as plastic bags or cigarette butts. Others are known to become tangled in plastic strapping.

Pollution is directly detrimental to human health. High incidences of diarrhoea and cholera occur in some EAME countries as a result of organic pollution of water sources (UNEP 2004). Pollution can also decrease the amenity value of the environment, with effects on tourism and local recreation, especially in areas where tourism is nature-based. This encompasses most of the EAME. High *E. coli* counts at popular beaches impact on tourist numbers, as the case of Durban's loss of Blue Flag beach status attests. Deaths occur due to indoor pollution from smoke (WRI et al. 2005). Aside from the direct health costs of such diseases, other effects are loss of productivity and potential loss of market value of products from polluted areas.

Pollutants also bio-accumulate in organisms rendering them unsafe for human consumption. Thus, filter feeding mussels and oysters can have high concentrations of faecal matter and other pollutants, compromising their value for personal consumption and marketing. Other species such as shrimps, larger species of fish and sharks also accumulate poisons, including heavy metals. This has already resulted in the closure of certain EU markets to some of these products from the EAME region, prompting Mozambique to set up a special marine resource quality inspectorate and research institute.

3.1.5.2 State of knowledge and thresholds

Some aspects of pollution and its effects are well described. For example, water and air quality standards and their relationships to human health are measurable and can be monitored. Some environmental effects of pollution are also well documented, although not always in quantitative terms. For instance, it is apparent that eutrophication is a consequence of organic pollution. However more needs to be known about the thresholds at the scale of local environments, the relationships between organic pollution, eutrophication and other aspects of environmental state, such as the status of herbivore and filter-feeder populations that may provide resilience in the system.

3.1.5.3 Trade-offs and policies

The trade-offs in this issue are fairly obvious. Most industrial and agricultural activities result in pollution of one or other form, yet are necessary if poverty alleviation is ever to extend beyond the barest of subsistence livelihoods. It has been argued that Africa is under-polluted. Most of the EAME countries need better infrastructure and more electrification. Although some of this can be through renewable electricity resources, it is likely that considerable electricity generation will still come from fossil fuels. Increased inputs into agriculture are needed, and although the negative effects can be minimised, they may not be entirely avoidable. However, considerable reductions in other forms of pollution, notable solid wastes and sewerage are possible. Indoor pollution, from cooking and heating can be alleviated by electrification or even by improved kerosene burning stoves or the highly efficient charcoal stoves piloted by IUCN.

3.1.6 Global climate change

The reality of anthropogenic climate change and its effects are already being felt. Although climate change seems to be progressing faster at the poles than at the tropics, tropical regions, including the EAME are home to a large proportion of the people most vulnerable to its effects. All the countries of the EAME are rated in the top 3rd in terms of vulnerability to climate change (Yohe et al. 2006). Effects of climate change already include mass bleaching of coral reefs, which caused mass mortalities throughout the Indian Ocean, including the EAME region in 1998, ocean acidification which could affect the ability of many calcifying organisms, including corals, to build skeletal structures. There is some debate about the ability of corals to adapt to changing conditions, but little doubt that even if species do adapt reef communities will be greatly reduced. Many of the changes to ecosystems may be gradual at first and may not be perceived until a critical threshold is reached (Adger et al. 2005).

More frequent and severe extreme weather events are predicted consequences of climate change, including ENSO events, storms, droughts and floods and changes and increased variability in long term weather patterns. The EAME is predicted to receive more precipitation in the wet months but less in the dry months (IPCC 2001, cited in Case 2006). Overall, the growing season in much of the region expected to be affected, possibly become shorter (Case 2006) and the region may experience more droughts (IPCC 2001, cited in Case 2006). The ice cap and glaciers on Mt Kilimanjaro are already shrinking and may disappear completely by 2015-2025 (Thompson et al. 2002, cited in Case 2006). The

distribution and intensity of diseases, including malaria may change, as might the distributions of many plant and animal species. Low lying land, especially in the SIDS may be submerged completely. Up to 70% of the land area of the Seychelles is at risk (UNEP 2004), possibly including the atoll of Aldabra, a world heritage site. This coral atoll, the largest in the world constitutes almost a third of the Seychelles land area and hosts a range of unique species, including the threatened flightless rail and one of the only nesting grounds in the area for frigate birds (UNEP 2004). The situation is even more dire for the Maldives (outside the WIO region) as the average height above sea level of the entire country is only ≈2m.

Urban vulnerability to climate change - Mombasa and coastal disasters

In terms of the potential impact of climate change in an urbanised environment, the case of Mombasa, Kenya's second largest city with more than 700,000 inhabitants stands out (Awuor et al. 2008). It is the largest seaport in East Africa, but also a city prone to natural disasters (Table7).

Table 7: Climate-related disasters typology, trends and impacts relevant to Mombasa, Kenya (taken from Awuor et al., 2008).

Disaster type	When it is/was experienced	Established incidence rate or return period	Impact profile (who, what was affected most and quantity/extent of damage)	Remarks
El-Nino	1947, 1961 and 1997	Approximately 5 years	-Houses destroyed -Property lost -Livestock and crops lost -Human lives lost -Increased disease incidents (cholera, typhoid cases)	Most affected areas are estates located near the ocean and lacking or with poor drainage structures or systems.
Floods	Frequently (almost annually)	unpredictable	Houses destroyed -Property lost -Livestock (all types lost) -Human lives lost -Increased disease incidents (cholera, typhoid cases)	Most affected areas are estates lacking or with poor drainage structures or systems.
Tsunami	2006	Unpredictable	-several fishing boats reportedly destroyed	1 human life reportedly lost
Drought	2005/6	Every 4-5 years	-All agricultural activities are affected. -Women spend more time looking for water.	As time is spent in looking for water, other activities suffer time allocation. - Droughts also cause famine
Hunger/Famine	Every year	Every year	-Loss of human lives from starvation (not quantified) -Gross mal-nutrition and under-feeding leading to poor economic productivity	Effects are felt across all age-groups and gender.

The people most at risk from climate change in an urban environment are those (Satterthwaite 2008):

- Least able to avoid the direct or indirect impacts (e.g. by having good quality homes and drainage systems that prevent flooding, by moving to places with less risk or by changing jobs if climate-change threatens their livelihoods);
- Likely to be most affected (for instance infants and older groups who are less able to cope with heat waves);
- Least able to cope with the illness, injury, premature death or loss of income, livelihood or assets caused by climate change impacts.

3.1.6.1 Ecosystem services affected and links to poverty

Although the effects of climate change are difficult to predict in quantitative terms, it has the potential to devastate entire ecosystems and the ES that they supply. Almost all ES discussed above may be affected, as well as cultural ES, for example if climate change forces increased migration, or leads to destruction of sites of cultural importance or loss of traditional lifestyles. Decreased regional rainfall in Tanzania has reduced flow of rivers resulting in water shortages, lowered agricultural production, increased fungal and insect infestations, decreased biodiversity and variable hydropower production (Orindi and Murray 2005, cited in Case 2006). Reduction of runoff from the glaciers of Kilimanjaro will similarly affect agricultural productivity and the availability of drinking water (some effects are already

being felt) and such effects are likely to be widespread in the region. More erratic rainfall may result in more frequent floods and increase erosion and loss of topsoil with resultant sedimentation at the coast. Food security will be reduced and overall vulnerability increased. Marine fisheries will likely be affected, both because of the loss or degradation on habitats, such as coral reefs and mangroves, and due to effects of higher water temperatures on many species of tropical fish. Intertidal habitats, including rocky shores and beaches may become submerged or eroded, with implications for harvesting and possibly tourism and recreation. Migration patterns of many animals may change. Some of the effects of climate change have already been felt in the EAME area. Much of the area was affected by the mass coral bleaching in 1998, although the subsequent effects on livelihoods have not been well documented. A seaweed farming project in Tanzania was affected when rising water temperatures resulted in die-offs of seaweed stock.

3.1.6.2 State of knowledge and thresholds

Predictions about the effects of climate change on east African countries have been well reviewed (Case 2006 and references therein) and will be broadly similar in the region, at least within tropical zones. Temperatures are expected to rise by between 0.2 and 0.5°C per decade, causing wetter wet seasons and dryer dry seasons before 2050, along with more sporadic, intense and less predictable rainfall. Effects on migration routes and species distributions are expected, although they cannot be predicted with any certainty. These may result in conflict between humans and animals and lower resilience in biological communities as their species composition changes. More droughts, reduced river flows, including of the Pangani and Ruvu river in Tanzania and the disappearance of Kilimanjaro's glaciers will decrease food security and possibly increase desertification. More intense El Niño events will exacerbate these problems. Effects on human vulnerability and on human health due to the spread of diseases, on biodiversity and resilience of ecosystems are all predicted, but with fairly wide confidence intervals and time scales.

3.1.6.3 Trade-offs and policy

Many of the trade-offs are similar to those for pollution and land use, since climate change is an effect largely of the burning of fossil fuels and degradation of ecosystems' absorptive capacities. Since countries in the EAME contribute little to climate change on a global scale, their ability to mitigate it is limited. It's even arguable that many countries, including in the EAME need to increase their carbon footprint to spur economic development. Mozambique is a case in point, with per capita carbon emissions at only 0.1 ton per year, compared to one for Sub-Saharan Africa as a whole and a global average of 10. While cleaner energy sources are obviously preferable, they are often expensive and in many cases involve other trade-offs. As an example, Mozambique is heavily reliant on hydro-electric power, and is planning to increase its capacity. But the negative effects of large dams, both environmental and social are well known. There have also been recent cases in Mozambique where the effects of flooding were exacerbated by the need to release water from dams upstream of flooded areas. Carbon trading schemes may provide some incentives for conserving ES services related to climate regulation, although the advantages need to be carefully weighed.

There is a great need for early warning systems and public education about them, to avoid situations, as were reported from Kenya, of people ignoring warnings about the 2004 tsunami. Improved capacity to withstand extreme weather events, including better water storage methods and possibly improved food storage. People living in low lying areas susceptible to flooding, both at the coast and in flood plains of rivers are particularly vulnerable. Improved forecasting, for example in the case of ENSO and Indian Ocean Dipole (IOD) events can help farmers in their choice of crops or the timing of planting. Better knowledge of the spread and epidemiology of diseases such as malaria will allow quicker responses.

Conservation strategies need to take account of the likely consequences of climate change. In case studies across the region, in which environmental susceptibility and social adaptability were considered together, it was concluded that strategies need to incorporate large-scale protection of ecosystems; active transformation and adaptation of social-ecological systems; building the capacity of communities to cope with change; and government assistance focused on de-coupling communities from dependence on natural resources in varying proportions according to the site (McClanahan et al. 2008). However, countries in the region are ill-prepared to implement such measures.

