Ecosystem Services for Poverty Alleviation: Marine & Coastal Situational Analysis

Synthesis Report

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Contents

Executive Summary

This study focuses on assessing the scientific knowledge of the linkages between ecosystem services and poverty alleviation in coastal and marine ecosystems. It does not seek to undertake new analysis *per se*, but rather to assess existing data, to consider how they can be used to address these linkages, and to identify the key gaps in knowledge and capacities in research, knowledge generation and application to policy.

At the outset there are a number of important definitional and 'boundary issues' which preface this study. First, what are the boundaries of coastal and marine systems? Second, what is the most appropriate measure of poverty? Third, how valid is it to separate individual ecosystem services? These issues influence how existing data can be used and their compatibility. For example, in examining the incidence of poverty among people who are dependent on coastal and marine ecosystem services, how can existing national or cross-national or global data be disaggregated or interpreted? How far inland should watersheds be analysed in order to understand coastal processes and ecosystem services? How can the important interactions between marine, coastal and other terrestrial systems be integrated to understand change in ecosystem services? In the report, the examples of Bangladesh, and the special case of small island developing states (SIDS) are used to illustrate these points.

Key messages emerging from the assessment are:

1. The poor have had minimal impacts *overall* on changes in ecosystem services and have also received a disproportionately small share of the benefits of ecosystem services in coastal and marine systems. However, in particular locations, the unsustainable use by poor stakeholders who have limited options is a major driver of degradation of ecosystem services.

2. The poor prioritise provisioning services over all other ecosystem services, and identify the most important benefits from these services as being cash, food and employment, which are not explicitly and separately considered in the Millennium Assessment conceptual framework.

3. Many other ecosystem services are not of *direct* relevance to the poor and have no straightforward or simple role in alleviating poverty. Supporting services for the provisioning and regulating services are recognised by poor people. Very often their role in protecting livelihoods is extremely important, for example providing the basis to support provisioning services, in protecting homes, providing clean water and moderating environmental risks, but their role in active poverty alleviation is not direct and sometimes much less clear than provisioning services.

4. Most data are available on direct use of provisioning services but the information is patchy and very rarely relates specifically to poor, vulnerable or marginalised sections of society.

5. There are few examples of mechanisms to enhance ecosystem services and alleviate poverty; and very little precise information to show exactly how ecosystem services can contribute towards poverty alleviation. For example, this is not a topic usually addressed in country PRSPs. There are some, limited, suggestions of how payments for environmental services (PES), marine protected areas (MPAs) or community-based natural resource management (CBNRM) may provide benefits, but no systematic or comprehensive analysis exists to adequately guide policy. There are many assumptions about the co-benefits of conserving ecosystem services and the potential knock-on effects on poverty alleviation, but few concrete instances from which lessons can be learned or practices transferred. In many cases, there may be a conflict between income generation for poverty alleviation with the short term and long term sustainability of resources and maintenance of biodiversity.

6. There is evidence of shifting patterns of dependence on ecosystem services and shifting vulnerabilities to change in ecosystem services. This relates to where poor people live – for example increasing number of people concentrated in urban coastal areas in many countries and regions; how people construct their livelihoods – related to patterns of diversification and specialisation and movements in and out of fishing; processes of globalisation and changing access and exploitation, particularly penetration by global markets (e.g. aquaculture transforming coastline, and industrial fishing exploiting sea), each of which potentially puts poor people at risk.

7. The rate and scale of many changes to ecological and social and economic systems are accelerating and are often non-linear and not easily predicted. Current examples include the causes and impacts of fuel and food crises. Other important drivers may be slowing in some regions, for example population growth.

8. There are many and significant knowledge gaps, including about how the flows of ecosystem services are linked to the stocks of ecosystems, processes and rates of change, complex causality, behavioural responses, economic responses and social impacts of change.

9. How knowledge is managed is equally important. There is an overwhelming lack of integration of knowledge on ecosystem services and poverty; rarely is information on ecosystem services and poverty generated, analysed, stored or utilised jointly by same institutions in developing countries. Secondly, knowledge is not shared between and within countries, and there are widespread difficulties with lack of access to existing information. This is not only about data rich countries versus data poor countries, or major international donors or developed country institutions restricting access; often key individuals within countries restrict access to data, becoming gatekeepers of knowledge.

10. The scale of analysis is important and there are scale mis-matches and inconsistencies in interrogating the linkages between ecosystem services and poverty alleviation, meaning there is potential for contradictory results depending on the scale lens employed. The analysis of vulnerability to changes in ecosystem services is an example. It is important to consider multiple and cross-scale analysis as each scale has inherent biases and different processes operate at each scale.

11. Governance of ecosystems and of the socioeconomic context of ecosystem services use by the poor is fundamental to the benefits from, and sustainability of, ecosystem services. In many developing countries, policies on environmental protection are weak or poorly integrated. Decisions on ecosystem use are often not accountable to poor and corruption and vested interests lead to the needs and desires of marginalised people being ignored at various scales from national-scale policy decisions to village level elite capture of benefits. Governance of ecosystem services is influenced by global markets, donor policies, internal country politics and powerful commercial interests.

1. Introduction

This **Situational Analysis** assesses the dynamics of change in ecosystem services associated with marine and coastal systems, and identifies how they support the livelihoods and well-being of human societies and particularly the rural and urban poor in developing countries. It focuses specifically on the current and potential role of ecosystem services to alleviate poverty in developing countries. It identifies the key challenges for research, current gaps in knowledge and capacity, in order to inform the development of a research strategy to support the maintenance of ecosystem services explicitly for poverty alleviation.

This synthesis report summarises and synthesises findings from three assessments: a global analysis of the state of knowledge and available data linking ecosystem services and poverty alleviation; two regional reports – one from Western Indian Ocean and one from South East Asia presenting reviews of scientific knowledge, views from key stakeholders and focus groups to inform these issues. The report is organised in twelve sections. The following section explains the approach taken, the conceptual framework applied and methods employed. Sections 3-6 present the evidence and scientific knowledge explicitly on the linkages between ecosystem services and poverty alleviation. The sections are organised according to the linkages outlined in our conceptual framework. The following four sections, numbered 7-9, then examine cross cutting issues, including who is particularly vulnerable to changes in ecosystem services, trends in ecosystem services and poverty, governance of trade-offs between ecosystem services and poverty alleviation, and the assessment of knowledge and capacity. Recommendations for further research and capacity building follow, and then the report finishes with a short conclusions section.

Much additional and detailed information is contained in electronic supplements to this report. These include the global and regional assessments themselves; the reports of stakeholder engagement activities; and a consolidated bibliography of all referenced literature. The text refers to specific points from these Appendices and cites them where appropriate.

2. Framework for Analysis

2.1 Background

The coastal region provides critical services for over two billion people worldwide who live within 100km of the coast or estuaries as well as inland populations. In turn, the degradation of coastal and marine resources poses critical challenges for the maintenance of ecosystem services and poverty alleviation. Poor people dependent on ecosystem services of marine and coastal resources live in a wide diversity of environments, from the flood-prone slum regions of coastal megacities such as Manila, to small islands such as Songo Songo off the Tanzanian coast, remote from social services and markets for their products, but not from local resource degradation and global environmental change and the depredations of the 'roving bandits' of the global fishing fleet (Berkes et al., 2006). The poor live among the effluents of industry - the ecosystem service of waste disposal taking precedence over their requirements for healthy living conditions and safe food. The poor may also be alienated from the beaches and reefs they fish from by the tourists and wealthy residents who can generate higher aggregate economic benefits from the same ecosystems. The way that coastal ecosystem services are distributed and degraded is currently making the poor poorer, more vulnerable and more marginalised and is undermining their ability and incentive to contribute to preserving the ecosystems services that sustain them (Newton et al., 2007).

What the poor in these diverse circumstances have in common is their high levels of direct dependence on ecosystem services and their high level of exposure to environmental hazards, both natural and induced by the rapid pace of anthropogenic change. We analyse their situation, identify the key drivers affecting the linkages between poverty and ecosystem services and their degradation, and develop a research agenda to identify gaps in our knowledge of these processes and means of addressing them.

The scientific literature highlights the significant and increasing importance of coastal and marine resources for human well-being: 26 million poor people fish for a living (FAO, 2007); fish supplies >50% of the essential animal protein and mineral intake for 400 million people from the poorest African and South Asian countries (FAO, 2007). Coastal zones and their ecosystems also provide a wide range of other ecosystem services: coastal protection, sink for domestic and industrial wastes, the maintenance of global biogeochemical cycles, source of income, and employment, destination for tourism and source of building materials, sites of human habitation as well as objects of cultural and spiritual value and environments for recreation. The Millennium Ecosystem Assessment (MA) and others (Jackson et al., 2001; Donner and Potere, 2007; Adger et al., 2005) have demonstrated how these systems and the services they support are under increasing pressure from a range of drivers; they are being seriously degraded; and if trends persist, will be unable to support human well-being as in the past. Future pressures from climate change, population increases in coastal areas, pollution, aquaculture development, greater human mobility, and the spread of invasive species are likely to further exacerbate these trends.

Conceptualising these systems in terms of the ecosystem services they provide, and how these support and sustain human well-being, provides more integrated and holistic insights, and the MA framework (outlined for example in Alcamo et al., 2003) provides a useful starting point. A consideration of poverty alleviation *per se* requires that we must examine explicitly *who* is able to benefit from ecosystem services and the impacts particularly of any changes in ecosystem services on the livelihoods and circumstances of poor people in poor countries. Importantly, findings from around the world suggest that the trends and changes which are influencing ecosystem services are also having profound impacts on the poor and that these in turn put further pressure on resources; in other words some of the same drivers affect both ecosystems and people, in both positive and negative ways. Understanding trade-offs between these trends is necessary to evaluate the impact of dynamics, as well as to inform difficult policy choices.

There is increasing interest in both science and policy communities on importance of ecosystem services and their role in supporting human well-being. This stems at least in part from the MA, which published its main findings in 2005. The MA delivered a stark message; our impacts on the world's ecosystems are already causing significant harm to some people, especially the poor, and that unless addressed, will substantially diminish the long-term benefits we all obtain from ecosystems (see Millennium Ecosystem Assessment, 2005). It highlights the extent and rate of change in ecosystem services around the world; that there is an increasing likelihood of non-linear changes in ecosystems which have particularly profound implications for human well-being; and that the harmful effects of

degradation of ecosystem services are being disproportionately borne by the poor, and are contributing to growing inequities and disparities across the world. The MA therefore made a strong link between ecosystem services and poverty, and presented a view of the impacts of changes in ecosystem services on the poor. It said little about how ecosystem services might help to bring people out of poverty, or how ecosystem services might act as a safety net in preventing poor people from falling further into poverty. The MA thus raised a whole set of questions and important issues about the linkages between ecosystem services and poverty alleviation, but did not answer them.

One of the major gaps identified by the MA concerns the lack of integration of concerns about ecosystem services and poverty, and the fact that 'very few macro-economic responses to poverty reduction have considered the sound management of ecosystem services as a mechanism to meet the basic needs of the poor. More generally, the failure to incorporate considerations of ecosystem management in the strategies being pursued to achieve many of the eight Millennium Development Goals will undermine the sustainability of progress that is made toward the goals and targets associated with poverty, hunger, disease, child mortality and access to water, in particular" (Chopra et a., 2005: 4-5)

The MA Working Policy Responses report (Chopra et al., 2005) highlights promising responses for ecosystem services and human well-being, and contains some assessment of the implications of these for human well-being and poverty reduction (Chapter 17), and the implications for achieving the Millennium Development Goals (Chapter 19). It argues that explicit consideration of the linkages between ecosystems and human well-being is necessary for effective poverty reduction and that this must be mainstreamed, for example within countries' Poverty Reduction Strategy Papers (Chopra et al., 2005:489). Furthermore, it argues that this sort of information, if it does exist, is rarely available to policy-makers. This is precisely the gap which this analysis, along with others in the ESPA programme, aims to fill (see WIO Report pp32-33 for a summary of how coastal and marine ecosystem services and poverty alleviation are represented in PRSPs in the region).

Since the publication of the MA a number of important scientific studies have emerged which have advanced knowledge in this field. Some studies have been able to provide new evidence to substantiate points made in the MA, others have applied the concepts developed in the MA to particular empirical settings. The analysis of ecosystem services has certainly advanced, reflected by papers in top ranking scientific journals, and there have been some significant studies which have made linkages to human well-being and development processes. For example, global analysis of the costs and benefits of the degradation of ecosystem services re-iterate the MA findings about the scale and rate of environmental change and its impacts on the flow of ecosystem services (Srinivasan et al., 2008). They have also highlighted the global inequities of these changes. The economic analysis of key changes, including climate change, overfishing and mangrove loss, shows that poor countries bear a disproportionate burden of the total damage costs compared to their share of damaging activity, highlighting the so-called 'ecological debt of nations' (see also Turner and Fisher, 2008).

Recent research has made advances in mapping ecosystem services, and comparing their distribution with conservation priorities, using proxies for ecosystem services; this shows that there is no simple concordance between areas prioritised to maximise biodiversity with those that would maximise flows of ecosystem services (Naidoo et al., 2008). In other words, maximising biodiversity is not the same as maximising ecosystem services; there are synergies and trade-offs in conserving biodiversity and ecosystem services. Barbier et al.'s analysis (2008) of coastal ecosystem functions and values highlights this point, demonstrating the non-linear relationships between ecosystem services and habitat size which implies that optimal land use options may be a mix of development and conservation rather than a stark preservation-versus-conversion choice. Kareiva et al. (2007) further highlight the need to quantify trade-offs among ecosystem services, for example how increasing the provision of one service may decrease system resilience and the provision of other ecosystem services.

Recent work on coastal and marine systems, which highlight the transformation of ecosystem services include that by Lotze at al. (2006) for estuaries and coastal seas, and Worm et al. (2006) for oceans. These studies link changes in habitats and species to a range of ecosystem services. Studies such as Brunner et al. (2008) make the further link between marine ecosystem health and potential collapse of marine fisheries, to human well-being and food security.

There is increasing interest in the impacts and desirability of a range of policy approaches and institutional innovations to provide incentives to conserve ecosystem services. Goldman et al. (2008)

present ecosystem services approaches as cost effective; they may attract more funding from more diverse sources than traditional conservation, but they are equally or more difficult to monitor impacts. Olsson et al. (2008) for example, show the complexities of moving coastal and marine governance systems towards and more ecosystem-based approach in the case of the Great Barrier Reef Marine Park in Australia.

These studies all show how the initial findings of the MA have been built on, how research gaps identified by the MA have started to be filled, but at the same time how others are opening as the field of science understanding ecosystem services and human well-being expands. This is well summarised in an introductory paper to a recent special feature on Payments for Ecosystem Services by Daily and Matson (2008). They highlight the need to identify appropriate institutions and incentives to guide investments in ecosystem services. They argue that we need more knowledge on first, the science of ecosystem production functions and service mapping; second, on the design of appropriate finance, policy and governance systems; and third, on how these can be implemented in diverse biophysical and social settings. This study aims to address these issues in the context of coastal and marine systems, and with a specific focus on the linkages between ecosystem services and poverty alleviation. This means interrogating the linkages between ecosystem services and poverty, on the processes which undermine ecosystem services but also those which create and keep people in poverty, and what opportunities exist for interventions and policies which maintain ecosystem services and enable people to come out of poverty.

While references to the role of ecosystem services in poverty alleviation are common in the literature, much of the evidence concerns the role of ecosystem services in sustaining livelihoods by reducing vulnerability and preventing further impoverishment. However poverty alleviation implies poor people becoming better off over time and a set of actions and positive changes to human well-being. Given that ESPA is explicitly about improving the well-being of the poor based on the sustainable management of ecosystem services, research is needed on options to expand the benefits from coastal ecosystem services to the poor in order not only to prevent further declines in their well-being, but also enable significant and sustained improvements to it. Potential examples include aquaculture, improved resource management, secured entitlements or payments for environmental services (PES). This study aims to highlight the extent to which the poor are actually able to benefit from such activities. We treat poverty alleviation and vulnerability reduction as related and thus include relevant information on both in this report. The section below explains the framework devised to analyse these issues.

2.2 Conceptual framework

In order to define the focus for the analysis, a conceptual framework was devised to guide the analysis and to shape the synthesis. This is shown in figure 2.1.

This highlights the linkages between ecosystem services and poverty alleviation, and where there is potential scope to enhance the benefits to poor people from ecosystem services, in the arrows marked *a*, *b*, *c* and *d*. The framework enables analysis of three important aspects of the relationship between ecosystem services and poverty alleviation.

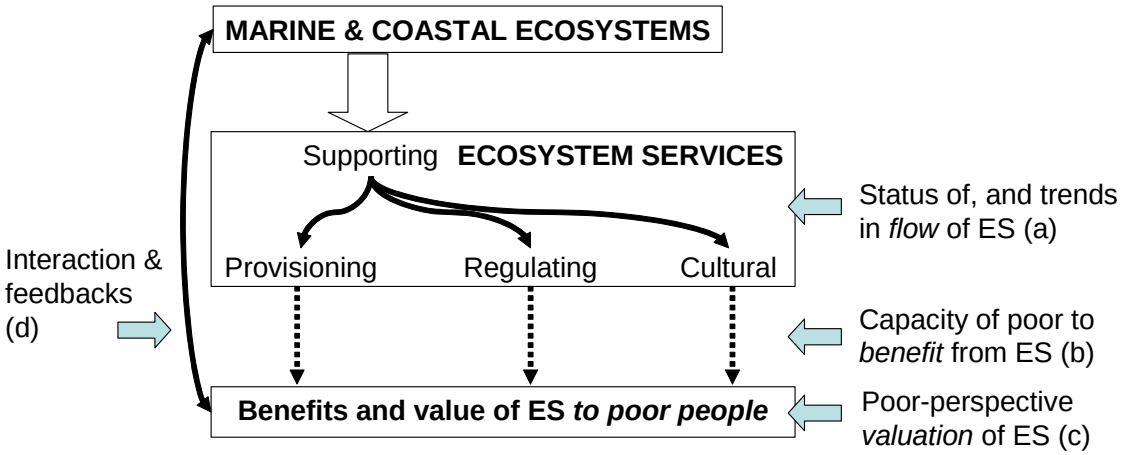


Figure 2.1. Conceptual framework for linking ecosystem services to poverty alleviation

First, the status and condition of ecosystem services is instrumental in determining the flow of ecosystem services potentially available for poor people, and is discussed in Section 3. The flow of ecosystem services, depicted by linkage labelled *a* in Figure 2.1 will be determined by ecological constraints and ecosystem status. Potential interventions to improve the flow of ecosystem services include aquaculture, restoration ecology and more sustainable exploitation strategies. The analysis then identifies the factors determining the ability of the poor to benefit from ecosystem services, including access to resources (in turn mediated by gender, class, ethnicity, age etc.), markets, technology and others. This is indicated by arrow *b* in the diagram, and discussed in Section 4 of the report. The value of ecosystems services to the poor in a variety of socio-ecological settings, including rural and urban areas, and with reference to different ecosystems (e.g. peri-urban mangroves, estuaries, coral reefs) and ecosystem conditions (e.g. from relatively well preserved to heavily degraded) is indicated by arrow *c* and discussed in Section 5, giving a pro-poor perspective on ecosystem services values. This allows the appraisal of ecosystem services from the perspective of poor stakeholders and makes use of local knowledge to identify priority ecosystem services.

Secondly, the changes in ecosystem services and management and policy response options are analysed, recognising and synthesising quantitative data on the consequences of ecosystem change for the poor. The report also compiles qualitative information about the dynamic nature of the relationships in Figure 2.1 and the impacts of change for the poor as well as potential impacts from future change. It appraises knowledge on the range of direct and indirect drivers of change in coastal and marine ecosystems, including the interaction between drivers and the scale of impacts (see Section 8). Direct drivers are those that directly affect ecosystem condition and services such as pollution or destructive fishing practices, while indirect drivers are, for example, institutions and policies that stimulate one or more direct drivers. It also identifies another set of interactions and feedbacks, marked d in the diagram, between livelihood activities that rely on ecosystem services and their impacts on coastal ecosystems, and their vulnerability to environmental change. These are discussed in Section 6.

Thirdly, the report identifies key challenges and critical gaps in knowledge and strategies to address them. For future programmes aiming to safeguard and enhance the role of ecosystem services for poverty alleviation it is critical to determine whether knowledge is i) limiting, ii) available but not disseminated to the stakeholders and decision-makers who need to apply it or iii) available and widely distributed, but not applied because of economic, cultural or political structures. The knowledge assessment identifies the key challenges for ecosystem services and poverty alleviation through applying the framework above to the assessment of status and trends, and by examining possible future scenarios and policy options in workshops with key stakeholders (discussed in Section 10). A set of key challenges (for science and policy), critical gaps in knowledge and recommendations of how to address them are outlined in Section 11.

2.3 Methods

2.3.1 Partners and study locations

The analysis was undertaken by a partnership of seven organisations, providing global, regional and national perspectives and an international team of experienced multidisciplinary and interdisciplinary scientists. The core partners in the consortium are:

Overseas Development Group/School of Development Studies UEA, UK which co-ordinated the analysis.
World Fish Center, Penang, Malaysia acted as co-ordinator for the SEA regional study, and compiled data bases for the global knowledge assessment.
Centre for Environment, Fisheries and Aquaculture Science, UK, provided oversight of global assessment and inputs into the reports.
Oceanographic Research Institute, Durban, South Africa acted as co-ordinator for the WIO regional study, compiled data bases for global knowledge assessment and convened stakeholder workshops in Mozambique.
Coral Reef Conservation Project, Mombasa, Kenya provided specialist scientific inputs to the regional analysis and to global analysis on environmental susceptibility of reef systems to environmental change and convened workshops and focus groups in Kenya and Tanzania.
University of the Philippines-Visayas and **The Centre for Marinelife Conservation and Community Development (MCD),** Vietnam, contributed with a range of government and NGO contacts and experience in community-based assessments of marine and coastal resource use, supported the regional analysis and convened national workshops and focus groups.

The two regional assessments focus on South East Asia and Western Indian Ocean. Boxes 2.1 and 2.2 below give a brief overview of the two regions, stressing the characteristics which make them relevant contexts for the situational analysis.

Box 2.1: South East Asia (SEA)

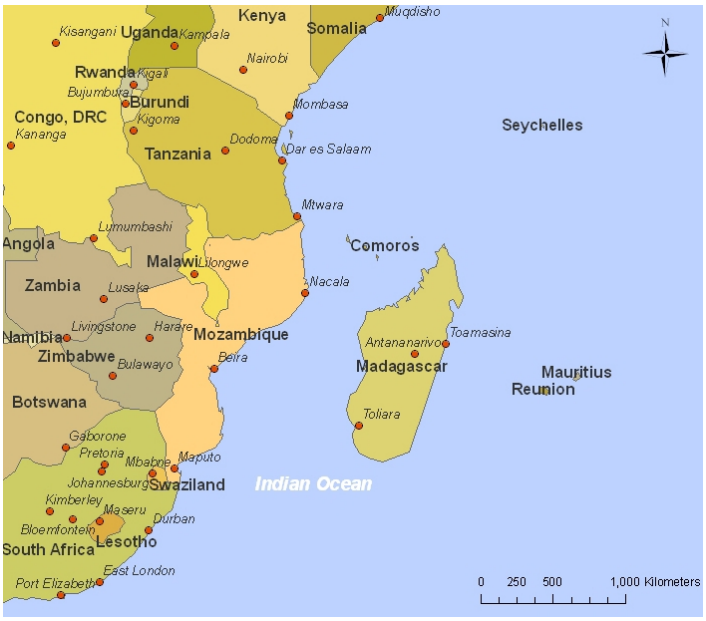
The SEA analysis considered the South China, Celebes & Sulu Seas large marine ecosystems (LME's), with an emphasis on coastal Vietnam and the Philippines. The region exhibits extraordinary levels of diversity in terms of habitats, marine and coastal species, cultural diversity of coastal inhabitants and resource users, and the many threats to the ecosystems and services that the region's coastal seas provide. Eight nations surround the South China Sea and the Sulu-Celebes sea, all at different stages of development, but all rapidly industrialising (Cambodia, China, Taiwan, Indonesia, Malaysia, Philippines, Thailand and Vietnam). Effective governance of marine and coastal resources in the region is inhibited by socio-political factors at play in the region including widespread poverty, transmigration, separatism, illegal fishing and corruption (DeVantier et al., 2004).