3.1.7 Inadequate governance and institutional capacity

Institutional capacity and governance effectiveness are key components of the successful management of ES and of poverty alleviation. Planning, implementation and monitoring of management programmes are essential ingredients of potential success. As countries in the EAME make more commitments to international programmes and treaties, the capacity to meet those commitments needs to expand. Countries of the EAME frequently lack the capacity at all levels of government, from local to national. Lack of institutional capacity is often exacerbated by poor governance. In some countries, governance capacity was lost during Structural Adjustment programmes, when decreasing the size of the public service was often a requirement. As a result, measures are either not instituted to protect resources, or are poorly executed. An obvious example is the management of MPA's. The Kenyan Wildlife Service depends on visitors' fees for the finances to manage MPA's, but the revenue generated by fees is inadequate for effective management (McClanahan et al. 2005). Lack of knowledge about resources and resource management among the officials in charge is also a problem, at least in Mozambique (Enosse et al. 2001). In Tanzania, coordination between state agencies and sectors is limited and the lack of a comprehensive institutional framework is a drawback to the implementation of ICZM (UNEP 2001).

3.1.7.1 Ecosystem services affected and links to poverty

Three of the most important aspects of governance from the point of view of poverty alleviation have been identified as resource tenure and property rights; decentralization of resource management; and the rights to participation, information, and justice (WRI et al. 2005). Poor governance can undermine efforts at sustainable development, leading to degradation of all ES. Inappropriate rural taxes and an over-bureaucratized government structures are frequently found in the region, such as in Tanzania (UNEP 2006b). In Madagascar the land tenure system is being overhauled

Although somewhat of a separate issue, the slow development and adoption of new technologies is also related to governance structures. In particular, continued reliance on technology developed outside the region, that may not be designed to best address the problems of the region is a problem (UNEP 2006b, and references therein). Technologies that need to be further developed include relatively simple ones, such as rainwater harvesting, which is the subject of considerable attention in Kenya (UNEP 2006b).

Poverty Reduction Strategy Papers (PRSPs)

"Poverty Reduction Strategy Papers (PRSP) describe a country's macroeconomic, structural and social policies and programs to promote growth and reduce poverty, as well as associated external financing needs. PRSPs are prepared by governments through a participatory process involving civil society and development partners, including the World Bank and the International Monetary Fund (IMF)." (World Bank Group 2008).

PRSPs are thus planning tools that guide national policy development, implementation and budgetary allocations. PRSPs are being developed and adopted by national governments of developing countries as frameworks for government's actions and priorities resulting in policies committed to reducing poverty. In 2004, 40 countries had full PRSPs and 14 had complied interim PRSPs (I-PRSPs). Of the ten Western Indian Ocean (WIO) states, four have full and complete PRSPs viz. Tanzania, Mozambique, Madagascar and Kenya. The Comoros has previously received a grant for the preparation of an I-PRSP and Mauritius and the Seychelles, which are under no obligation to produce such documents, demonstrated commitments to reducing poverty in their national policies (Walmsley et al. 2006).

Tanzania's and Mozambique's I-PRSPs were all accepted in 2000 and covered the periods up to 2003 and 2005, respectively. Kenya's I-PRSP was submitted to the World bank in 2002 and accepted in 2004 (Walmsley et al. 2006). Madagascar first prepared its PRSP in 2003, finalised it in 2005 and has subsequently also produced a new PRSP called the Madagascar Action Plan (MAP) to cover the period from 2007 to 2011 (The World Bank 2006). A summary of the PRSPs in the WIO region is provided in the table below.

Table 8: Summary of the PRSP status, period of the most current PRSP and achievements of each Western Indian Ocean country. (“-” indicates there is no PRSP for that country).

Country	PRSP status	Current PRSP	Achievements
Comoros	Forthcoming	In preparation	-
Kenya	Full	2004-2007	<ul style="list-style-type: none"> ● National Environment Action Plan (NEAP). ● Environment Management and Coordination Act (1999). ● National Environmental Management Authority, by 2005. ● Natural resource inventory and valuation, by 2007. ● Other activities include the implementation of WSSD, MDG, and Lake Victoria Environmental Management Project. ● A fisheries policy and master plan is currently under development.
Madagascar	Full	2007-2011	<ul style="list-style-type: none"> ● Creation of and additional 500 000 and 100 000 hectares of protected areas in 2004 and 2005, respectively. ● Implementation of 2 management plans for the conservation and promotion of the importance and the quality of natural resources to allow sustainable economic growth and better quality of living. ● Reforested 7.300ha in 2004. ● Decreased burnt areas from 680 000ha in 2004 to 555 938ha in 2005. ● Increased the number of environmental permits from 18 in 2004 to 37 in 2005. ● The Foundation for Protected Areas is 80% operational.
Mauritius	-	-	N/A
Mozambique	Full	2006-2009	<ul style="list-style-type: none"> ● Ecosystem services are recognised for their importance in poverty reduction and as a result a high level of detail for this sector is included in the PRSP. ● Implemented the collection of public revenues from the use of natural resources. ● Goals in place from 2006 to 2009 for decreased violations with respect to the management of flora and fauna (natural resources) via increased inspections to monitor compliance with laws on natural resources.
Réunion	-	-	N/A
Seychelles	-	-	N/A
Somalia	-	-	N/A
South Africa	-	-	N/A
Tanzania	Full	2005/06-2009/10	The environment has been recognised as an important source of subsistence and income and as a result has been added to the 2005-2010 PRSP.

With respect to the content of the National PRSPs, there has not been adequate promotion of the importance of the influence of marine and coastal ecosystem services on poverty in the WIO region and thus also inadequate budgetary allocations for addressing the sustainable and equitable management of natural resources (Walmsley et al. 2006). Madagascar has however incorporated a longer term vision in its 2007 MAP which puts emphasis on rural areas via the optimal use of its resources while also respecting the environment (The World Bank 2006), and that development of natural resources must be accompanied by adequate provision for the protection of the environment (Republic of Madagascar 2003). Kenya's PRSP recognises the importance of natural resources in long-term economic growth but the strategies identified do not specifically address the potential contribution to livelihoods and poverty reduction (Government of the Republic of Kenya 2004). Mozambique's PRSP recognises that

“Most of Mozambique’s population depends on natural resources for subsistence and income. Action Plan for the Reduction of Absolute Poverty (PARPA) II, in light of that reality, recognizes that attaining its objectives depends heavily on how those natural resources are managed and preserved, and on the relationship between their use and exploitation and benefits for the poor.”

and it is,

“...the priority of PARPA II in the fisheries sector and the coastal and marine zone management program is to ensure that appropriate measures are taken to promote environmental sustainability in these sectors through integrated management of the marine and coastal environment, and of fishery resources that protects important ecosystems (mangroves, coral reefs, and coastal and interior wetlands).” (Republic of Mozambique 2006).

Tanzania acknowledged the link between poverty exacerbation and environmental degradation, and the lack of adequate mechanisms for dealing with cross-cutting issues such as the environment. As a result the government addresses water and environmental health under the non-income poverty status and other cross-cutting issues through sustainable development and improvement in the quality of life in the framework (United Republic of Tanzania 2005).

Tanzania's and Kenya's PRSPs contain little detail about natural resources and their links to poverty. Although these are now included in the newly formulated PRSPs, constituting an improvement, there is still a need for more detailed recognition of the role of natural resources to assist in implementation and attainment of poverty relief goals. Mozambique and Madagascar have a high level of detail regarding the environment, the services it provides and the effects on poverty in their PRSPs which is concomitantly reflected in their poverty reduction achievements.

4. ECOSYSTEM SERVICES AND POVERTY ALLEVIATION SUMMARISED

One of the problems, with elucidating links between poverty alleviation and ES is that while the services that are offered by particular species, habitats or ecosystems and the linkages between them are well described, there is far less meaningful information to quantify the relationship between the state of the ecosystem on the state of the related ES. Where these links have been quantified (such as with fisheries yields) they are often tentative or have fairly low confidence. Although more efforts are being made in this direction (such as the benefits of MPA's to fish stocks), much remains to be done (see also MA, ch5, box5.2). It has been noted (Gutman 2007) that more is known about the consequences of ES collapse than about their management and about managing environments to provide single services than a variety at once. Yet it is the knowledge to effectively manage complex ecosystems to provide multiple ES that is needed if decisions about the inevitable trade-offs among different use options are to be informed and effective. Similarly, while the effects of individual threats or events on environments are becoming clearer, the effects of multiple stresses occurring simultaneously are more difficult to understand (Adger et al. 2005), as is the extent of ecological resilience to them.

There is little doubt that more is known about the provisioning services than about regulating or supporting services, particularly in quantitative terms. Degradation of the latter two can certainly result in increased poverty, largely because their loss affects the provisioning services through the loss of production of environmental goods, but also through effects on human health and increased vulnerability. Hence, although all three categories must vitally be maintained, it is through the provisioning services that material benefits are most directly realised. Perhaps as a result, the links between provisioning services and human well-being seem to have received the most attention, at least in quantitative terms. Another reason may be that environmental goods – fish, timber, water among others – are simply easier to quantify and their decline more visible than regulating or supporting services.

Although it is intuitive that the loss of regulating and supporting ES due to degradation of ecosystems will cause the loss of provisioning ES, it is just as important but far less intuitive that the reverse is also true - the loss of provisioning services also affects the regulating and supporting services. This has been cogently demonstrated by Jackson et al. (2001) who show that historical overfishing led to the collapse of many marine ecosystem services, including resilience to pollution and eutrophication and resistance of important species groups to disease. Thus what are generally regarded as provisioning goods and services also supply important supporting and regulating services. This should emphasise the primacy of protecting such stocks and resources as the first step in the conservation of marine ES in general. Another result to emerge from Jackson et al. (2001) was that gradual depletion of resources led to a catastrophic and unpredictable change when a threshold that had not been anticipated was reached.

Other examples, although not as extreme are available, such as when mangroves fail to recover after mangroves have been cleared from large areas, which remain as salt barrens (Taylor et al. 2003).

It has been suggested that the extent of rural poverty can be partly attributed to the changing dynamic of the relationship between rural and urban areas. Over the last century or more, the proportion of GDP attributable to rural production has declined globally and rural populations have become proportionately poorer than those in urban areas, including in most EAME countries. Yet urban areas absorb and depend on many of the ES that emanate from rural ecosystems, while rural areas continue to be viewed as sources of goods and labour (Gutman 2007), resulting in poor terms of trade between urban and rural areas which can diminish the effects of GDP growth on poverty alleviation (RAWG 2005). To some extent, then, it is not an exaggeration to say that rural populations and especially the rural poor are carrying the burden of sustainability, potentially at some cost to their own well-being, leading at least one view that conservation "...resembles a group of rich urban people telling a group of poor rural people, "You should not do this; you should not do that...because we like it that way" (Gutman 2007). It has been demonstrated that resource-dependent communities living adjacent to terrestrial conservation areas bear a disproportionate share of the costs of conservation (references in McClanahan et al. 2005). This problem is exacerbated by other factors. Many ES are still not adequately included in national accounts, despite some progress in this area. Combined with the continued use of GDP as the primary measure of national progress, this leads to the undervaluation of ES and the rural contribution to economies as a whole. Various solutions have been suggested to this dilemma, including setting up markets for environmental goods and services (Gutman 2007), as has already been done in some places. The government of Costa Rica pays landowners for ES services, including protection of watersheds and biodiversity, and recoups the money by a tax on fossil fuels (Daily et al. 2000). It has been suggested (Barnes 2006) that corporations pay 'rent' for their use of common resources. In coastal areas this could include, for example, aquaculture companies paying rent directly to local communities for the services that have been lost due to mangrove clearance. A model for this type of payment already exists, in the form of the 'polluter pays' principle. At an international level, wealthy countries, which are overwhelmingly responsible for the emissions that lead to climate change should contribute to mitigating and adapting to its effects in developing nations (Sachs 2005). Such a fund should not be considered as aid, but reasonable rent for expropriation of global common property resources.

A couple of issues have not been addressed above, which are nonetheless crucial. These include health, with malaria and HIV the most obvious. Land and resource tenure has been briefly addressed under governance issues, but could be considered an issue on its own. All of these are cross-cutting and affect all of the issues addressed above. Cultural ES have been largely subsumed by the other categories and need separate treatment.

The state of knowledge in the region is generally inadequate. However, a number of regional and international initiatives, many linked to the Nairobi Convention and including the EAMEP, WIOMSA, RECOMAP and CORDIO should help to address this issue. Conservation and resource management have been prioritised in the region, but the infrastructure to ensure their success is still inadequate. Many ES are probably considerably depleted throughout the region. For example, four priority conservation sites in Mozambique all showed deteriorating resources and diversity (Enosse et al. 2001), including the Bazaruto Archipelago, a world heritage site. This case can probably be generalised – the way that natural resources are currently used and managed is neither sustainable nor equitable (Campbell et al. 2006) nor can continued exploitation of natural resources provide incomes for increasing numbers of people (Jackson 1997, Campbell et al. 2006). A shift away from coastal resource dependence to alternative livelihoods such as non-primary industries must therefore become a key strategy in poverty alleviation (Campbell et al. 2006) and is also regarded as important for EAME countries to cope with climate change (McClanahan et al. 2008).

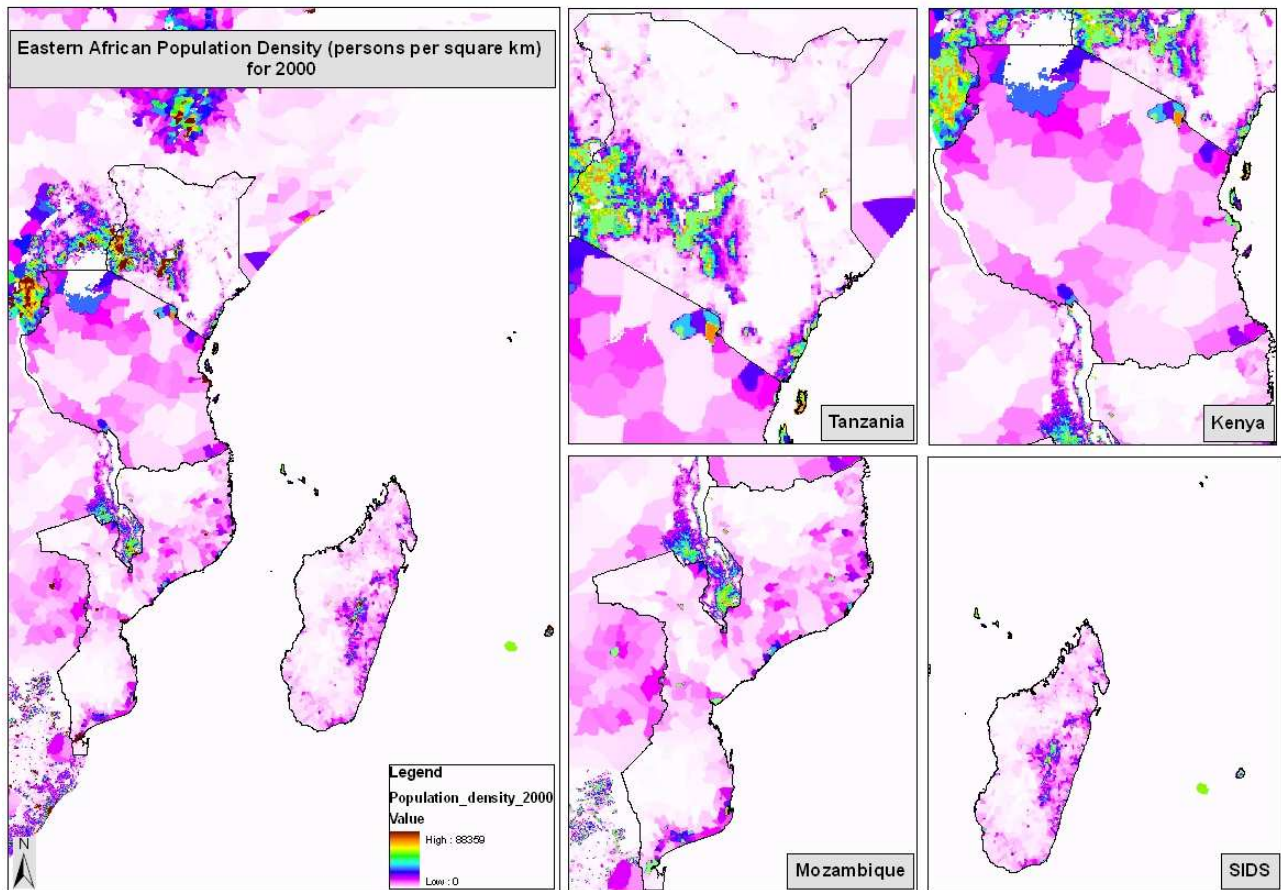


Figure 1: Population density (persons per square km) for East Africa in 2000. [East African population density for 2000 was sourced from the Gridded Population of the World Version 3(GPWv3). Population density grids were created by the Center for International Earth Science Information Network (CIESIN)].

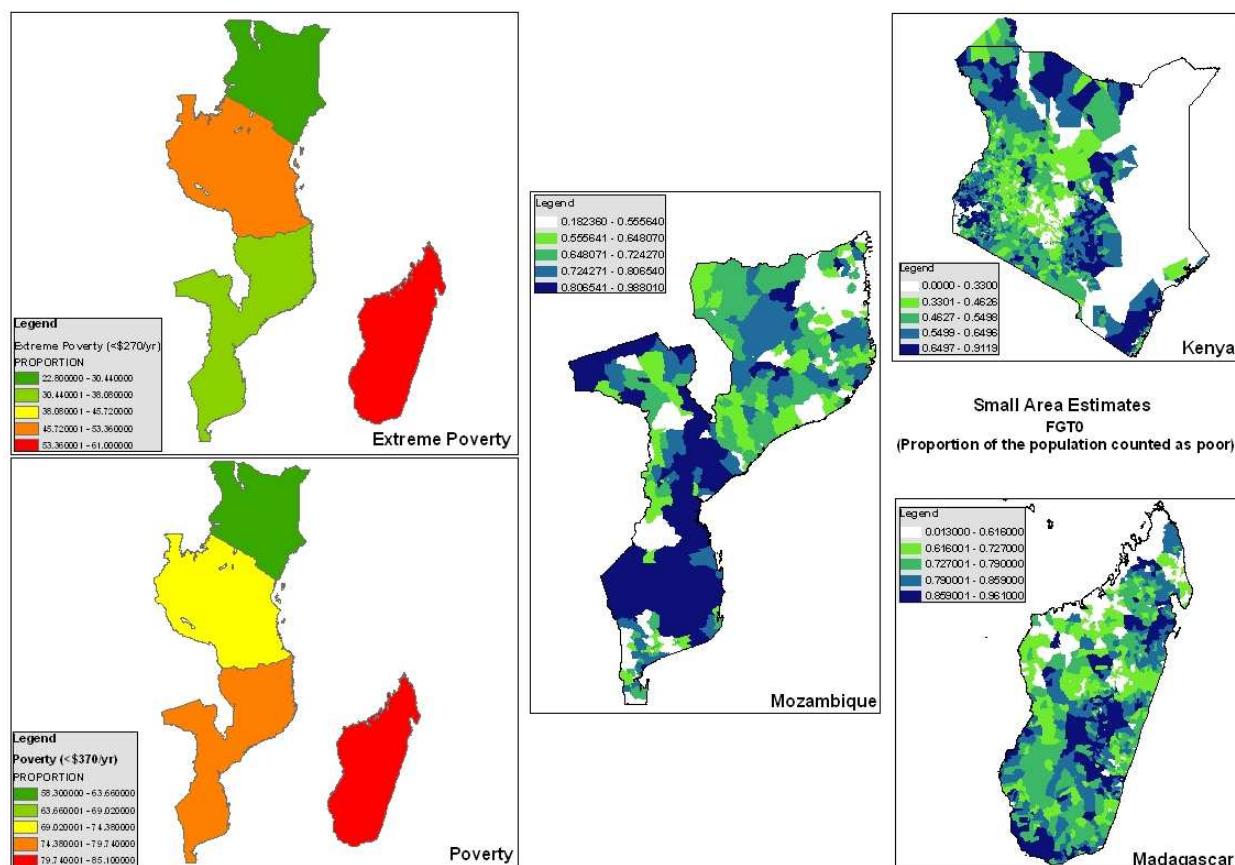


Figure 2: Poverty, a) poverty (<\$370 per year) and extreme poverty (<&270 per year), in East Africa and Small Area Estimate (SAE), FGT0 (proportion of the population counted as poor) for b) Kenya, c) Mozambique and d) Madagascar. [East African poverty and extreme poverty were created by the FAO Food Insecurity, Poverty and Environment Global GIS Database (FGGD) and Small Area Estimates (SAE) for Mozambique and Madagascar data were created by the Center for International Earth Science Information Network (CIESIN)]. SAE for Kenya were created by the World Resources Initiative (WRI)].