The underwater topography, complex hydrology and numerous small islands contribute to the exceptional richness of marine biodiversity in the Celebes Sea, where 1800 species of fish, 400 species of algae, 5 species of sea turtle, 22 species of marine mammal and 450 types of coral have been recorded. The area is classified as a low pelagic productivity area in contrast to the South China Sea region, classified as a moderately high productive region, attributed to the gulfs, coastal zones, and reef and seagrass areas of the region, particularly common in the Philippines. Marine resources provide a vitally important source of food and income for poor people, and contribute to food security throughout the region. Fish provide more than 20% of animal protein consumed by more than 1.6 billion of the 3.5 billion people in the Asian region. With a population of over 510 million, of whom approximately 35% live below the poverty line, average fish consumption is 22 kilograms per capita per year and is even higher in coastal communities. Concern focuses on the likely gap between fish supply and the ability of capture fisheries to meet increased demand from a growing global population.

Urbanisation is taking place at a dramatic pace, and often in the coastal zone. In Southeast Asia, more than 75% of the population lives within the 100km of the coast, with 38 cities with more than 1 million inhabitants located on the coast (Yeung, 2001). Mega-cities Hong Kong, Guangzhou, Manila and Ho Chi Minh city are located around the region. The needs, daily challenges and links to ecosystem services of these coastal, urban dwellers differ greatly from their rural counterparts. Ecosystem services in the region are threatened by pollution from both terrestrial and marine sources. Waste management systems are frequently inadequate to cope with the increased volume of waste generated by a rapidly growing coastal population. As a result, coastal zones act as a sink for domestic and industrial waste generated by coastal urban centres. Coastal dwellers also bear the brunt of activities far removed from the coastal zone, with wastes from upstream sources depositing in the seas by rivers. Furthermore, climate change threatens to impact the region, which is already vulnerable to storms and flooding. Currently 270 million people live below storm surge level and are vulnerable to sea-level rise.

Figures 1-4 in the SEA Report show the extent of the region and the distribution of key habitats within it.

Box 2.2 *Western Indian Ocean (WIO)*



The Western Indian Ocean (WIO) is the site of some of the most dynamic and variable LMEs in the world. Complex current systems that include the Agulhas Current retroflection, migrating anti-cyclonic eddies in the Mozambique Channel and di-polar vortices off East Madagascar induce variability into ecosystems of the region. In addition, coupling between atmospheric circulation and ocean processes lead to extensive monsoon systems that in turn lead to the development of unique events, such as the seasonal Somali LME, one of the most intense and nutrient-rich coastal upwelling systems in the world. Similarly, the Agulhas LME, to the south, represents a region of dynamic nutrient cycling and associated fisheries potential. These two large LMEs, as well as the influence of the 2000km long Mascarene Plateau, have a profound basin-wide and transboundary influence over the region's ecosystems, biodiversity and fishery resources, including the coastal zone with its considerable human populations (Spencer et al., 2005). At their present level of economic development, countries of the WIO region are neither able to estimate the potential of their marine ecosystems nor to draw sustainable long-term benefits from them.

In Eastern Africa the combined effects of poverty, food security and poor governance, accentuated by the loss and degradation of critical habitats, such as mangrove and coral reef ecosystems, pose enormous environmental challenges to this region. Estimates suggest that more than 60 million people reside within 100 km of the coast, which equates to approximately one third of the region's total population (WRI, 2002). This region also includes some of the poorest nations in the world. Most countries lie below the top 100 level in the United Nations Human Development Index (WRI, 2002), and there is considerable dependency on coastal and marine resources for income and food. The main environmental concerns are the loss and degradation of habitats and the modification of mangrove and coral reef ecosystems. Human-related pressures come from over-fishing and fishing-related damage, from urbanization and tourism development, from agriculture and industry, and from damming for hydropower and fresh water supplies. Climate change issues include coral bleaching, which has contributed to coral reef degradation, and the impacts of sea-level rise, particularly with regard to coastal erosion and the inundation of coastal lowlands.

2.3.2 Data and methods

The study comprised a series of work packages which undertook global and regional assessments. These were based on review of scientific knowledge (from both peer-reviewed and 'grey' literature); national workshops in five countries (Kenya, Tanzania, Mozambique, Philippines, Vietnam); and a series of focus groups. Reports on each of these activities are included as appendices to this report. The **Global Analysis** (see Appendix 1) examines global and cross-national datasets and assesses their usefulness in understanding the linkages between ecosystem services and poverty alleviation. Although data on ecosystems, their spatial extent and, (to a somewhat limited extent) the changes overtime do exist, these are often incompatible with information on poverty distribution and extent. For example at a cross-national of international scale, it is difficult to identify populations dependent on coastal and marine ecosystem services and their poverty characteristics or status. The Global Analysis undertakes a global vulnerability assessment to highlight where the people and systems most vulnerable to changes in ecosystem services are, and to illustrate the limitations of existing data.

Two **Regional Analyses** extend the framework in order to identify and elaborate the key challenges facing coastal and marine ecosystems which are most likely to threaten their ability to support livelihoods and provide benefits to human populations in regions with high levels of poverty, high

dependence on marine and coastal resources, from a diverse range of ecosystems**.** The Regional Analyses reviewed country and regional-level scientific information to assess knowledge on ecosystem services and poverty alleviation within two regions: the Western Indian Ocean and South East Asia (see Boxes 2.1 and 2.2). The regional reports (Appendices 2 and 3) explain the geographical definitions of the regions. The assessments included stakeholder analyses and institutional analyses in addition to scientific reviews. National Workshops included regional scientists, and research and policy personnel, including government, donor and NGO representatives. These had three objectives: to provide feedback on draft findings; to discuss main drivers of change in the region, identify policy options and trade-offs; and to identify priority areas for future research and regional capacity building. The reports of these workshops are presented in Appendix 4. Focus groups were undertaken in order to gain some insights into specific issues (for example fishers and dependency on ecosystem services in SIDS), and to provide alternative voices and perspectives on ecosystem services and poverty alleviation. These findings are discussed especially in Section 5. We recognise that the focus groups did not always include the poorest and most marginalised in coastal communities, but they serve to provide a different perspective on the issues; reports are included in Appendix 5. We use the findings and observations from National Workshops and Focus Groups to add local knowledge; to back-up or contradict other information and especially to draw attention to issues which are of primary concern to local scientists, policy makers and resource managers and users. Where possible we provide a reference (data point) – either a scientific citation, a quote or a reference to one of the appendices so that the information, observations and views can be sourced and verified. We have tried to balance citations of quotes with scientific references where possible as a means to achieve 'balance'. However the inputs of regionally based scientists, government officials and policy makers, in the case of National Workshops, and the voices of local resource users in the case of Focus Groups, is given prominence in some sections fo the report. This is a key original contribution of this Situational Analysis and represents the inputs and perspectives of key research users and beneficiaries.

Figure 2.2 provides a simple schematic of how the components of the study fit together.

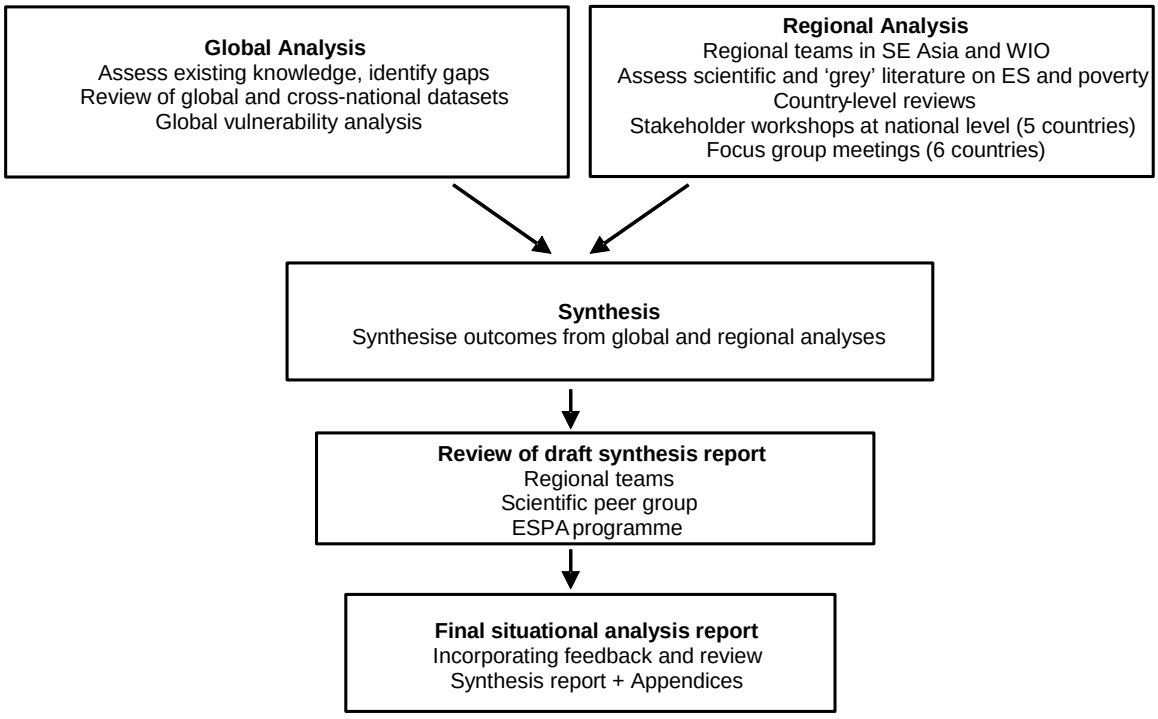


Figure 2.2 Components of ESPA-MA Situational Analysis

2.3.3 Definitions and boundaries

We adopt the key definitions as set out in the MA and outlined in the table below.

Table 2.1 Definition of key terms

Ecosystem	An ecosystem is a dynamic complex of plant, animal, and microorganism communities and the nonliving environment interacting as a functional unit. Humans are an integral part of ecosystems. Ecosystems vary enormously in size; a temporary pond in a tree hollow and an ocean basin can both be ecosystems
Ecosystem services	Ecosystem services are the benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as regulation of floods, drought, land degradation, and disease; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, spiritual, religious and other nonmaterial benefits. The pro-poor perspective of this study emphasises employment and earnings as an important benefit from ecosystems.
Well-being	Human well-being has multiple constituents, including basic material for a good life, freedom of choice and action, health, good social relations, and security. Well-being is at the opposite end of a continuum from poverty, which has been defined as a ''pronounced deprivation in well-being.''

The boundaries of coastal and marine systems are indistinct and required us to define them somewhat arbitrarily (Table 2.2).

Table 2.2 Defining system boundaries

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System	***Central concept - MA***	***MA boundary limits***	***Alternatives used for ESPA-MA***
Marine	Ocean, with fishing typically a major activity	Marine areas where sea is deeper than 50metres	No distinction between coastal and marine. Any marine areas linked to the wellbeing of poor coastal dwellers become, by definition, part of the coastal system.
Coastal	Interface between ocean and land, extending seawards to about the middle of the coastal shelf and inland to include all areas strongly influenced by the proximity to the ocean	Area between 50m below mean sea level and 50m above the high tide level or extending landward to a distance 100km from shore. Includes coral reefs, intertidal, zones, estuaries, coastal aquaculture, and seagrass communities.	This report uses Low Elevation Coastal Zone and the 100km coastal fringe to define the coast (for example in mapping poverty incidence within nations) as well as districts or municipalities bordering the coastline for aggregated data at national scale (e.g. in examining poverty incidence in Philippines and comparing coastal to non-coastal populations)
Islands	Lands isolated by surrounding water, with a high proportion of coast to hinterland	Islands of at least 1.5ha included in the ESRI ArcWorld Country Boundary dataset.	We have concentrated focus on Small Island Developing States in the Global Analysis and highlight scarcity of systematic, comparable data on SIDS; and used Rodrigues in Western Indian Ocean as a case study to undertake Focus Groups to highlight SIDS issues

Attempts to integrate social or economic data (number of poor people etc.) with data on ecosystems and ecosystem services, raise problems with boundaries and data incompatibility. Basically, social and economic data are not collected on a spatial or system-based scale; it is available either nationally, or within countries by administrative unit. These problems are discussed at more length in the assessments and in the relevant analytical parts of this report.

Finding an appropriate indicator of poverty and means to identify who the poor are, where they live, how they are characterised in order to examine their relationship to ecosystem services proves even more problematic and fluid.

Again the analysis started with the Millennium Ecosystem Assessment definition of well-being (see above) and extended this to assess the impacts and implications of these changes and dynamics of the system for poverty and well-being, adopting a broad understanding of well-being as highlighted in Box 2.3.

Two key aspects are highlighted in the analysis. First, the extent to which the dynamics and uncertainty within the system affect human well-being; for example, are livelihoods becoming riskier more precarious? Second, are changes making poor people more vulnerable and therefore less likely to cope with other changes or shocks? Within each assessment a number of indicators of poverty and well-being are applied; due to both their relevance and also because of available data. For example, national data on GDP per capita, number of people earning less than one dollar per day, or below a defined poverty line may be used. Each have their own difficulties of reliability and compatibility, issues fairly well discussed in the literature. The analysis has also used indicators such as child mortality and percentage children underweight, as well as indices such as the Human Development Index. Each has positive and negative aspects and this is discussed in the text. Suffice to say, no one indicator is applicable to all types of assessment and analyses.

3. Ecosystem Health and Flows of Ecosystem Services

This section discusses the linkage depicted by *a* in Figure 2.1 highlighting what is known about the status of ecosystems and the resultant flow or ecosystem services from them.

3.1 Coastal and marine ecosystem services important to the poor

Clearly coastal and marine ecosystems provide a wide range of benefits to society as a whole, as the MA has shown, and fisheries in particular make significant contributions to the national economies of many developed and developing countries (see analysis by Allison et al., 2005, and the figures used in the vulnerability analysis in Global Report). Fisheries can be seen to be an important component of economic wealth or natural capital, and can have an important role in economic growth and poverty alleviation if appropriately managed (IDDRA, 2005). A wide array of marine and coastal ecosystem services supporting poor people are described in the literature and identified by the stakeholder consultations, which encompass all of the four types of ecosystem services defined by the MA conceptual framework (Table 3.1).

The specific poverty focus of this assessment led to some different categorisations of services compared to the MA by participants in our consultation exercises. With this assessment's focus on particular individuals and groups (i.e. the poor) it became relevant to consider income and employment benefits (e.g. from selling food fish) as part of the benefits provided by ecosystems. These types of benefits are not explicitly considered in the MA conceptual framework which considers the contributions of ecosystems to human well-being in an aggregate sense, with no particular emphasis on poor people. To include employment and cash as ecosystem services benefits is unusual, but from the pro-poor perspective taken for this assessment, it does correspond with the MA definition of ecosystem services as *'the benefits people obtain from ecosystems"*. Another example is that the MA viewed tourism as a cultural ecosystem service to humankind, but from a pro-poor perspective, the main benefit of tourism is not as a cultural ecosystem services but as a source of livelihood and is therefore classified in this report as a provisioning service.

Several ecosystem services are inter-dependent, thus categorising (and especially ranking) ecosystem services is complicated by the fact that one ecosystem service (e.g. rainfall), may be based on a different supporting service (e.g. forest growth) but also itself be seen as a supporting service for another benefit (e.g. agricultural production). Such conceptual confusion between the MA categories may create challenges for clear communication to end-users of ESPA research and presents risks of double counting for valuation-based research (Fisher and Turner, 2008).

The ecosystem services identified by the scientific literature, national workshops and focus groups during this assessment as being of most relevance to the poor are overwhelmingly dominated by various provisioning services, especially those that generate or safeguard economic opportunities for the poor, such as fishing. Regulating services and ecosystem services that support provisioning services are next most important (see section 5). Such priorities are unsurprising given the material poverty, shortage of income and food, short time-horizons and vulnerability of the coastal poor.

Table 3.1. Ecosystem services from coastal and marine ecosystems which contribute to the wellbeing of poor coastal dwellers *(summarised from UNEP, 2006a, Workshops and Focus Groups).*

Type of ES	Ecosystem services	Key ecosystems providing services
Supporting	Habitat provision	Coral reefs, mangroves, seagrass
	Support for aquatic life cycles	Open ocean currents
	Hydrological cycle	Coastal forest, wetlands, mangroves
	Nutrient cycling	Various coastal ecosystems
Provisioning	Building materials (e.g. poles, limestone)	Mangroves, coral reefs
	Fuel (Wood and charcoal)	Mangroves, coastal forests
	Fisheries	All marine habitats
	Aquaculture	Coastal land, mangroves
	Agricultural products	Coastal land
	Other natural products (e.g. honey)	Mangroves, coastal forests
	Employment and Income	Systems providing provisioning services
	Medicines	Forests, mangroves, seawater
	Fresh water	Forests, coastal waterways
	Seaweed production	Shallow lagoons
	Tourism income	Coral reefs, beaches
Regulating	Protection from erosion	Muddy offshore banks
	Protection from storms & flooding	Mangroves, coastal vegetation
	Maintenance of air & water quality	Mangroves, coastal forest, coral reefs
	Waste disposal	Open sea and tidal currents
	Climate regulation	
	Pest and disease control	
Cultural	Cultural identity related to coastal livelihoods	Various coastal ecosystems
	Education and research	
	Bequest value	
	Recreation	
	Pleasant environment to live	

The importance of fisheries as a key provisioning service is highlighted by literature and reinforced by this assessment. Global data on fish production have been collected by FAO since the 1960s but are focussed mainly on large-scale fisheries which have limited relevance for the poorest communities (Global Report p61) due to their low provision of employment, low accessibility to the poor due to high capital and fuel costs, and high proportions of catch reduced for fish meal or targeted towards international markets (Berkes et al., 2001). Small scale fisheries are of more direct relevance to the coastal poor, providing valuable protein (Thorpe, 2004), livelihood options (Allison and Ellis, 2001) and generating economic opportunities for an estimated 200 million people, who are dependent on small scale fishing in developing countries in addition to millions for whom fisheries provides a supplemental income (FAO, 2005). It is unclear what proportion of these global figures represent coastal fisheries as they include freshwater fisheries, which are important in many regions, e.g. mainland Asia and central Africa. Aquaculture is an increasingly important provisioning service contributing to livelihoods and food especially in Asia (FAO, 2007) but also to a lesser extent in East Africa (Rönnbäck et al., 2002).

Large scale life support systems such as climate regulation, ocean current regimes, ocean-atmosphere climate interactions are essential for all human life and wellbeing, and may impact poor people's livelihoods directly. For example the distribution, and availability of mobile species can be altered by changes in ocean currents, thermocline depth and upwelling strength. The dynamics and productivity of the Somali current LME is driven by ocean-atmosphere interactions. However such ecosystem services do not have a particular role in poverty alleviation at the temporal and spatial scales of poor coastal dwellers when compared to the dynamics of near-shore ecology and socioeconomic drivers like markets and are rarely considered relevant for poor livelihoods. There is a need for integrating understanding of such large scale processes with the realities of local coastal people and linking the long-term dynamics of these large systems with short-term variability experienced by the poor. Examples include the impact of global climate change on the productivity of systems used by poor communities through droughts, coral bleaching, extreme weather and current variations.

A range of coastal ecosystems are responsible for the identified ecosystem services (Table 3.1, also see Agardy et al 2005) but mangroves and coral reefs attract particular attention due to their functional significance, conservation status and ecological interest. Mangroves provide a wide range of

ecosystem services for local people (Walters et al 2008) and support fisheries production by providing juvenile and feeding habitats. In the Caribbean, the presence of mangroves has been shown to double the biomass of some species on adjacent reefs (Mumby et al., 2004). Mangroves have also been demonstrated to contribute significantly to coastal protection and regulating the impacts of storms on land and land-derived sediment on marine systems (Melana et al., 2000; Janssen and Padilla, 1996). Coral reefs support fisheries production and coastal protection through acting as a physical barrier and producing sediment which nourishes beaches. The distribution of coral reefs, coinciding with large numbers of developing country populations in South East Asia, East Africa and throughout the Pacific lead Whittingham et al. (2003a) to conclude that many millions of small-scale fishers are dependent on coral reefs for their livelihoods.

Other coastal ecosystems including seagrass beds, soft bottom habitats, estuaries, coastal wetlands, intertidal mudflats and deep oceans have been the focus of fewer studies but are important for a range of ecosystem services (UNEP, 2006a). One study in Zanzibar, for example, demonstrates a wide range of supporting, provisioning, cultural and regulating services provided to coastal people by seagrasses (De la Torre-Castro and Rönnbäck, 2004). In fact, adjacent seagrass ecosystems may generate most production in heavily fished tropical nearshore 'coral reef' fisheries (McClanahan et al., 2008).

3.2 Information on ecosystem health

Some data on the status of certain ecosystems, especially coral reefs and mangroves exist at each scale although the resolution and reliability of this at global and national scales is uncertain (Global Report, Tanzania National Workshop p11). Data which are available confirm the general pattern identified by the MA of poor and declining extent and condition of coastal and marine ecosystems in developing countries (Agardy et al 2005, e.g. Philippines National Workshop III,1) largely as a result of habitat modification, overexploitation and climatic extremes. Mangroves and coral reefs are a particular focus for concern and have been subject to the most extensive attempts to provide a synoptic picture (Vietnam National Workshop 2.3, Burke et al., 1998). For example Wilkinson (2004) estimates that 20% of the world's coral reefs have already been "destroyed and show no immediate prospects of recovery". However the condition of coastal ecosystems in developing countries is often not well documented (e.g. Tanzania National Workshop p11), even though local stakeholders are concerned about loss of breeding grounds in coral reefs, mangroves and seagrass beds and the impacts of pollution from sewage, refuse, agriculture and aquaculture activities. For example, Vietnamese focus groups identified pollution due to refuse and agricultural chemicals as a concern with impacts on the productivity of fisheries (Vietnam Focus Group 2).

3.3 Links between ecosystem health and flows of ecosystem services

The degradation of coastal ecosystems inevitably has implications for ecosystem services of importance to the poor, for example loss of mangroves and siltation of river channels was identified in Mozambique as responsible for declining fish catches (Mozambique Focus group 2). In the case of the Zambezi river, shrimp landings are directly related to river flow and declined by 20% after upstream dams were constructed (Hoguane, 1997). However, in general, such linkages have not been quantitatively shown and require further research so that the impact on the livelihoods of poor people as a result of the loss or degradation of coastal ecosystems can be clearly illustrated and, if possible, quantified to inform policy.

Despite the consensus on decline of coastal ecosystems and the availability of data on ecosystem area (Global Report), data on the actual production of ecosystem services are rarely available at any scale, so the effect of ecosystem decline on ecosystem services and poverty is normally assumed rather than being explicitly measured. A notable exception is the quantification of fisheries enhancement by mangroves in Caribbean coral reef ecosystems (Mumby, 2006; Mumby et al., 2008). The relationship between ecosystem condition and extent (i.e. the stock of the ecosystem) and the flows of ecosystem services is likely to be non-linear and variable for each ecosystem service considered. For example the coastal protection function of mangroves has been shown to be non-linearly related to the quantity of mangroves (Barbier et al., 2008). For coral reefs, severe degradation as a result of coral bleaching in Seychelles initially showed no impact on the provisioning service of productivity of local artisanal fisheries (Grandcourt and Cesar, 2003), but the relationship may be complicated by ecological shifts and time lag effects (Graham et al., 2007). These functional relationships between ecosystems and ecosystem services may be spatially variable, and the sporadic quantification of such relationships, makes it difficult to generalise or perceive place-based variation in relationships due to geography and the social environment.