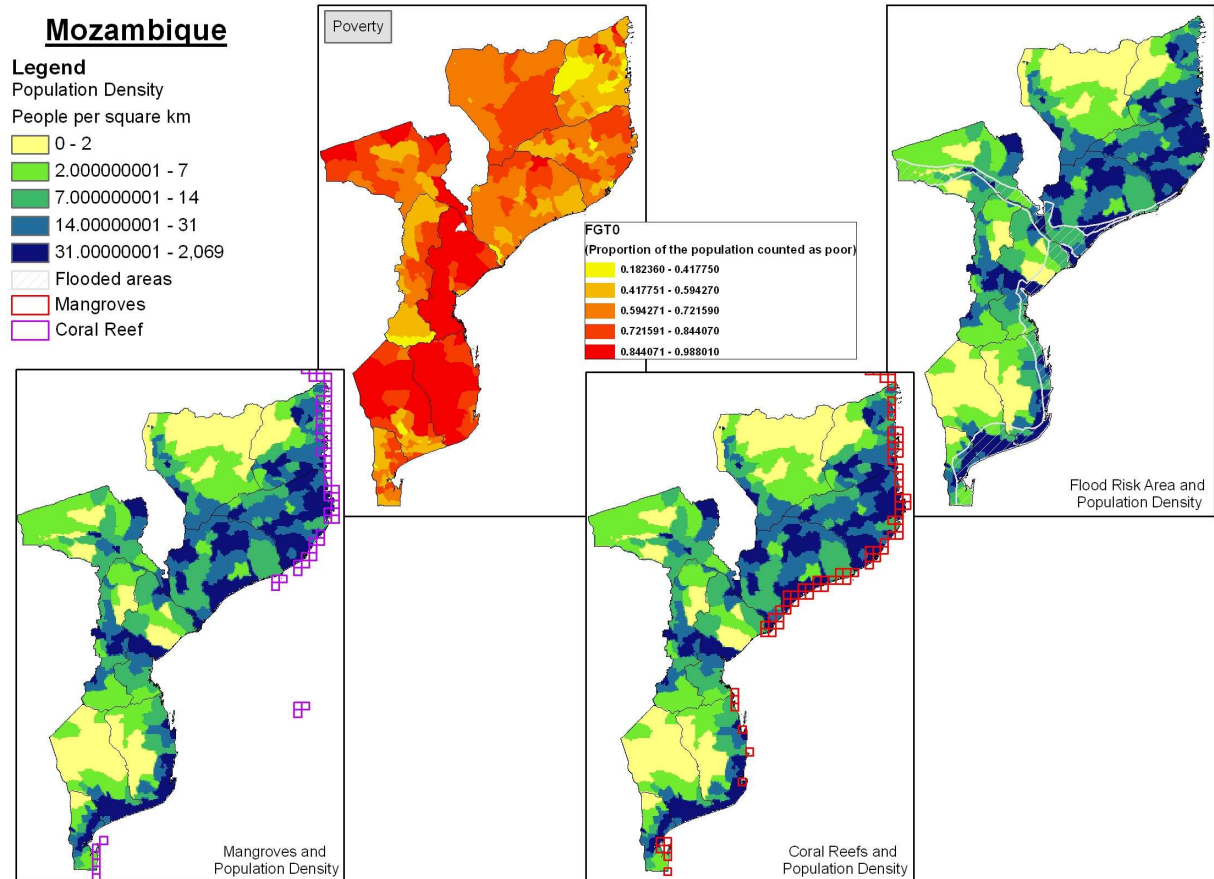


Figure 3: Mozambique population density and a) mangrove locations, b) coral reef locations and c) flood risk area [Population Density data for Mozambique were created by the Centre for International Earth Science Information Network (CIESIN). Mangrove and coral reef locations were determined using a 0.5 degree grid and data created by TRANSMAP 2004 and UNEP and, the Innovation Fund, Council for Geoscience, World Resources Initiative and UNEP, respectively. Flood risk areas were created by SAHIMS. (UNEP data were downloaded from the Nairobi Convention Clearinghouse and Information system at <http://gridnairobi.unep.org/CHMPortal>).].

B - INSTITUTIONAL ANALYSIS: KENYA

Summary questions:

a) What are the key institutions with capacity to generate research on the links between ES and poverty?

These institutions include but are not limited to the Kenya Wildlife Service, Kenya Marine and Fisheries Research Institutes, Ministry of Fisheries (formally fisheries department), Kenya Forest Service, National Environment Management Authority, Wildlife Conservation Society, Coral Reef Conservation Project, Coral Reef Research and Development in the Indian Ocean, Pact Kenya and Kenya Sea Turtle Conservation Committee. Most of the institutions in Kenya are involved in ES activities and may have aspects of poverty alleviation but may not specifically focus on poverty alleviation.

b) What are the key institutions with capacity to interpret and apply knowledge on ES and poverty?

Most institutions have the capacity to interpret and to some extent apply knowledge on ES and poverty. Sometimes application is limited by lack of resources. However, key institutions include KWS, the ministry of fisheries, KFS, and NEMA.

c) What are the main capacity needs and what are they related to?

Major capacity needs relate to personnel and financial resources.

d) What are the possible strategies to address these needs?

Capacity building through training and funding.

Table 1: Key institutions in ES and poverty alleviation in Kenya

1. Organisation / institution	2. Responsibilities / mandate	3. Main area (ES, poverty, span poverty and ES?)	4. Power	5. Scale	Institutional capacities to generate and use scientific						
					6. Involved in generating scientific knowledge? Natural, social, interdisciplinary?	7. What capacity does it have to generate this knowledge?	8. Does it use scientific knowledge? Natural, social, interdisciplinary?	9. What capacity does it have to interpret and apply knowledge?	10. Which sources of knowledge does it have access to	11. Where is this knowledge located?	12. Can other institutions gain access to the knowledge possessed by the institution?
KWS – Kenya Wildlife Service	-Implement research on wildlife that has the capacity to inform and provide policy direction - protection and conservation of the country's fauna and flora in and outside protected areas	Span poverty and ES -KWS conducts research and supports community development infrastructure through mobilisation and education as well as compensation from wildlife damages	Legal KWS is a state cooperation with legal mandate To protect and manage fauna and flora and has a legal mandate to suggest policy directions	Geographical KWS activities cover a protected areas and some areas outside protected areas although its mandate is national	Both, interdisciplinary KWS undertakes research is natural in nature but with aspects of socioeconomic and environmental management	Medium KWS is able to access funds to undertake the studies. Most of the researchers are natural scientists. Research outputs are relied upon in developing management efforts.	Both, interdisciplinary Both natural and socioeconomic knowledge have been used especially in identifying the need to involve communities in wildlife management	High KWS was initially an enforcement agency but capacity has been developed to undertake research, interpret and apply results	They have their own databases from research activities, own reports, and have access to external reports and sometimes engage external consultants	Both internally and externally Have a research station in Mombasa and others inland and collaborate with other government institutions and stakeholders	Yes They have a library where their reports are available both raw and published. - have a website where additional reports can be downloaded - Other information may be accessed through request
Ministry of fisheries	-institutionalise fisheries monitoring system -facilitate demand driven research -encourage analysis of data collected as an early warning system of exploitation impacts and for evaluation of management interventions and -scientific reporting	Span poverty and ES Undertakes fisheries resource research through monitoring and recently issued 17 boat engines to community based organisation	Legal The ministry has a legal mandate to develop specific policy framework for fisheries resource management	Geographical It has a national central office, provincial and district offices	Both, interdisciplinary Monitoring is undertaken by both natural and social scientists. Also collaboration with the Kenya Marine and Fisheries Research Institute and other researchers is sought	Medium The ministry was initially staffed with fisheries resource managers but has recently started building research capacity	Both, interdisciplinary These are used in general management of fisheries in terms of closures (recent BMU initiative) and gear management	High The staff are highly trained personnel in fisheries resource management	They have their own database, generates own , and consults external reports, and sometimes engage external consultants	Both internally and externally Have a provincial office and various district offices involved in monitoring and data collection at landing sites and run their own database	Yes Through request and a website where additional information can be downloaded for free. - a library is also available and one can use with permission

KMFRI-Kenya Marine & Fisheries Research Institute	- conduct aquatic research covering all the Kenyan waters, corresponding riparian areas including the Kenyan's EEZ	Span poverty and ES It is within their mission to contribute to the management and sustainable exploitation of aquatic resources and thus alleviate poverty, enhance employment creation and food security through multidisciplinary and collaborative research.	Legal It is a state cooperation established through an act of parliament and therefore has capacity to affect policy	Geographical Has a central office and satellite stations	Both, interdisciplinary -Its research programs are aquaculture, environment an ecology, fisheries information and data management, natural products and socioeconomics	High Its main focuses are research but are also involved in poverty alleviation initiatives specifically through mangrove project.	Both, interdisciplinary The information collected is used to inform policy and management	Medium The capacity to interpret is high but since it is mainly a research institute, they are only occasionally involved in its actual application	Have their own databases, generates own reports and have access to external databases and reports. They collaborate with external partners through various projects including WIO Lab etc, and undertakes commissioned research	Both internally and externally KMFRI has its own data base, produces reports and publications from their own research activities and also have access to external databases.	Yes Through requests
KFS – Kenya Forestry Service	Enhance development, conservation and management of forests	Span poverty and ES -KFS supports and facilitates farmers to raise trees and forest products in their farms to release pressure on gazetted forests as a way of diversifying income and contributing toward environmental conservation. -An addition activity is micro-enterprise development	Legal It is a state cooperation established through an act of parliament and therefore has capacity to affect policy	Geographical Its operations are limited in specific gazetted forest areas in the country	Both, interdisciplinary -Through rehabilitation and protection of catchments sites, seedlings production, biodiversity conservation, micro-enterprise development, an interdisciplinary framework is adopted	Medium -It is a very new and may not have developed adequate capacity within the short period of time it has been in existence	Both, interdisciplinary Probably in rehabilitation and protection of catchments sites, biodiversity conservation, and micro-enterprise development, an	High Have highly trained personnel	Develop their own reports, may also have access to external reports depending on the needs of their researches, and engage external consultants	Both internally through own reports, and externally (sister/collaborating institutions) and libraries	Yes Through requests

NEMA – National Environment Management Authority	Ensuring clean and healthy environment for all by supervising and co-ordinating over all matters relating to the environment - it is the principal instrument of Government in the implementation of all policies relating to the environment	ES -All its activities relate to environment and policy issues but not poverty alleviation	Legal -It has legal mandate to implement all policies relating to the environment	National Has a national central office, provincial and district offices in the country. Its programs operate nationwide.	Both, interdisciplinary Especially through environmental impact assessment and audit reports	Medium Personnel are trained specifically in environment management fields	Both, interdisciplinary -Both are used in making decision relating to environment quality issues	High Interpretation follows specific guidelines. Reports are also subjected to public review and comments	Own expertise reports, external reports, external consultants	Both internally and externally Produce own reports, reports from external consultancies and have developed own guidelines	Yes Through the website and or request
WCS – Wildlife Conservation Society	Technical and financial support for research activities on marine reserves and fisheries	ES Focuses mainly on provision of technical and financial support for research activities mainly on marine reserves and fisheries but not poverty alleviation	- Results are relied upon in undertaking advocacy of science-based solutions and partnerships	Geographical Has a central office where all research is coordinated	Both, interdisciplinary Natural research on coral reefs, fisheries, sea cucumber and socioeconomic drivers to resource management is conducted	High It is able to access funds to undertake research and has built partnerships and collaborations	Both, interdisciplinary -Through recommendation of science based solutions	Medium Have adequate capacity to interpret results but is not involved in implementation but does advocate and evaluate implementation	Own databases, own reports, and publications external reports, external consultants, commissioned research	Both internally and externally Have own databases, reports and published work in library	Yes Through request
CRCP- Coral Reef Conservation Project	Research on impact of management on coral reefs	ES Involved in research in coral reefs and fisheries but not directly poverty alleviation	Advocacy of Science-based solutions and partnerships	Geographical Has a central office where all research is coordinated	Both, interdisciplinary Natural research on coral reefs, fisheries, and socioeconomic research	High It is able to access funds to undertake research and has built partnerships and collaborations	Both, interdisciplinary -Through recommendation of science based solutions	Medium Have adequate capacity to interpret results but is not involved in implementation but does advocate and evaluate implementation	Own databases, own reports, and publications external reports, external consultants, commissioned research	Both internally and externally Have own databases, reports and published work in library	Yes Through request