Local users of ecosystem services do perceive linkages between the quality of the coastal environment and loss of supporting ecosystem services. Focus group participants, for example, often cited the supporting services of mangroves, coral reefs and seagrass, for provisioning services.

3.4 Potential to increase ecosystem service flows

In most cases, the flow of services from coastal and marine ecosystems are constrained by biophysical processes, for example the physical extent of shallow waters along East Africa limits the potential for small-scale demersal fisheries (WIO Report, section 1) while the growth and reproductive parameters of fish stocks determine limits to sustainable exploitation rates. Thus the opportunities to alleviate poverty by increasing the flow of many ecosystem services often have biophysically imposed natural limits. In these cases increased utilisation of ecosystem services may lead to overexploitation of the underlying ecosystems and undermine the sustainability of future ecosystem services. The key research area in this case therefore is to establish the limits of pressure or change on coastal ecosystems that endanger their integrity and ability to provide ecosystem services.

The development of aquaculture is an example in which the provisioning services of fish production can be increased. However, this impacts on natural ecosystems and thus may compromise the provision of other ecosystem services. A significant example is the loss of mangroves through the development of pond aquaculture in SE Asia which has been the main driver behind the loss of 70% of mangroves in the region (SEA Report section 3.1.5). The sustainability of major increases in fish production from aquaculture has also been called into question by the experience of aquaculture in SE Asia where many intensive shrimp farms have been abandoned due to self pollution, disease and loss of supporting services from nearby mangroves (SEA Report section 3.1.5). Aquaculture of carnivorous species can also increase the demand for wild caught-fish and enhance pressure on wild fisheries as well as compete with poorer communities for access to cheap fish protein, potentially reducing the food benefit of fisheries available to the poor (Funge-Smith et al., 2003). For aquaculture and other new production technologies to contribute to sustainable poverty alleviation, continued research is needed on forms that do not lead to over-harvest of wild ecosystems for food, seed or broodstock, and how to draw these ecosystem services without causing severe or irreversible loss of other ecosystem services.

Where resources are heavily overexploited there may be potential to increase flows by more appropriate levels of exploitation,for example reducing fishing pressure or establishing marine protected areas (MPAs). The MA and the regional and global assessments identified extensive overexploitation of fisheries throughout the world, including small-scale tropical fisheries of most relevance to the coastal poor. For heavily overfished stocks, such as those involved in the live reef fish food trade (Sadovy et al., 2003), reductions in fishing pressure could result in increased production and more stable yields, stock resilience and long-term security for local people along with corresponding benefits for ecosystem integrity and biodiversity conservation. For example increasing the size at capture of shrimp in Mozambique and avoiding ‘growth overfishing’ could increase catches by 55% (Van der Est, 2003). However, artisanal fisheries can also provide high yields of fish at high fishing pressure due to shifts in species composition to fast growing herbivorous species (McClanahan et al. 2008) even though catch and value per individual fisher may be low. In such a situation, reducing fishing pressure may not lead to an increased total production of fish or employment. Thus attempts to decreasing or increase fishing pressure may involve trade offs between different ecosystem services and over different timescales. Basic ecological research on the response of ecosystems to different types of exploitation at different scales and over time is needed to inform such trade-offs.

Examples from the Philippines and East Africa suggest that establishment of MPAs can increase flows of provisioning services by enhancing the production or value of catches in neighbouring ground through ‘spill-over’ or protecting breeding populations (SEA Report 4.1.3; Russ et al., 2004) as well as provide opportunities for tourism development. However, MPAs’ ability to enhance fisheries production is widely debated and probably rely on particular conditions (Hillborn et al., 2005; WIO Report p29). In addition, poor people who have immediate provisioning needs for cash and food, may not be able to wait for up 5-10 years benefits of MPAs to accrue (Philippines National Workshop III.1, Mozambique National Workshop 3.1) and may not be able to profit from tourism or other benefits which arise (e.g. Kenya Focus Group 1, Mozambique National Workshop). Finally, reviews of active MPAs in the Philippines show that, in order to realize the expected benefits from sanctuaries, there needs to be a network of such protected areas, rather than isolated geographically scattered sanctuaries. This is because intensive fishing effort adjacent to no-take areas can negate the fish abundance generated by MPAs (Philippines Country Report).

A pro-poor perspective, therefore presents a trade-off when dealing with 'overfishing'. Although reduction in fishing pressure and establishment of MPAs may increase the flow of services in terms of maintenance of biodiversity, ecosystem integrity, resilience, and tourism, they may not cater to poor people's priorities of provisioning services of fish production in the short term. Thus, in the Philippines where there is extensive experience of MPAs, it was recognised that they are primarily a tool for environmental protection and are not efficient nor effective routes to poverty alleviation (Philippines National Workshop III.2).

Where ecosystem services have been diminished as a result of ecosystem degradation, there may also be potential to restore flows of ecosystem services by rehabilitating coastal ecosystems. This has most widely been attempted with mangrove replanting in Asia, although only a fraction of deforested mangroves have been replaced (Rönnbäck et al., 2007). Moberg and Rönnbäck (2003) argue that rehabilitation of coastal ecosystems is inevitably more expensive than preservation of existing habitat while Rönnbäck et al. (2007) found that coastal dwellers in Kenya derived significantly more ecosystem services from natural than replanted mangroves. This suggests that efforts to maintain existing ecosystem services presents a more efficient way to benefit the well-being of the poor than rehabilitating ecosystems after degradation. However, in cases where extensive loss of natural habitat has been lost, research is needed on affordable restoration techniques that rehabilitate the flow of ecosystem services.

Increasing or expanding the nature of fisheries by providing fishing vessels or engines to exploit more distant or deeper resources is often seen as an opportunity to increase the flow of provisioning services (Tanzania National Workshop, Kenya Stakeholder Workshop, Mozambique Focus Group 1&3, Rodrigues Focus Group1) and in a few cases there is scope for development of fishing on pelagic stocks (WIO Report p27). However the productivity of offshore resources is often unknown or highly uncertain (Kenya National Workshop). Previous attempts to facilitate offshore expansion of fisheries have suffered from incorrect assumptions about the behaviour of fishers and have led to overexploitation of nearshore waters (Wakeford, 2000). In terms of poverty alleviation, more industrialised fisheries in East Africa tend to have limited uptake by poor local fishers (WIO Report p27). Thus expansion and modernisation of fisheries, although often associated with development and poverty alleviation, need to be appraised in the light of more detailed assessments of the potential sustainable productivity of unexploited stocks and understanding of fishers' behaviour and the ability of poor communities to benefit from such development.

4. Ability of Poor to Benefit from Ecosystem Services

This section examines the factors that determine the ability of the poor to benefit from ecosystem services, represented by the arrow labelled *b* in the conceptual diagram Figure 2.1. For many poor their livelihoods depend almost entirely on various ecosystem services (WIO Report: 4). Their ability to access and benefit from such ecosystem services is thus integral to ensuring their livelihood. Evidence suggests that numerous barriers prevail in enabling the poor to access or to benefit wholly from ecosystem services, particularly provisioning services. Box 4.1 shows key factors identified through focus groups in the two regional assessments. This section analyses these barriers, examining access to resources, technology, markets as critical issues. Marine Protected Areas (MPAs) are increasingly important as institutions which, designed to protect ecosystems and fisheries and thus maintain stocks of ecosystem services, may have profound impacts – both negative and positive – on the ability of the poor to benefit from ecosystem services in that they affect the flow of ecosystem services.

Box 4.1: Barriers to benefitting from Ecosystem Services identified by Focus Groups

Access to Resources	**Technology**
• Permits & Licenses • Law Enforcement • Land Availability • Gender • Geographical Location • Coastal Development • Technical Capacity • Climate Change • Marine Protected Areas	• Fishing Gear • Boats • Processing Facilities • Storage Equipment • Technical Skills
Markets	**Others**
• Isolation • Transportation • Price • Conflict with large-scale fisheries	• Regulatory/Law Awareness • Policy & Planning • User Conflicts • Migration • Community Organisation • Public Consultation • Subsidies • Pollution •

4.1 Access to resources

Limited access to provisioning ecosystem services is a particularly important factor in the ability of the poor to benefit from ecosystem services. Access to marine and coastal ecosystem services is determined by a range of property rights, mediated by formal and informal institutions. This section examines how these affect the ability of the poor to benefit from ecosystem services, and then how changes to these institutions and property rights may be important to increase benefits and potentially to ensure that ecosystem services have a role in poverty alleviation. Access is also denied as a result of physical factors such as incidence of storms (sometimes believed to have increased as a consequence of climate change); because of where people are forced to live, their lack of formal title to land, and their lack of access to landing sites.

4.1.1 Open Access Resources

In many parts of the world coastal and marine resources are de facto and de jure open access resources; typically the open ocean and the beach below mean high-water level in most countries. Ecosystem services associated with them are likewise often open access, in that they may have few regulations controlling access and use, including destructive use and extraction. This has advantages and disadvantages for the poor. It means the poor may be able gain entry to areas or access resources without formal rights or at relatively low cost. However, a key problem is that resource-poor users may be unable to exclude others from using these resources and thus have no guarantees to the benefits of any increase in ecosystem services flow.

4.1.2 Permits/Licenses

Although licensing can in theory be used to protect access to resources for the poor (e.g. 'subsistence permits' for poor fishers in South Africa), most attempts to regulate access to ecosystem services through permits or licences may have built-in biases against the poor. These regulations may be expensive for poor people, or may be restricted to certain types of gear or technology, may require legal or bureaucratic procedures which entail high transaction costs or levels of literacy. For example, the focus groups highlighted these difficulties in Kenya and Mozambique (Kenya Focus Group 1 & 3, Mozambique Focus Group 2). Furthermore focus groups often demonstrated a general lack of confidence in the fairness and legitimacy of permits and licences (Kenya Focus Group 1). Therefore any rights-based approach to regulating access and exploitation of resources must recognise and take account of these probable biases in their design and implementation, and where appropriate instigate measure to counter-act them. These illustrate some of the potential difficulties of rights-based frameworks currently promoted by international agencies, including FAO (see Box 4.2)

Box 4.2: Rights-based approaches and access of poor to ecosystem services

International agencies, including FAO, are currently promoting right-based frameworks for fisheries management. These approaches are believed to be essential tools to address problems of over-fishing, stock depletion and poor economic returns caused by overcapacity.

Rights-based approaches include Individual transferable quotas (ITQs) and territorial user rights in fisheries (TURFs).

However it is important that these approaches recognize customary and traditional rights of fishing communities; that they do not over-ride collective rights and community-based tenure, and result in blanket privatization of resources; and that they acknowledge men's and women's differing rights.

A recent workshop in Zanzibar asserted that fishing rights should not be treated as a tradeable commodity but should be seen as an integral part of human rights. New property rights – related to fisheries management, conservation or tourism, should respect the rights of coastal communities to unhindered access to beaches, landing sites and fishing grounds. Ideally the management of fisheries should be devolved to local level. Post harvest activities, the incidence of pollution and measures to prevent and combat unreported, unregulated illegal fishing, all of which have impacts on livelihoods of small-scale fisheries, also need to be addressed.

Thus rights-based frameworks have implications for how poor people can benefit from ecosystem services; positive in terms of regulated illegal users and 'roving bandits, and supporting the long-term sustainability of stocks, but negatively unless customary rights are recognised and incorporated into frameworks.