CORDIO – Coral Reef Research and Development in the Indian Ocean	Natural and socioeconomic research on coral reefs as well as improving livelihoods through information communication & technology (ICT)	Span poverty and ES Involved in basic research on coral reefs and have recently embarked on building capacity of local community to raise income through ICT	Partnerships It is a recognized NGO in coral reef and community development through partnerships	Geographical Has a central office where all research is coordinated and involved in a regional socioeconomic monitoring networking office	Both, interdisciplinary Natural scientists are involved in generating information relating to coral reefs while socioeconomic network monitors socioeconomic factors	High It is able to access funds to undertake research and has built partnerships and collaborations	Both, interdisciplinary -Through advocacy and participating in poverty alleviation through ICT	Medium Have adequate capacity to interpret results but is limited in terms of implementation because of limited resources	Website, own databases, own reports, and publications external reports, external consultants, commissioned research	Both internally and externally Have own databases, reports and published work in library	Yes Through their website and or through request
Pact Kenya	Development organisation focusing on capacity building for sustainable development	Es and Poverty Builds capacity of local organisations, networks and coalitions with the aim of reducing poverty	Enforcement of moral suasion Builds capacity of local institutions through grant making and organisational development to be involved in conservation and diversify livelihoods	Geographical -Have a national office and a regional office with staff	Both, interdisciplinary Both information is generated for the purposes of their activities	Medium Their activities focus on developing organisations and not strictly generating knowledge	Both, interdisciplinary Suppose only during grant making	Medium Their activities focus on building capacity of organisations and not interpreting and apply knowledge	Own reports, external reports, external consultants	Both internally and externally Generate own reports that can be accessed through website	Yes Through their website and or through request
KESCOM – Kenyan Sea Turtle Committee	Sea turtle conservation, capacity building and diversification of livelihoods	Span poverty and ES -Initially were involved in stakeholder engagement is conservation & management of sea turtles but have started diversifying livelihoods to address poverty & relieve pressure on resources	Enforcement of moral suasion It is a recognized and respected NGO in sea turtle conservation and engagement of stakeholders	Geographical Activities cover most sections of the Kenyan Coast	Both, interdisciplinary Through own personnel and institutional collaboration, both natural and socioeconomic information is generated	High Through institutional collaboration, KESCOM has access to scientific capacity needed to generate knowledge	Both, interdisciplinary The information collected is used to direct conservation efforts and inform policy and management	Medium-High Capacity to interpret is high, however application may be limited by availability of resources	Own reports, external reports, external collaboration, regional database	Both internally and externally Own database and reports, and own website	Yes Through website and request

C - INSTITUTIONAL ANALYSIS: TANZANIA

Summary questions:

a) What are the key institutions with capacity to generate research on the links between ES and poverty?

Ministry Livestock Development and Fisheries (Fisheries Department), University of Dar es Salaam (Faculty of Aquatic Sciences and Technology (FAST), Institute of Marine Sciences (IMS), Department of Sociology and Anthropology and Institute of Resource Assessment (IRA)), Tanzania Fisheries Research Institute (TAFIRI), WWF, National Environment Management Council (NEMC), Tanzania Coastal Management Partnership (TCMP), Marine Parks and Reserves Unit (MPRU), Research on Poverty Alleviation (REPOA), Western Indian Ocean Marine Science Association (WIOMSA), Sea Sense, Tanga Coastal Zone Conservation and Development Programme (TCZCDP) and Marine and Coastal Environment Management Project (MACEMP).

b) What are the key institutions with capacity to interpret and apply knowledge on ES and poverty?

Fisheries Department, TAFIRI, TCMP, REPOA, NEMC, TCZCDP, FAST, MACEMP and Marine Parks and Reserves.

c) What are the main capacity needs and what are they related to?

Human and financial resources needs to carry out applied research on ES and poverty.

d) What are the possible strategies to address these needs?

Financial assistance to enhance capacity building through research and development.

Table 1: Key institutions in ES and poverty alleviation in Tanzania

1. Organisation / institution	2. Responsibilities / mandate	3. Main area (ES, poverty, span poverty and ES?)	4. Power	5. Scale	Institutional capacities to generate and use scientific						
					6. Involved in generating scientific knowledge? Natural, social, interdisciplinary?	7. What capacity does it have to generate this knowledge?	8. Does it use scientific knowledge? Natural, social, interdisciplinary?	9. What capacity does it have to interpret and apply knowledge?	10. Which sources of knowledge does it have access to	11. Where is this knowledge located?	12. Can other institutions gain access to the knowledge possessed by the institution?
University of Dar es Salaam (UDSM) (FAST, IMS, IRA and Department of Sociology and Anthropology)	Pursuit of scholarly and strategic research, education, training and public services including consultancy activities.	Span poverty and ES Attainment of equitable and sustainable socio-economic development of Tanzania	Legal UDSM was established on 1 st July 1970, through parliament act no. 12 of 1970 and all the enabling legal instruments	Geographical Research and training activities are national wide	Both, interdisciplinary involving different Faculties and Institutions	High UDSM has grown in terms of teaching staff, student intake, academic units and academic programmes	Both, interdisciplinary involving different Faculties and Institutions	High Vision of UDSM is: "to become a reputable world-class university that is responsive to national, regional and global development needs through engagement in dynamic knowledge creation and application.	Databases, own reports, external reports, external consultants, journals	Both internally and externally	Yes UDSM has a library where reports are available. UDSM website is a place where reports can be downloaded. Other information may be accessed through request
World Wide Fund For Nature (WWF)	The global conservation non governmental organization for doing research, conservation, capacity building	Span poverty and ES WWF is involved in stakeholder engagement in the conservation and management wildlife and diversifying livelihoods to address poverty and relieve pressure on resources	Legal Advocacy, partnerships and enforcement of moral suasion	Geographical WWF team up with local non-profit agencies and other global NGOs and form relationships with village elders, local councils and regional government offices.	Both, interdisciplinary Through own personnel and institutional partnerships to generate both natural and socioeconomic information	High Funding is not a problem thus capable of undertaking research and has built partnerships and collaborations with other institutions in the region	Both, interdisciplinary WWF has employed a wide range of capable natural and social scientists	High Capacity is high and through partnership with government institutions is capable of interpreting and apply knowledge	Databases, own reports, external reports, external consultants	Both internally and externally	Yes WWF has a library and updated website where reports could be accessed and downloaded
The National	NEMC was	Span poverty	Legal	Geographi	Both,	High	Both,	High	Databases,	Both internally	Yes

Environment Management Council (NEMC)	established with a broad mandate in response to the national need for such an institution to oversee environmental management issues and also implement the resolutions of the Stockholm conference (1972)	and ES NEMC reviews and monitors environmental impacts assessments, facilitates public participation in environmental decision-making, raises environmental awareness and collect and disseminate environmental information related to poverty alleviation	NEMC is a parastatal organization which came into being in 1983 when the Government of Tanzania enacted the National Environment Management Act No. 19 of 1983. Later Act No. 20 of 2004 provides for a legal and institutional framework for sustainable management of the environment, prevention and control pollution, waste management, environmental quality standards, public participation, environmental compliance and enforcement.	cal Nationally NEMC vision is to excel in sound environmental management in order to assist the nation fulfils its aspiration for sustainable development	interdisciplinary NEMC is focused toward achieving high quality of livelihood for all, good governance, the rule of law and building a strong and competitive economy that can effectively withstand global competition as well as observance of high quality environmental standards for sustainable development.	Employ qualified personnel trained in all fields including natural sciences, socioeconomic and lawyers	interdisciplinary Both are used in making decision relating to environment quality issues	Interpretation of research findings follow specific guidelines to ensure protection of the environment and sustainable use of resources for enhancing the quality of lives of the people of Tanzania	own reports, external reports, external consultants	and externally	NEMC has a library where reports are available. NEMC website is a place where reports can be downloaded. Other information may be accessed through request
Fisheries Department	A government institution in the Ministry of Livestock Development and Fisheries responsible for fisheries Monitoring, Control and Surveillance (MCS), catch	Span poverty and ES Fisheries Department is in line with policies and strategies on poverty reduction including Poverty Reduction	Legal The Ministry of Livestock Development and Fisheries has a legal mandate to develop specific policy framework for fisheries resource	Geographical Covers fisheries resources in freshwater and marine water including EEZ. Promotes	Both, interdisciplinary Research activities are undertaken by both natural and social scientists in collaboration with existing research	Medium Personnel engage with fisheries resource management other than research activities	Both, interdisciplinary Results are applicable in general management of fisheries	High Employ trained staff in fisheries management at all levels (Nation, Region and District level)	Database, own, and consults external reports	Both internally and externally such as in FAO website particularly FAO Fishing Area 51 (WIO Region)	Yes Through its library, website and a number of office reports upon request

	data collection as an early warning system of exploitation impacts and for evaluation of management interventions	Strategy (PRS) and National Strategy for Growth and Reduction of Poverty (MKUKUTA)	management. Amongst are: Deep Sea Fishing Act (1998), Territorial Sea and Exclusive Economic Zone Act (1988), a review of Fisheries Act (2003) and the Deep Sea Fishing Authority (2005)	aquaculture productivity to relieve pressure from wild stocks	institutions						
Tanzania Fisheries Research Institute (TAFIRI)	To promote, conduct and coordinate fisheries research within Tanzania. To improve and protect the fishing industry through developing and promoting better methods and techniques of fishing, fish farming, processing of fish and fish products	Span poverty and ES TAFIRI contributes to the management and sustainable exploitation of aquatic resources and thus alleviate poverty, enhance employment creation and food security through multidisciplinary and collaborative research	Legal TAFIRI is a parastatal organization established in 1980 to cater for fisheries research in the country.	Geographical TAFIRI comprises five centers: Mwanza and Sota on Lake Victoria, Kigoma on Lake Tanganyika, Kyela on Lake Nyasa/Malawi and HQ in Dar es Salaam on the Indian Ocean	Both, interdisciplinary Research priority areas: Fisheries biology and aquaculture, socioeconomic, fish processing and marketing, hydrobiology and water pollution, and gear technology	High Its main objective is research using employed technical staff in collaboration with external donors	Both, interdisciplinary To document and disseminate research findings for use by the Government, public institutions or persons engaged in the fishing industry in the country	High To advise the Government, public institutions and persons or bodies engaged in the fishing industry in Tanzania on the practical applications of findings of research	Databases, own reports, external reports, external consultants, commissioned research	Both internally and externally through collaborating institutions (COSTECH, TIRDO, TNSRC)	Yes TAFIRI has a library and website where reports and other information may be accessed through request
Marine and Coastal Environment Management Project (MACEMP)	MACEMP is a six-year comprehensive programme (2005 - 2011) with the responsibility for the management of coastal and	Span poverty and ES MACEMP is aimed at improving management of marine and coastal resources, with a view to	Legal MACEMP is implemented by Fisheries Department which has a legal mandate to develop specific policy framework for	Geographical MACEMP operates in coastal and marine waters of Mainland Tanzania and	Both, interdisciplinary MACEMP is designed to be primarily an institutional support Project that strengthens all	Medium Staffed with fisheries resource managers but has a role of strengthening all institutions in their endeavour to	Both, interdisciplinary Research findings are used in general management and conservation	High MACEMP has trained personnel in fisheries resource management. MACEMP is collaborating with a number	Own reports, external reports, external consultants	Both internally and externally (sister/collaborating institutions)	Yes