Asserting Rights, Defining Responsibilities: Perspectives from Small-scale Fishing Communities on Coastal and Fisheries Management in Eastern and Southern Africa, 24-27 June 2008, Zanzibar, Tanzania, ESA Workshop II for report see:
http://icsf.net/icsf2006/uploads/publications/proceeding/pdf/english/issue_100/ALL.pdf

4.1.3 Enforcement of regulations

Many countries report poor enforcement of regulations. This observation has been widely reported in the scientific literature and was a key feature in focus group discussions within the regions we studied. For example, in the Philippines the lack of political will and support in enforcing regulations, such as that on illegal and destructive gears and of competition with commercial fishers that encroach in fishing areas intended for subsistence fishers, is seen as a barrier to poor people benefitting from ecosystem services (Philippines Focus Group 1). Often, even when regulations are enforced, violators pay the penalty but then continue to violate, suggesting that fines are not high enough to provide a deterrent (Philippines Focus Group 2). Strongly supported government enforcement action can help to safeguard resources for local poor communities. For example in Mozambique increasing enforcement capacity, in the form of new patrol vessels has led to the successful impoundment of large scale foreign vessels illegally fishing in Mozambique waters. There is a general concern that regulations may be unevenly enforced on the less powerful. As reported in one focus group, 'small people' are

affected by them but 'big people' do not have rules enforced on them (Philippines Focus Group 2). Vietnam lacks effective control on aquaculture and fisheries planning. But focus group participants recognised the need to strengthen the coordination between local stakeholders to patrol and treat strictly the violation cases fishing by dynamite. The involvement of community informants would support the local authority in fishery enforcement (Vietnam Focus Group 1).

4.2 Technology

Technology also constitutes an important constraint or enabler to access by the poor. The use or ownership of larger, more efficient boats and fishing gear and access to processing, storage, and transport facilities affects how people can utilise and benefit from provisioning services. Technology can advantatge or disadvantage particular groups of people, and can shift the distribution of benefits from ecosystem services in important ways. Focus groups highlighted the competition between motorised and non-motorised boats for example in disadvantaging poorer fishers (Kenya Focus Group 2). Boat owners and those with improved gear have better access to ecosystem services, but they may not be better-off as this equipment is expensive to acquire and maintain (Kenya Focus Group 2, Mozambique Focus Group 1 & 2). These are seen as significant constraints which prevent resource-poor fishers from accessing certain species and fisheries (e.g. distant or deep-sea), and from being able to conserve fish or generate more income from fishing (Mozambique Focus Group 3, Rodrigues Focus Group 1). Lack of credit available to fishers was noted as a constraint to them acquire bigger boats and better gear to enable them to fish in deeper water (Mozambique Focus Group 3).

4.3 Markets

Limited access to markets means that prices can be dictated by intermediary buyers and so fishers are often forced to sell their catch below the market price. Where direct sale takes place some fishers may have preference over who to sell their fish to; large-scale commercial fishing and cheap frozen imports (such as frozen horse mackerel from Namibia marketed throughout Mozambique) have pushed the price of fish down. High inflation rate has increased price of materials and fluctuations in product selling price has reduced income of poor (Vietnam Focus Group 1). Lack of means to transport fish from the landing sites situated further away from the main road where intermediaries come to buy the fish is another factor limiting the economic benefits generated by fishing resources (Mozambique Focus Group 2). In the Philippines, participants believe that the lower prices of fish is driven by the much larger catch (increasing fish supply) of commercial fishers and the cheaper prices of frozen imports (Philippines Focus Group 1). Middlemen provide access to markets and may provide security for fishers exploiting fluctuating fisheries, however they may also bond fishers to them through credit arrangements (Crona et al., 2008). Fish dealers and processors are themselves an important group in the coastal zone who depend on provisioning ecosystem services, as well as serving important functions in the dynamics of the fish trade (e.g. Kenya Focus Group 2). In Belize, lobster fishers successfully organised to exclude middlemen and capture significant financial benefits from lucrative export markets within their own communities (Huitric, 2005)

4.4 Marine Protected Areas

Marine Protected Areas (MPAs) may positively or negatively in terms of their ability to support poor people's access to ecosystem services. If MPAs are seen to conserve the ecosystem services overall then they are perceived as a benefit. But locally they may impose restrictions which displace fishers and so are often viewed with suspicion by local stakeholders (e.g. Rodrigues Focus Group 2, Philippines Focus Group 1).

4.5 Other factors

Development activities and competing land uses such as tourism, industrial development, and agriculture are also seen as undermining the ability of poor people to access and benefit coastal and marine ecosystem services. For example in Kenya and Tanzania, local people lost access to the beach for launching fishing boats due to the beachside privatisation and tourism development (Tanzania National Workshop). In the Philippines, land reclamation projects encroach on the fishing grounds for local fishers (Philippines Focus Group 1) and fishers report significantly reduced number of spawning fishes and shells previously harvested (Philippines Focus Group 2). Development of coastal infrastructure is forcing those engaging in near-shore mariculture to vacate the area (Philippines Focus Group 1).

Such developments result in conflicts between different users and uses of various ecosystem services. In Vietnam particularly, development of aquaculture ponds is seen as a threat to poor fishers in reducing the available fishing grounds and areas available to collect crabs, shrimps and mollusc (Vietnam Focus Group 2).

4.6 Increasing access of poor to coastal ecosystem services for poverty reduction

This section suggests that improving the poor's ability to benefit from ecosystem services (arrow *b* in Figure 2.1) can be achieved in various ways:

- Local stakeholders can be assisted to exclude more powerful competitors from open access resources that they depend on. For example improved monitoring, control and surveillance of large scale fisheries or accountable coastal planning with regards to infrastructure developments may help to prevent the displacement of the poor from important ecosystem services.
- Marginalised groups can be supported in their claims to entitlements to access ecosystem services. For example in South Africa, specific literacy support could help poor fishers to navigate bureaucracies required to access subsistence fishing licences.
- The capacity to exploit provisioning ecosystem services can be enhanced by improved technology or credit. This was widely requested by focus groups participants, but obviously may lead to overexploitation of resources in some cases. Also, the ability of specifically the poor to benefit from such innovations may be limited by access to credit or risk adversity due to high vulnerability.
- Exploitation of provisioning ecosystem services can produce greater financial benefits by assisting the poor to access markets and develop value-adding activities. This could provide a direct financial benefit to the poor, but may also drive over-exploitation as has been observed in the development of the live reef fish food trade in SE Asia (Sadovy et al., 2003), or attract others to exploit that resource, displacing the marginalised groups who previously relied on it (Tanzania National Workshop).
- Rights-based approaches to fisheries management must insure that they do not exclude or marginalise small-scale fishers, subsistence users of marine and coastal resources, nor the poor, as highlighted in Box 4.2.

5. Pro-poor Perspectives on Values of Ecosystem Services

This section summarises evidence from the literature and available data on the contribution of ecosystem services to the livelihoods of the coastal poor in developing countries. It also assesses which ecosystem services the poor recognise and value, based on evidence from the focus groups. In so doing, it highlights what the poor themselves consider as being important to them, in different contexts.

Scientific evidence regarding the contribution of ecosystem services for the coastal poor is related mainly to provisioning services, particularly fisheries and other resources. Advances have been made in understanding the complex dynamics of how people make a living and how they respond to change using the analytical lens of sustainable livelihoods (Allison and Ellis, 2001) and resilience frameworks (Adger et al., 2001, 2005; Marschke and Berkes, 2006; Berkes and Seixas, 2005). The importance of other types of ecosystem services for livelihoods is also recognised, but few studies investigate the complex linkages between the full set of ecosystem services and poverty.

Focus group discussions indicated that the poor recognise the value of most categories of ecosystem services, but prioritise provisioning services as a means to meet immediate economic and consumption needs. The economic value of provisioning services was highlighted, which is linked to increasing reliance on markets and need for cash to acquire goods and pay for services such as education and health care. In some cases, supporting services, especially the function of some ecosystems such as mangroves and estuaries as habitat and nursery for fish and other marine species, were prioritised, but people ultimately related this to the key function of supporting services in sustaining the particular provisioning services upon which they rely for livelihoods.

5.1 Contribution of ecosystem services to livelihoods and poverty alleviation

The global analysis, which interrogated national-level data available for most countries, provides a limited perspective of the contribution of ecosystem services for the livelihoods of the coastal poor. The quantitative information available covers some provisioning ecosystem services, especially related to fisheries, and to a much lesser extent regulating and cultural services (Global Report:6-7). Throughout the global analysis, it was necessary to extrapolate information and make assumptions to relate these data to the coastal poor. Fish production data provided the most useful metric, given that fishing and aquaculture provides livelihoods, employment and income for millions of people in developing countries (Section 3.1). However, it can only be assumed that many of these people are poor, since the data is not socio-economically stratified. Moreover, the data do not distinguish between marine, estuarine and inshore (lake and river) fishers, nor do they adequately capture small-scale and occasional fishers, many of whom are likely to be poor (Global Report:65-66).

Consumption of fish provides a metric of the importance of provisioning ecosystem services which is more from the perspective of the user. However, it was not possible to assess the contribution of fish to nutrition and food security of the poor. Per capita fish consumption of coastal populations was calculated using the LECZ (low elevation coastal zone) population figures. This metric assumes that fish is equally consumed by poor and better-off alike, which is unlikely to reflect the real situation. Nevertheless, the results revealed that the top 10 countries in terms of fish consumption per capita were all SIDS, which demonstrates the importance of fish as a source of food in these states (Global Report:60). However, these data have important limitations. For example, FAO data indicate an annual consumption of only 2.1 kg for Mozambique. In contrast, figures using reconstructed estimates and national data put annual fish consumption at between 6 and 7.5 kg (Jacquet and Zeller, 2007). Given the high levels of poverty in the country, the global dataset may underestimate the role of fish in food security, not only for the coastal poor but also for inland populations who consume marine fish (salted and dried), especially in the northern Mozambique provinces of Nampula and Cabo Delgado (Pinto and Baptista, 2000).

The literature suggests that ecosystem services are of particular importance to the poor given their reliance on natural resources for livelihoods. However, there is little quantitative information on the precise contribution of ecosystem services to livelihoods and most of this focuses on provisioning ecosystem services, given the more direct link between these services and human well-being (WIO Report:45). Case studies are an important source of mostly qualitative and semi-quantitative data on the benefits of particular ecosystems to the livelihoods of the coastal poor, and some try to go beyond

provisioning services. Good examples of case-studies assessing the benefits of coral reefs to poor households are reported in Whittingham et al. (2003b).

Reliance on fisheries for livelihoods is often associated with poverty and portrayed as a last-resort occupation for the very poor (see Béné, 2003:956). In some countries, this is supported by national statistics. In the Philippines, for example, fisher-headed households have a significantly higher poverty incidence (61.9%) than households in general (33.7%) (Philippines Country Report:10). However, information breaking down poverty incidence among different occupational groups at the national scale is not generally available for most countries.

There are also studies that contradict the view of fishing as a poverty trap (for example Allison and Ellis, 2001; Allison and Horemans, 2006; Béné and Neiland, 2003). This is gradually being replaced by a more complex and dynamic picture, where fisheries have diverse functions in livelihoods, and may make significant contributions to poverty alleviation and decreased vulnerability (Béné et al., 2007; Smith et al., 2005). However, there is often very little precise information on the real contribution of fisheries to livelihoods of the poor, and the factors that affect movements in and out of fishing. Given that fisheries is the best researched ecosystem service in coastal and marine systems, and its links to poverty are frequently explicitly made in the literature, quantitative information on the contribution of other types of ecosystem services to the livelihoods of the poor is even scarcer and requires more attention, particularly beyond provisioning services.

5.2 Ecosystem services recognised and valued by the poor in the study regions

Local perspectives
The focus groups with poor people linked to coastal and marine ecosystem services in different ways and in different countries, aimed to learn which ecosystem services poor stakeholders themselves recognised as being important to them and why, how they valued and prioritised these, and how they perceived and understood changes.

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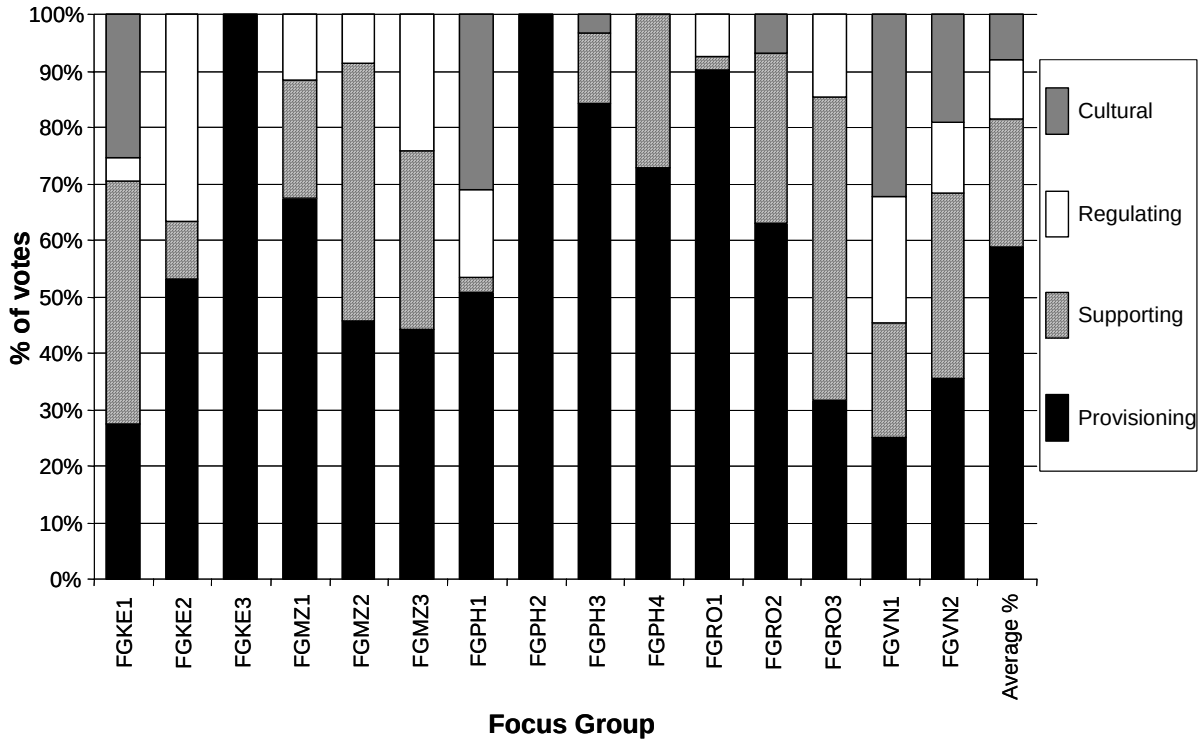


Figure 5.1. Total scores of each category of Ecosystem Services as identified by focus groups in each country. Bars indicate the total proportion of beans allocated to ecosystem service in each MA category in a participatory ranking exercise. KE – Kenya, MZ – Mozambique, PH – Philippines, RO – Rodrigues, VN – Vietnam

The focus group participants were also asked to score the different ecosystem services they mentioned to illustrate their value to them. This was done by asking each participant to distribute a set number of 'beans' by the ecosystem services identified. Figure 5.1 shows the total scores of each of the MA categories of ecosystem services from focus groups in each country. Although most focus groups identified three or more of the MA categories, demonstrating a broad awareness of the coastal and marine ecosystem services, provisioning services clearly dominated. In some countries and groups, supporting services were also considered of key importance, in particular the function of ecosystems such as mangroves, estuaries and coral reefs for the life-cycle and habitat of marine species. People ultimately related this to the key function of these ecosystems in sustaining fisheries, a provisioning service upon which they relied for livelihoods.

Focus groups were designed to not impose any pre-defined conceptual framework (e.g. MA) but to record as well as possible the way in which stakeholders themselves perceived benefits from coastal ecosystems. Figure 5.2 shows an example of how ecosystem services and benefits are linked in peoples' own mental models according to the results of a Rodrigues focus group. This illustrates the difficulty of applying the MA categories directly, as people often described the final benefits of ecosystem services rather than ecosystem services themselves, thus fish can be directly consumed as food or sold for money (see section 3.1). These sequential linkages create conceptual problems when ranking and valuing ecosystem services due to the potential for double counting. For example the multiple benefits octopus (food, money and employment) or the multiple goods that contribute to food (octopus, fish, cono cono).

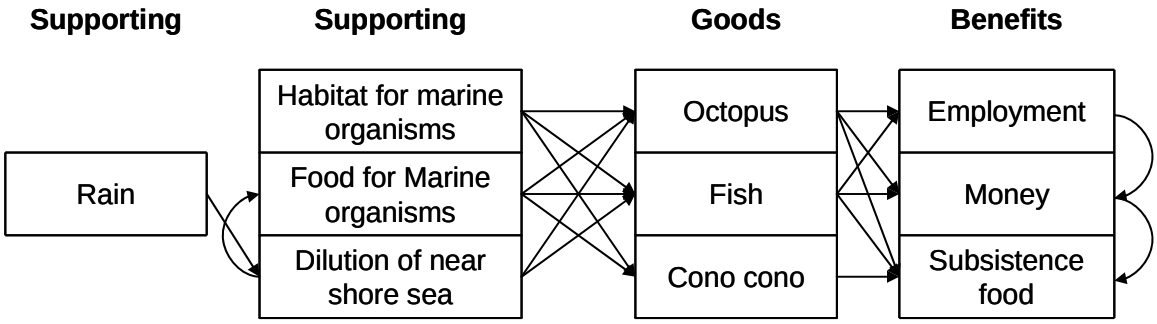


Figure 5.2 Representation of stakeholders' conceptual understanding of benefits to them from coastal ecosystems (interpreted inclusively in this report as ecosystem services) Rodrigues Focus Group 2. Cono cono is a gastropod species that is locally harvested for food.

Table 5.1 shows the wide array of ecosystem services identified by the focus groups in each country and a weighted score based on the ranks of each, which allows a crude comparison between focus groups. Based on the above discussion Table 5.1 includes the categories from Figure 5.2 of supporting, goods, and benefits. Mixing these sequential benefits in a ranking exercise is problematic as discussed above, suggests an important finding for understanding the incentives of the poor with regards to coastal ecosystems. Although, the participants were aware of ecosystem services from supporting to final benefits, they prioritised final benefits, especially employment and income. Thus the participants may place less value on intrinsic existence of ecosystem services and may ultimately see ecosystem services as substitutable.

High rankings for employment and income were linked to the need for cash to acquire goods and pay for services such as education and health care. The increasing integration of the poor into the market economy leads them into adopting profit maximisation strategies. In Mozambique, for example, fishers often sell all their catches and then buy cheaper, usually small-sized fish for their own and their household's consumption.

Table 5.1. Ecosystem services identified from focus groups in each country.
Numbers indicate the maximum weighted score based on ranks from participatory scoring exercises in response to the questions "*How does the sea and coastal area, (and the animals and plant that live there) benefit you and your community*?" and "*Which of these is most important to you*?". Weighted Score = 1 + (Rank-1)/(number of ecosystem services identified-1). Each is categorised as supporting services; goods, which are produced and utilised directly; or benefits that accrue from the ES. Mean weighted score and frequency (number of focus groups mentioned in) are also shown. Shading of cells indicates whether values are >0.25, >0.5 or >0.85 to highlight main trends.

Category	Ecosystem Service	Kenya			Mozambique			Philippines				Vietnam		Rodrigues			Mean	Freqency
Benefit	***Employment/income***	0.3			**0.7**	**0.6**	**0.8**	**0.9**	**0.9**	0.2	**0.9**	**0.7**	**1.0**	**0.8**	**0.7**	**0.8**	**0.7**	13
Benefit	***Food***		**0.9**		**0.9**	0.1	0.3	**0.5**	**0.4**		**0.6**	**0.8**	**0.8**	**0.5**	**0.8**	0.2	**0.6**	12
Support	***Marine animal habitat and life cycle***		**0.4**		**0.4**	**0.5**	**0.9**	**0.4**			**0.7**	**0.5**	**0.8**	0.0	**0.9**	**0.9**	**0.6**	11
Benefit	***Tourist attraction***	**0.9**		0.1		0.1					0.1	**0.5**	**0.9**			**0.5**	**0.4**	7
Support	***Storm & flood protection***		**0.7**									**0.5**	**0.6**	**0.3**		**0.7**	**0.6**	5
Goods	***other products***		**0.6**	**0.4**					**0.7**	0.2	**0.4**		**0.4**				**0.4**	6
Benefit	***Land/space***				**0.3**	**0.8**			0.1	**0.7**			**0.4**			0.2	**0.4**	6
Support	***Erosion protection***				**0.6**	**0.4**	**0.4**	**0.6**				0.2				0.2	**0.4**	6
Benefit	***Fisheries***	**0.6**		**0.7**						**0.9**							**0.7**	3
Support	***Fresh water & rain***					**0.9**	**0.6**							0.2	**0.4**	0.2	**0.4**	5
Goods	***Wood (fire & construction)***			**0.6**	0.1		0.0			**0.8**		0.0	0.0			**0.5**	**0.3**	7
Benefit	***Health***									0.2		**0.9**	**0.9**				**0.7**	3
Goods	***Medicine***			**0.3**	**0.6**		0.1					**0.8**	0.2				**0.4**	5
Goods	***Seawater***			**0.9**							**0.3**		**0.8**				**0.6**	3
Benefit	***Cultural/community values***	**0.5**								0.2		**0.5**	**0.5**		0.2		**0.4**	5
Benefit	***Education***	**0.7**						**0.8**					0.2				**0.6**	3
Goods	***Shade & breeze***	0.1	**0.3**				**0.6**	**0.7**									**0.4**	4
Support	***Climate***											**0.8**	**0.5**				**0.7**	2
Support	***Ecological functions***												**0.5**		0.0	**0.8**	**0.4**	3
Benefit	***Recreation***	0.3		0.1				0.1	0.1	**0.4**	0.0						0.2	6
Benefit	***Marine Transport***	**0.5**						**0.5**									**0.5**	2
Benefit	***Animal food***													**0.7**			**0.7**	1
Support	***Building materials***	0.1						0.1									0.1	2

National perspectives

National workshops elicited the perceptions of scientists and representatives from various institutions and sectors about the most important ecosystem services for the coastal poor. This enabled the perceptions and understandings of poor stakeholders and high-level personnel involved in research and decision-making on ESPA-related issues to be assessed. Participants at the national workshops were also asked to identify which were the most important ecosystem services for the coastal poor in their country, alongside with the main changes affecting those ecosystem services and the drivers of such changes (reported in Section 8). The array of ecosystem services elicited and respective ranks is shown in Table 5.2. Provisioning services associated with fisheries, food, employment/income ranked highest, followed by supporting services related to the function of ecosystems in primary production as habitats for fish and other marine organisms, and regulating services linked to erosion protection and climate regulation. There was a considerable degree of overlap between the focus group and national workshop valuations both in overall terms and on a country basis. The national workshops, made up of representatives of regional and national scientific, research and policy organisations reflect an 'expert' view from the region. Lists of individuals who attended the workshops can be found in the reports in Appendix 4.

Table 5.2. Ecosystem services identified from national workshops in each country Numbers indicate the maximum weighted score for each issue calculated as in Table 5.1, in response to the question "*Which coastal ecosystem services are most important for livelihoods and poverty alleviation in this country?*". Mean weighted score and frequency (number of workshops groups mentioned in) are also shown.

Category	Ecosystem Service	Kenya	Mozam.	Phil.	Vietn.	Tanz.	Mean	Freq-uency
Goods	***Fisheries***					**1.0**	**1.0**	1
Benefit	***Food***	**0.8**	**0.9**	**0.9**	**0.9**		**0.9**	4
Benefit	***Employment/income***		**0.6**	**0.9**	**0.8**		**0.8**	3
Support	***Marine animal habitat and life cycle***	**0.7**		**0.3**	**0.6**	**0.9**	**0.6**	4
Support	***Erosion protection***	**0.4**				**0.8**	**0.6**	2
Support	***Climate***			**0.7**		**0.4**	**0.6**	2
Goods	***Fresh water & rain***	**0.4**				**0.6**	**0.5**	2
Support	***Storm & flood protection***	0.3	0.3	**0.8**	**0.8**	**0.5**	**0.5**	5
Benefit	***Wood (fire & construction)***	**0.4**	**0.6**	**0.3**	**0.5**	**0.7**	**0.5**	5
Support	***Ecological functions***	**0.3**		**0.3**		**0.9**	**0.5**	3
Benefit	***Tourist attraction***	**0.7**	0.1	**0.7**	**0.6**	**0.4**	**0.5**	5
Benefit	***Marine Transport***			**0.3**		**0.7**	**0.5**	2
Support	***water & air quality***	**0.5**	**0.8**	**0.3**	0.2		**0.5**	4
Goods	***Building materials***	**0.4**	**0.8**		0.2		**0.5**	3
Benefit	***Education***			**0.3**		**0.6**	**0.4**	2
Benefit	***Cultural/community values***	**0.6**	**0.4**		0.2	**0.5**	**0.4**	4
Goods	***seaweed culture***					**0.4**	**0.4**	1
Benefit	***Land/space***	**0.6**	0.2				**0.4**	2
Benefit	***Existence & bequest***	**0.4**					**0.4**	1
Benefit	***Recreation***	**0.4**				**0.3**	**0.3**	2
Goods	***Medicine***	0.2	**0.4**		0.2	0.1	0.2	4
Goods	***other products***	0.2		**0.3**		0.2	0.2	3
Benefit	***Shade & breeze***					0.1	0.1	1

6. Feedbacks

This issue concerns the linkage identified as *d* in the conceptual diagram. It is assumed that there is a set of feedback mechanisms whereby poor people affect the stock and flow of ecosystem services, through their management, behaviour and choices. What is known about how poor people's perceptions, uses and values of ecosystem services feedback and affect the management and trends in ecosystem services? What impact do the poor have on the drivers of change in ecosystem services?