	marine environment	contributing to economic growth and poverty reduction among the coastal communities. Funds to coastal communities have been disbursed via Tanzania Social Action Fund (TASAF)	fisheries resource management	Zanzibar including EEZ	institutions in their endeavour to provide better management of marine and coastal resources. The Project also empowers local communities to manage and utilize biodiversity resources on which their livelihoods depend.	carryout research	of coastal and marine resources	of institutions with a stake in marine and coastal resources for the implementation of the Project			
Marine Parks and Reserves Unit (MPRU)	MPRU has a role to oversee the management and administration of marine parks and reserves to ensure sustainable use of the marine resources	Span poverty and ES To improve the economic welfare of the local communities living inside marine Parks and Reserves through promotion of ecologically, socially and economically acceptable practices	Legal Established under the Marine Parks and Reserves Act Number 29 of 1994	Geographical Establishment of a well managed, integrated network of marine and freshwater protected areas, which ensure the sustainability of Tanzania's aquatic biological diversity and ecological processes for the benefit of present and future generations	Both, interdisciplinary Research in natural and socioeconomic and environmental management aspects of aquatic protected areas	Medium It is government funded and mostly depends on development partners to undertake research	Both, interdisciplinary Knowledge is applied to protect, conserve and restore the species and genetic diversity of living and non-living marine resources and ecosystem processes of marine and coastal areas. Also facilitate research to monitor resource conditions and uses within the marine protected area	Medium Mainly it is an enforcement agency with little capacity to undertake research, interpret and apply results	Databases, own reports, external reports, external consultants, commissioned research	Both internally and externally (sister/collaborating institutions)	Yes Through website, library, reports and external consultant
Tanzania Coastal Management	TCMP is a partnership of donor	Span poverty and ES Develop a	Legal Work in collaboration	Geographical Covers the	Both, interdisciplinary	Medium Few trained staff but still	Both, interdisciplinary	Medium Low capacity to interpret	Databases, own reports, external	Both internally and externally (sister/collaborating institutions)	Yes Through its library,

Partnership (TCMP)	interests USAID in collaboration with NEMC for effective coastal governance in Tanzania	National Integrated Coastal Management (ICM) strategy to be applied to coastal management at both the national and local levels;	with NEMC the partnership which was established in 1998	Coastal Zone of Mainland Tanzania by through built relationships and promoted collaborative behaviour between national government agencies, district governments and private interests	Through training, mentoring and learning-by-doing, the working group members have learned to interact across disciplines and hierarchies, thereby improving the relationships between various constituencies	has capacity to generate knowledge through institutional collaboration	The information generated demonstrates cross-sector mechanisms for addressing emerging coastal economic opportunities used to direct conservation efforts and inform policy and management	results dependent on external valuation	reports, external consultants	ating institutions)	website and a number of office reports upon request
Sea Sense	NGO for the conservation of marine turtles and marine mammals	Span poverty and ES Promote local community livelihoods through marine turtle and dugong-based tourism, provision of incentives and habitat protection	Legal NGO which was set up in 2001 to protect the rare dugong and five species of marine turtles, and promote the protection of coastal and marine habitats vital to their survival	Geographical Field surveys collecting data on the status and distribution of marine turtles and dugongs in Tanzania	Both, interdisciplinary Sea Sense apply both natural and social sciences for the management of marine turtles and dugongs	Medium Few trained staff mostly dependent on local community participation in research and monitoring activities. MCS activities depend on local community participation	Both, interdisciplinary Utilising low technology in conducting research and monitoring activities	Medium Capacity to interpret is high, however application may be limited by availability of resources	Databases, own reports, external reports	Both internally and externally	Yes Website, own reports and external consultants
Tanga Coastal Zone Conservation and Development Programme (TCZCDP)	TCZCDP is a collaborative management, exemplified by the active participation of communities coordinated by the Districts, Regional and National government authorities	Span poverty and ES TCZCDP has aims to enhance the well being of coastal communities by improving the health of coastal and marine environment on which they	Legal TCZCDP is a partnership with IUCN through EARO funded by Development Cooperation Ireland (DCI)	Geographical TCZCDP is implemented in the three coastal Districts (Muheza, Pangani and Tanga Municipality) of the Tanga	Both, interdisciplinary TCZCDP ensures integrity of the Tanga coastal zone ecosystem is improved and its resources support sustainable development	Medium Few trained staff mostly dependent on local community participation in research and monitoring activities. MCS activities depend on local community	Both, interdisciplinary Utilising low technology in conducting research and monitoring activities	Medium Financial capacity is high but capacity to interpret is low being limited by unqualified staff	Databases, own reports, external reports	Both internally and externally	Yes

	and the private sector where appropriate	depend and by diversifying the options for using coastal resources		Region		participation					
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D - INSTITUTIONAL ANALYSIS: MOZAMBIQUE

Summary:

1. Mozambique is endowed with many (adequate) institutions at government and NGO level to deal with the coastal and marine ES and its links to poverty .
2. There is a good framework for financial support based on the major donors that have agencies in Mozambique.
3. The fine capacity and good work clearly being done by NGO's for ESPA is a credit but also technically appears to absolve government from certain tasks and responsibilities
4. There is a distinct lack of coordination in matters relating to ESPA. Fundamentally, this is the responsibility of government. However, despite the new initiatives at national level towards poverty relief – coordination appears poor. This is especially true of NGOs- who appear in several cases to be operating relatively on their own, partly to justify funding.
5. There is very poor curating of information - especially with NGOs. Once the report is produced as part of the commitment - the long term data management and archiving is poor. This contributes to a fragmented approach.
6. There is too much bureaucracy in government departments - at times there is distinct rivalry and friction between departments. This may be difficult to note publicly in a report but it is seen as a major impediment to delivery of services - including ES. (examples include MPAs and fisheries)
7. While capacity is technically adequate - associated training on environmental (especially marine) is moderate to low. UEM only offers to Masters level and several private Universities have arisen - some improved focus on training in ES would be useful.

In summary, there are enough institutions with capacity and mandates to do the job. Funding is not the main problem - it revolves around real (government) commitment and especially greatly improved coordination of effort.

Table 1: Institutional capacity to generate, source and use ecological, social, economic or multidisciplinary information and knowledge

Organisation / institution	Interest and mandate in coastal and marine ES and poverty alleviation	Approach	Power	Scale of influence	Institutional capacity to generate, source and use ecological, social, economic or multidisciplinary information and knowledge						
					1. Generate knowledge type? (ecological, social)	2. Capacity to generate data & info?	3. Use of info?	4. Capacity to interpret and apply knowledge?	5. To what sources of knowledge do they	6. Where is this knowledge/information	7. Wider access to data held by this
GLOBAL, MANAGEMENT AND DEVELOPMENT AGENCIES, NGOS, ETC											
Food and Agricultural Organisation (FAO) of the United Nations	As a UN agency, FAO has a mandate to support the integration of globally formulated and approved principles and commitments into member state policies and programmes, resulting from Summits and international conferences on food security and sustainable rural development. These range from environmental and sustainable development principles, declarations on the rights of women, the global fight against the HIV/AIDS pandemic, World Food Summit declarations and most recently the Millennium Development Goals.	Global ES assessments. Policy formulation, programmes emphasises food security	Most member nations follow broad policy and guidelines Not mandatory except some RFO's and via UN-HQ	Global	1. YES. Fisheries statistics and production data by region, including fisher participation, socio-economics, ecological, aquaculture, etc, Annual status assessment by region.	2. YES. Extensive in-house institutional capacity, network of consultants and member countries' fisheries departments	3. YES. Extensive use of information to assist nations, develop policy, provide detailed statistics globally, undertake regional assessments, etc	4. HIGH. Strong capacity to coordinate and analyse large scale data sets	5. YES. Country fisheries statistics; specialist studies; extensive network of experts and consultants in fisheries and ES	6. BOTH. Centralised in Rome-HQ, sustains extensive data-bases, extensive publication and reporting programmes.	7. YES. Provides an excellent information service via web, reports, consultation etc.
World Conservation Union (IUCN)	IUCN is a membership organization and the largest conservation body in the world. It provides technical expertise for conservation planning and building capacity to assist with conservation management. IUCN draws capacity from its extensive regional and global networks of experts. Traditionally at the forefront of new developments and concepts in conservation. Human development is central to its overall mission. Focal areas include the identification of priority areas for conservation; capacity building; and meeting socio-economic needs. Through conservation. Its vision is to promote conservation for development.	Conservation, with focus on sustainable development and livelihoods	Driver of global standards in conservation. Not legally enforceable but strong membership support.	Global (with selected regional and country offices)	1. YES. Extensive activity in developing strategy, policy and technical support documents, often integrating natural with socio-economic and governance.	2. HIGH. Using its network of consultants and members IUCN is a major generator of knowledge primarily coordinating at global level. Specialist interest groups serve primary information gathering functions.	3. YES. Extensive use if made of knowledge in developing technical and policy support material	4. HIGH. Besides membership IUCN has considerable permanent expert staff based at HQ in Gland and in regional offices	5. Very extensive data sources, such as Red lists, species assessments, global environmental trends, etc.	6. EXTERNAL. Reports are mostly generated from HQ or regional offices. Raw data, especially via contracted work is often not well archived and lost for future benchmarking.	7. Access to most IUCN reports is available, either via web interface or through excellent range of publications and reports.
World Wide Fund	Initially a funding body with large donor	Nature &		Global	1. YES. Funds and supports projects that collect information. Includes natural and social data						

for Nature (WWF)	support base, Increasingly implementing. International WWF activity (especially USA branch) has been instrumental in developing EAME programme with specific targets in East Africa., including Mozambique. Large scale conservation planning and root cause analyses. Strong in Tanzania, Mozambique and South Africa.	ecosystem conservation- includes alternative livelihood activities			<p>2. MEDIUM. Depends extensively on consultants and short term contracts to generate data under specific projects.</p> <p>3. YES. Makes use of data to develop strategies and management plans.</p> <p>4. MEDIUM. Modest in-house capacity but major funder of experts to apply information</p> <p>5. Has access to data generated by its own projects and based on partnerships with other agencies</p> <p>6. Selectively retains information in-house. Most available in reports, although long-term curating of info is poor. Mostly individual and project based.</p> <p>7. WWF reports are available, not all free. Does not hold extensive internal data sets.</p>
REGIONAL CONSERVATION & MANAGEMENT AGENCIES AND NGO'S					
South West Indian Fisheries Commission (SWIOFC)	The Regional Fisheries Management Organization for area 51 (RFMO) supported by FAO and providing multi-national coordination of fisheries management. Though not (yet) binding on nations, the SWIOFC strives to reach consensus on regional and transboundary fisheries management approaches, including worker and fisherfolk related issues. Strong proponent of EAF concepts. Located in Harare. Can facilitate a range of activities relating to EAF	Regional assessment of fisheries as basis for developing management actions by all member countries.	SWIOFC is formally endorsed by governments although adherence is voluntary. Chairmanship fluctuates between member countries.	Regional	<p>1. YES. Fisheries statistics and production for WIO, including status. Landings, fisher participation, socio-economics, ecological, EAF, etc</p> <p>2. YES. Modest in-house capacity, but depends on supporting expert committees drawn from member countries; formal scientific and data management committees</p> <p>3. YES. Extensive use of information to assist WIO member nations in sharing management advice; contributes to annual status reporting. Etc</p> <p>4. HIGH. Strong capacity drawn from member countries</p> <p>5. MODEST. Voluntary WIO submissions & FAO data. Excellent historic information from WIO region</p> <p>6. Primarily accessible via FAO web and in formal meeting documents. Specialist studies are published in FAO report format.</p> <p>7. YES. Provides a reasonable amount of information and facilitation service, in part relating to ES.</p>
Secretariat for the Nairobi Convention	An inter-ministerial convention dedicated to the conservation of East African biota and ecosystems, with focus on marine and coastal. Hosted by UNEP and dedicated to assisting nations with transboundary conservation issues. WIOLab is located here with strong focus on anthropogenic links to ES.	Regional umbrella for coordination of environmental actions. Strong focus on human development and ES	3-year workplan formally adopted at COP by ministers – but not legally binding.	Regional	<p>1. YES, Extensive facilitator of projects as part of 3-4 year COP work programme.</p> <p>2. Capacity vested in member states, consultants and affiliated institutions (e.g.FARI)</p> <p>3. YES. Makes extensive use of information in drawing up regional policy strategies and supporting transboundary initiatives</p> <p>4. LOW. Capacity in-house is low to modest – but extensive network of experts and governments apply the information generated</p> <p>5. Clearing House is main source as a meta-database. Also specific programmes such as WIOLab. Generally a poor custodian of information.</p> <p>6. Considerable reporting; extensive data in metadata-base: www.clearinghouse.unep.org</p> <p>7. YES. Good access via web and direct from UNEP</p>
IUCN-EARO and ROSA	IUCN operates regional offices. Historically this has included the East	Regional facilitation of			<p>1. YES. Selective support for projects that generate data. Mostly biological but also socio-economic</p>

	African Office in Nairobi (EARO) and the Regional Office for Southern Africa (ROSA). EARO had a particular focus area on the marine environment of the WIO. This has recently been downscaled. ROSA has moved from Harare to Pretoria. Both offices are active in ES issues, supporting projects and facilitating regional actions. Support is derived from local members and head office in Gland.	conservation planning and research linked to human development and sustainable use			<p>2. Modest in-house capacity but actively recruits consultants and experts to generate data</p> <p>3. YES. Integrates data into reports and especially advice to local governments</p> <p>4. Modest in-house capacity but actively recruits consultants and experts to interpret data- preferably from its membership base</p> <p>5. Can draw on HQ data and access to member data, including governments. Most via commissioned research.</p> <p>6. Knowledge is mostly located in consultant reports. Little formal archiving of long term data</p> <p>7. YES. Access to reports is reasonable but often poorly disseminated. Most in report format. WIOMSA also generates in-house expertise – e.g. Transmap.</p>
West Indian Ocean Marine Science Association WIOMSA	A regional marine science body, membership-based but largely donor driven. Located in Zanzibar and influential in promoting marine science collaboration amongst scientific institutions in the WIO. Promotes publications, periodic symposiums, travel grants and considerable research funding.	Strong focus on integrating ES and human development	Voluntary participation based on shared vision and commitment by participants and members	WIO region	<p>1. Extensive support for generating knowledge via members and especially through contract research in the MASMA programme</p> <p>2. LOW. WIOMSA has a small but expert staff. However, through its network and project support is a major generator of information with strong ES focus.</p> <p>3. NO? WIOMSA is not an implementer – but facilitates the dissemination of information</p> <p>4. MEDIUM. Through its network has extensive capacity to interpret information.</p> <p>5. Has access to numerous contracted studies and can commission work according to need.</p> <p>6. EXTERNAL. Information is in reports, and the WIOMSA Journal</p> <p>7. YES. Via journals and reports.</p>
NATIONAL					
Centro Terra Viva	The Mozambique NGO linked to the international Access Initiative (TAI) focussed on fair access to ES, especially amongst poor communities. Facilitates policy development, advocacy, advice to government, and dissemination of environmental justice issues. Has links with other NGOs: Livangingo and Forum Naturez em Perigo. Not focussed on marine	Poverty alleviation, securing access rights to resources for the poor	NGO with advocacy and international networking skills	National within a global network of TAI	<p>1. YES. Collects data directly related to ES and poverty relief via access to resources</p> <p>2. UNSURE. Only recently established in Mozambique. Can draw on international links</p> <p>3. YES Interdisciplinary</p> <p>4. UNSURE. Only recently established in Mozambique. Can draw on international links</p> <p>5. UNSURE. Draws on international network, especially developing countries</p> <p>6. No extensive information holdings</p> <p>7. Can be approached for policy and advocacy support. Involved in dissemination of results and specialist reports.</p>
Environment Working Group Grupo de Trabalho Ambiental (GTA)	NGO group of specialists experienced in environmental issues, including communities, policy and education. Largely drawn from academia especially UEM. Provides consulting services. Strong on community participation. Not only marine	Environmental consulting, includes community & ES work	NGO consulting service; research, activism, education	National with some regional involvement	<p>1. YES. Generates reports, including pilot projects demonstrating sustainable use. Capacity building at all levels of society.</p> <p>2. HIGH. Groups of members is drawn from expert institutions.</p> <p>3. YES. Uses available and new data in consulting. Interdisciplinary</p> <p>4. HIGH.ditto</p> <p>5. Own reports as well as variably home institution data (UEM?)</p> <p>6. Published reports at HQ.</p>

<p>University Eduardo Mondlane,</p> <p>Departments of Biological Sciences and oceanography</p>	<p>This largest University in Mozambique (also a Uni in Nampula) has two relevant departments. The Department of Biological Sciences carries out investigations on the ecology of coastal and marine organisms. Some projects involve human dimension; new Masters course in ecology. Department of Oceanography undertakes studies on physical dynamics, often related to environmental health and anthropogenic issues.</p>	<p>Training in ecology and oceanography; consulting and research projects; some with ES links</p>	<p>Primary academic institution in Mozambique</p>	<p>National</p>	<p>7. LIMITED Access ?</p> <p>1. YES. Research theses, project reports; mainly ecological with ES is some</p> <p>2. MEDIUM. Knowledge based mostly on student projects to MSc level. Staff conduct research on moderate basis</p> <p>3. NO. Not a user of data other than for academic and consulting purposes. Some advisory activities to government as well.</p> <p>4. HIGH. Staff and visiting scientists have considerable analytical and deductive skills</p> <p>5. Access to student projects and some long term data – e.g. Inhaca. Also UEM library facilities</p> <p>6. Reports and these located in-house. Some work published in reports and papers.</p> <p>7. YES Access via request to HODs</p>
<p>Ministry for Coordination of Environmental Affairs, (MICOA)</p> <p><i>Ministério para a Coordenação da Acção Ambiental</i></p>	<p>A ministry uniquely dedicated to the coordination and integration of environmental policy and standards, especially between different ministries. Structured around seven main priority areas namely:</p> <p>(i) Strengthening of institutional capacity for environmental management through extension services and dedicated agencies; and inter-sector (ii) Definition and adoption of a clear and adequate legal framework for environmental management, (iii) Raising environmental awareness and education (iv) Producing and stimulating access to information related to the environment, including socio-economic policies and monitoring natural resources;</p> <p>(v) Increasing production in rural areas, in particular in the family / subsistence sector;</p> <p>(vii) Marine and coastal management via the CD-ZC.</p>	<p>Environmental planning & mangmnt coordination. Includes ES & people. International liaison & obligations.</p>	<p>Empowered by an Act of parliament Sets policy & also involved in compliance and enforcement.</p>	<p>National</p>	<p>1. YES. Maintains statistics relevant to environment and ES. Monitoring and planning data.</p> <p>2. MEDIUM. Dedicated specialist centres with in-house capacity – urban, coast, natural resources, education. Potentially strong in ES and poverty. Environmental monitoring.</p> <p>3. YES. Draws on its own and wider resources to formulate policy, legislation etc. Strong on ES matters</p> <p>4. MEDIUM. In-house staff capacity plus external consultants</p> <p>5. Extensive access to government data bases, reports, national data and specialist consulting reports. Internal databases.</p> <p>6. Knowledge mostly in the specialist centres. Also centrally at HQ and regional offices in the Provinces.</p> <p>7. YES. Reasonable access is available on request.</p>
<p>Centre for the Sustainable Development of Coastal Zones</p>	<p>CDS-ZC is a unit of MICOA with links the National Council for Sustainable Development, National Directorates of Line Ministries, NGOs and the private</p>	<p>COAST Environmental management</p>		<p>National</p>	<p>1. YES. Generates interdisciplinary information relating to coastal zone.</p>

<p>(<i>Centro de Desenvolvimento Sustentável para as Zonas Costeiras (CDS-ZC)</i>)</p>	<p>sector. The Centre is involved in Strategic Environmental Assessment of Development Plans and Programmes along the Mozambican coast. It advises on matters related to coastal zones and provides assistance in policy formulation and legislation. Involved in developing integrated coastal development plans and policies for managing marine and coastal ecosystems; improving capacity and the institutional framework in order to deal with coastal and marine protection issues; the establishment of marine and coastal protected areas to safeguard specific ecological values, wherever possible with the involvement of local populations; and the development of tourism master plans laying down principles and rules for new tourism developments.</p>	<p>t</p>			<p>2. LOW. In-house capacity is modest. Best opportunities exist via external consultants</p> <p>3 YES. All types of information are used, including socio-economics</p> <p>4. LOW</p> <p>5 Information is not actively advertised – so details of holdings not clear.</p> <p>6. INTERNAL. CDS-ZC depends considerably on external consultants. Information is mostly in the form of reports</p> <p>7. Information can be accessed on request from MICOA</p>
<p>National Directorate for Conservation Areas</p> <p>(<i>Direcção Nacional de Áreas de Conservação (DNAC)</i>)</p>	<p>DNAC is part of the Ministry of Tourism (MITUR) and is responsible for overseeing the management of conservation areas. DNAC used to be part of the Ministry of Agriculture (part of the Forests and Wildlife Directorate) but was transferred to MITUR, upon its creation in 2000, with the aim of exploring the tourism potential of these areas. Coastal and marine protected areas are considered of key importance for tourism development in Mozambique, one of the central elements of the government's strategy for poverty alleviation in the national Action Plan for the Reduction of Absolute Poverty (PARPA II), which is the Mozambique Poverty Reduction Strategy Paper (PRSP)</p>	<p>TOURISM Conservation for tourism development, link to livelihoods through role of tourism in poverty alleviation.</p>		<p>National</p>	<p>1. YES Statistics on conservation areas. Usage patterns, tourism development etc</p> <p>2. LOW. Modest in-house staff. Can use consultants and other departments to generate data.</p> <p>3. YES. Makes use of statistics and associated data for policy and planning. Contributes to MPA planning via Council of Ministers. Liaison with international partners and donors.</p> <p>4. MEDIUM. Applies knowledge in some cases, but</p> <p>5</p> <p>6</p> <p>7</p>
<p>National Institute for the Development</p>	<p>IDPPE is responsible for undertaking research and promoting projects</p>	<p>FISHERIES Mainly</p>		<p>National</p>	<p>1. YES Extensive survey data on coastal fishing activities, Strong ES and people focus.</p>

<p>of Small-Scale Fisheries</p> <p><i>(Instituto Nacional de Desenvolvimento da Pesca de Pequena Escala (IDPPE))</i></p>	<p>supporting the development of artisanal fisheries, therefore contributing to improving livelihoods and alleviating poverty. It has a network of provincial delegations, district-level stations and local-level extensions. It currently supports the organisation of fishers in associations and the creation of Community Fisheries Councils (CCPs), aimed at promoting the co-management of marine resources. IDPPE also collects socio-economic and catch data in fishing centres throughout the country.</p>	<p>livelihood issues, with link to resource management</p>			<p>2. HIGH. Strong institutional capacity at HQ in Maputo and also in the Provinces.</p> <p>3. INTERDISCIPLINARY information with social focus, provides information for the nation that is extensively used in various planning etc.</p> <p>4. HIGH. Excellent in-house capacity and systems management. Also draws on external consultants</p> <p>5. Primary sources are the national wide fishing community surveys – including ES and socio-economic data. Also specialist studies</p> <p>6. Many reports and survey data are published – Internal holdings of information exist, expertise of individual staff is high</p> <p>7. Good access to all forms of information.</p>
<p>National Institute of Fisheries Research</p> <p><i>(Instituto Nacional de Investigação Pesqueira (IIP))</i></p>	<p>IIP is an institute of the Ministry for Fisheries, responsible for undertaking research in support of fisheries management at all levels including artisanal fisheries. IIP makes recommendations to government on all aspects of fisheries management. IIP also provides training opportunities and past staff are located in many other institutions in Mozambique. Regional offices in all main Provinces</p>	<p>Fisheries and associated ecological research in support of resource use management</p>	<p>Empowered through Fisheries Legislation</p>	<p>National</p>	<p>1. YES Extensive research capacity, focus on stock assessments, includes extensive artisanal fisheries database from all Provinces. Quite a strong technical staff component.</p> <p>2. HIGH. Staff complement generates most data. Some external consultant support.</p> <p>3. YES. Data is extensively used in reports, publications and theses. Significantly, data advises DNAP and the minister on TAC, levels of access and other resource management issues.</p> <p>4. GOOD. A number of the scientific staff are competent in fisheries assessment</p> <p>5. Extensive in-house databases on fisheries. Library with basic information. Technical and cruise Reports. Individual scientist expertise.</p> <p>6. Extensive internal sources, modest reporting externally. Excellent small scale databases including socio-economic aspects from entire Mozambique coast.</p> <p>7. Information not freely available but access on request. Some publications produced.</p>
<p>National Administration of Fisheries</p> <p><i>(Direcção Nacional Administração Pesqueira (DNAP))</i></p>	<p>DNP is the main Ministerial body for administering the Fisheries Legislation and issue of access and licensing. Responsible for policy development and management plans. Generates and updates the national fisheries legislation – with strong internal legal support. Main interface with non-artisanal fishers and users. Includes aspects of compliance and MCS and IUU activities. Controls license issues and foreign access rights to Mozambique resources</p>	<p>FISHERIES Fisheries administration and management</p>	<p>Empowered through legislation Can generate rules and conditions</p>	<p>National</p>	<p>1. YES Generates primary statistics on fisheries trends, especially landings of industrial sectors. Includes data on license issues and use patterns.</p> <p>2. MEDIUM. Besides in-house staff makes good use of external and international consultants. Work is quite focussed on main areas of responsibility.</p> <p>3. YES Makes extensive use of data to underpin management plans, policy and new legislation</p> <p>4.</p> <p>5.</p> <p>6.</p> <p>7.</p>
<p>Directorate of Fisheries Economics</p>	<p>A senior directorate of the ministry of fisheries responsible for economic assessment of fisheries, aquaculture</p>	<p>Fisheries economy</p>	<p>Empowered through legislation</p>	<p>National</p>	<p>1. YES. Generates detailed statistics on fisheries economics at all levels. Relevant to ES and poverty</p> <p>2. MEDIUM. In house capacity with external consultant support.</p>

<i>(Direcção Nacional de Economia de Pesqueira (DNEP))</i>	development and planning. Plays pivotal advisory role in review of landings related to national economy. Significant in poverty relief as part of overall economic development in fisheries sector				3. YES Generates advisory and policy documents. Contributes to FAO data. Presents to Ministry and forums Undertakes four year sector review 4. GOOD with additional consulting assistance 5. National statistics of fisheries, trade employment etc 6. Data housed in DNEP and Ministry 7. YES. Publications and data reports available. Statistics can be sourced from DNEP.
Directorate of Aquaculture <i>(Departamento de Aquacultura (INAQUA))</i>	A directorate of the Ministry of Fisheries promoting and regulating aquaculture development activities as specified in the General Regulation of Aquaculture (Fisheries Act 3/90 of 2001, Decree 35/2001). Includes fresh water and marine – significant in development of labour opportunities relating to aquaculture.	Policy & developmnt of aquaculture & facilities.	Empowere d through legislation	National	1. YES Generates statistics on aquaculture and related factors- e.g. labour and economics. Undertakes and commissions research on aquaculture and its potential 2. MEDIUM 3. YES Data is used for policy and planning of aquaculture. Includes interdisciplinary info. 4. MEDIUM. Use of consultants and links with FAO and other departments. 5. National statistics on aquaculture, permit issues, trade, employment etc 6. Most information is held INTERNALLY. 7. YES statistics are made available via reports and presented at diverse forums
National Maritime Authority (INAMAR)	A Directorate falling under Transport and communication ministry. Main functions revolve around maritime legislation, including safety at sea. Port development, development of maritime information systems, control over maritime activities, relates to ES and control over fishing activities that are port based]	Maritime Security Port control including Fishing ports and control	Empowere d through legislation	National	1. YES 2. YES but uses consultants widely, some IDA grants 3. YES with consultant input 4. UNKNOWN 5. UNKNOWN 6. INTERNAL data held – monitoring 7. Access via request – consultant reports,
Care International Moçambique	CARE initiated in Mozambique in 1986 and in 1999 began a project in the capital city of Maputo that examined strategies for improving livelihoods in several urban neighbourhoods. In 2000, CARE launched a major emergency response to heavy flooding caused by heavy rains and cyclones, including emergency shelter and water supplies, managing camps for displaced persons, and distributing small grants to help families recover lost assets during the floods.	Poverty alleviation, livelihood security, disaster preparednes s	NGO impact based on quality of delivery	National	1 2 3 4 5 6 7
World Wide Fund for Nature (WWF) (Country Office)	WWF has an active country office in Mozambique which support several initiatives especially MPA development and implementing. E.g. The Bazaruto and Quirimbas National. Provides technical and logistic support to government. Facilitates research.	Conservatio n; includes improving livelihoods.	NGO impact based on quality of delivery	National & some regional/ transbound ary	1. YES. Considerable data gathered, especially through consultants and collaboration with institutes 2. MEDIUM. In house expertise is modest but good. Strong dependence on external consultants 3. YES. Strong use of data to formulate plans and policy support. 4. MEDIUM-HIGH Has been very effective on applying knowledge as WWF often fills a gap. 5. Extensive access to research projects and WWF global network. Has established strong

					links with a number of key institutions, locally and in region
					6. Reports are published. In house curating of data not great
					7. YES. WWF has good record of sharing data and contributing to other studies
Dept of Flora and Fauna <i>Direcção das Florestas e Fauna Bravia</i>	This is the main wildlife and conservation directorate of Mozambique, falling under the Department of Agriculture. Has marine implications for management of larger animals such as cetaceans and turtles. Hence links with job creation i.t.o. tourism	Conservation with global links and responsibilities- eg RAMSAR, UNESCO etc	Authorised by Lei (Act)	National	1. YES. Generates data on conservation. Commissions research projects. Provides general statistics for government on various conservation and ecological issues. 2. MEDIUM. Added capacity from consultants. 3. YES. Draws on its own and other data to develop policy and implement conservation. Includes element of ES and community interaction. 4. GOOD capacity to implement – Moderate interpretation 5. Departmental and own research. Data generated by conservation areas 6. Data mostly held internally – based on reports and monitoring. 7. Can be approached for information.
EU Mozambique office	Influential is developing and supporting projects and Framework Programmes funded by the European Commission–strong focus on human dimension and poverty relief				1. No- only project related- interdisciplinary ES and poverty are NB elements 2. LOW 3. YES. Draws on wide network and national statistics 4. LOW 5. Considerable access to resources via EU programmes and interaction with government 6. Does not have extensive information holdings 7. Access to considerable EU linked systems and data
DFID Mozambique office					
Embassies of Norway & Netherlands	Both play a strong role in funding and developing environmental programmes with poverty relief and ES as key elements				1 2 3 4 5 6 7
National Directorate of Rural Development <i>(Direcção Nacional de Promoção do Desenvolvimento Rural)</i>	?	Rural development		National	1 2 3 4 5 6 7
National Directorate of Rural Water <i>(Direcção Nacional de Água Rural)</i>	?	Rural water supply		National	1 2 3 4 5 6

Ministry of Education	Major ministry responsible for all aspects of education in Mozambique. Has strong focus on poverty and disadvantaged communities. Includes environmental issues and relates to ES to a degree. Potentially significant contributor.	Education sector	Authority by Act	National	7 1 2 3 4 5 6
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