On a broad scale this might include decisions to move or migrate because of lack of access to, or changes in the quality or flow of ecosystem services. For example the Global Analysis highlights the need for information on migration and adaptation strategies of poor people (Global Report 7.2). It might concern decisions to utilize particular ecosystem services or not, or to switch direct or indirect use strategies. It may involve the way in which a particular ecosystem services is managed; for example a change in the technology employed in exploiting an ecosystem services. It might also be articulated through a set of societal decisions or priorities favouring conservation or exploitation of ecosystem services.

Overall, there is scant understanding about these behavioural and motivational factors; much of findings are based on assumptions about what motivates peoples' behaviour (for example, the poor being forced to unsustainably utilise ecosystem services because of lack of alternatives, short time horizons or inertia to changing traditional lifestyles). These issues have been relatively recently studied in the context of rich countries through behavioural economics, but are very rarely focused upon for the poor in developing countries.

This section examines the evidence of these linkages in two main areas; first, what we know about the impacts specifically of the poor on ecosystem services; secondly, what feedback mechanisms exist. It asks what knowledge exists about how 'vicious circles' of degradation of ecosystem services and impoverishment are turned into 'virtuous circles' of conserving and optimizing ecosystem service flows and alleviating poverty.

6.1 Impacts of poor people on ecosystem services

National workshops identified unsustainable exploitation by local people as one of the major drivers of changes in coastal ecosystem services (Table 8.3). Many examples exist of the impact of poor people on coastal ecosystem services include:

- Coastal people resorting to agriculture on marginal land, impacting sediment load on marine ecosystems
- Declining catches compelling the use of smaller meshed nets and even destructive fishing practises resulting in growth overfishing and habitat degradation
- Selected harvest of high value or easily accessible species, e.g. sea urchins can lead to cascade effects such as excessive algal growth.
- Overexploitation of mangrove and coastal forests for fuelwood and building materials in the light of lack of access to or ability to afford alternatives.

There is evidence at the global scale (from the MA) that although economic development and global economic growth have lifted many people across the world out of poverty, the costs has been the degradation of ecosystems and loss of ecosystem services. The benefits and costs have not been equally distributed; in particular the costs have been disproportionately borne by the world's poor, and the disparities between rich and poor (measured in mean income) have grown (Turner and Fisher, 2008). This is borne out by the analysis in the regional assessments and by the stakeholder consultations. For example, in the Philippines Workshop it was noted that the poorest of the poor often have least impact on ecosystem services (Philippines National Workshop p9). This is because they lack access to ecosystem services and to technology or capital necessary to exploit them effectively.

6.2 Feedback mechanisms

6.2.1 Motivations and behaviour

What are the motivations and behavioural factors which bring about changes in relationships between poor people and ecosystem services? The Philippine country report notes that when there is a strong

degree of involvement from the community there is more sustainable reef management. Again, this seems to confirm the prevailing findings in the literature. In this sense there is evidence to support the assertion that when the poor are involved in decisions and actively participate in conservation, there is a higher chance that they will comply with rules and manage resources in a more sustainable manner.

The Community Based Coastal Resource Management approach which has the community as the starting point of management, rather than the fishery resource, has demonstrated gains in terms of social capital – leadership development, sense of empowerment and involvement – although silent in terms of gains in financial and physical capital. Nonetheless social capital provides a good foundation for bringing in capital resources and interventions, which poor communities most lack. The Philippines National Workshop cites examples of increased knowledge changing management practices (Philippines National Workshop p9) and the Philippines country study and SEA Assessment notes the lack of information on feedback mechanisms

The need to understand poor stakeholders' perceptions of the status of their resources and how that affects their motivation to conserve them is illustrated by the problem of 'shifting environmental baselines' (Pauly, 1995). This issue stems from failure of resource users to understand the extent of their impact on the environment over the long term. Box 6.1 illustrates the 'shifting baselines' problem in Rodrigues, where research into how these have changed informed MPA policy and planning.

Box 6.1: Potential negative feedback into the state of ecosystem goods and services stemming from poor local and scientific knowledge: the "shifting baselines" problem

The state of ecosystems supplying goods and services is often unknown in poor countries due to a lack of research, meaning there are few baselines for setting policy with realistic objectives. An exploration of coral reef fisher's local ecological knowledge in the degraded small island of Rodrigues (Mauritius, Indian Ocean) by Bunce et al. (2008) underlined risks of "shifting environmental baselines" (Pauly, 2005). This suggests that successive generations of fishers adjust to increasing scarcity of fish and fail to understand the extent to which humans have modified their environment over the long term. Fishers, no less than fisheries scientists, may in the process perceive as "natural" the way the environment appeared to them when they were young and then use that as a yardstick for measuring subsequent change. In so doing, they discount the experience of previous generations, running the risk of wrongly perceiving social and ecological systems as stable and pristine and then failing to adapt even when change does occur. Even if fisheries managers do identify impairment of the marine ecosystem, shifting baselines among fishers may foster resistance to corrective policy, such as marine reserves. Fishers simply may not perceive any need to change their ways. In Rodrigues, younger fishers shared few of their elders' memories of former abundance. Of three generations, the oldest reported more fish species as depleted ($p=<0.001$), including predators indicative of ecosystem health and of interest to fishers, and also marine tourists potentially paying fees to see them. The median number of species reported by the oldest group of fishers was 18, compared to 14.5 for the middle-aged and 8.5 for the youngest. The average number of years of decline cited per fish rose by around 5 years for each generation of fishers (Young=5 years, Middle Aged= 9, Old=15). For many individual species, especially grouper, older fishers stated far higher numbers of years of decline. In particular, older fishers recalled larger catches of the most-cited species, the grouper *Epinephelus multinotatus,* and bigger fish ($p<0.001$). Based on their own perceptions, older fishers were more likely to have caught larger fish and landed more of them on their best day ($p=<0.005$ in both cases). Fishers cited a long-standing lack of work and fishery enforcement as the principle reasons for over-fishing and lagoon decline. Overall, older fishers remembered the ecosystem as being in better condition. They gave qualitative accounts of land-sea decline over decades supporting this, but the successive generations surveyed again differed in their perceptions of change, for example climate, deforestation, soil erosion and coral loss. This case study underlines how fishers' perceptions of environmental state need to be fully understood in coral reef fishery management contexts. Depletion of fish and degradation of coral exposes reef systems worldwide to the risk of unexpected phase shifts to less desirable states. Such change can devastate or limit social and economic development options in developing nations, entrenching their reliance on marine resources for survival.

One example of an intervention targeted to enhance feedback is work conducted by CRCP in Kenya to provide large-scale and long-term fisheries monitoring data to beach management committees. This has helped to provide feedback to stakeholders on the status of their resource and in some cases has contributed to collective action to remove destructive and illegal gears (McClanahan et al., 2008).

6.2.2 Markets and other instruments

What is the role of markets and policy instruments in mediating and moderating these feedbacks? External markets can dominate the development and behaviour of fisheries. For example the live reef

fish trade in SE Asia drove a massive increase in effort, and increasing use of destructive gears for particular high value species. As more valuable species (e.g. *Cheilinus undulates* and *Cromileptes*) became rarer, increasing market value for other species (e.g. *Epinephelus*) meant that the fishery continued for these lower value species rather than adjusting to the declining stocks of the most valuable.

Crona et al. (2008) identify the role of middlemen in Kenya and Tanzania in influencing the behaviour of fishers. The provision of credit during low-catch seasons serves an important purpose in terms of social vulnerability, but also reduces the impact of feedback from the status of ecosystems to fishers' behaviours. Thus traditional dual livelihood strategies in the region are becoming less common as fishers become specialised and continue to fish during periods of poor catches.

The failure of local people to support ecosystem conservation measures is often understood as a lack of understanding of the benefits of conservation (Mozambique Stakeholder Workshop 3.5). However, taking account of the uncertainties in benefits, short time horizons, prioritisation of provisioning services, dominance of large-scale drivers and difficulty of the poor in benefiting from other ecosystem services, resistance to conservation may be seen as a rational and informed response based on their situation. In such circumstances, local poor stakeholders cannot be "educated" into conserving their ecosystem services. Development of direct benefits to local stakeholders appears to be important for local support for conservation as reportedly achieved in Menai Bay Zanzibar (WIO Report p27). However, how such benefits are distributed within communities and whether the poorest benefit requires further study.

The MPAs declared in the Quirimbas in Mozambique were aimed at protecting the deteriorating ecosystems in the region and accordingly conservation would secure ecosystem services for fishers. Environmental NGOs involved, promoted the potential benefits to communities in line with their own virtuous intentions, however short-term results were not forthcoming, co-management was inadequate and fishers were alienated and tension was created between government departments, probably setting back MPA development in Mozambique (Johnston, 2004).

7. Who is most dependent on Ecosystem Services and most vulnerable to changes?

This section identifies where the coastal poor are, who are particularly dependent on ecosystem services and who are most vulnerable to changes in the flows of ecosystem services. 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; WIO Report:8). The analysis presented here aims to disaggregate the observation that the poor are most dependent and look at the different societal characteristics affecting dependence and vulnerability. The analysis examines different scales; at cross-national and global scales, identifying which countries are most dependent and vulnerable; which populations within countries and regions can be distinguished; and what factors operate at a local scale to determine that some people or households are more dependent on ecosystem services or more vulnerable to changes in them. Finally, it discusses how multi-scalar analysis is necessary, and how multiple factors interact in determining who, where and how people are made more dependent and vulnerable to ecosystem services changes.

This section uses the term vulnerability in the following way (adapted from IPCC and Allison et al., 2005), defining vulnerability as a function of exposure, sensitivity (or dependence) and adaptive capacity, shown in Box 7.1.

Box 7.1: Defining Vulnerability

VULNERABILITY (V) = Potential impact (PI) – Adaptive capacity (AC)
PI = Exposure (E) + Sensitivity or dependence (D)

Exposure: The nature and degree to which a system or individual experiences environmental or socio-political stress
Sensitivity: The extent to which a human or natural system can absorb the impacts without suffering long-term harm or some significant state change
Adaptive capacity the preconditions necessary to enable adaptation to take place, where *adaptation* is a process or activity undertaken in order to alleviate the adverse impacts of environmental stresses or take advantages of new opportunities

7.1 Where are the coastal poor?

The global analysis made use of available statistics to estimate where and in what numbers the global poor are in coastal regions of the world. Figure 7.1 and Table 7.1 shows the result of combining percentage incidence of poverty with population density in the 100km coastal strip to estimate the density and absolute number of coastal poor around the world's poor countries. Percentage incidence of poverty was estimated from the mean of percentage of malnourished children and percentage mortality by the age of 40 (modelled from infant mortality statistics). Various assumptions are made (for an explanation see the Global Analysis Report) but this gives an overall picture of where concentrations of coastal poor exist. Table 7.1 shows that a high proportion of the coastal poor are concentrated in a few countries; 80% in 15 countries.

Table 7.1: Number of coastal poor in non-OECD countries (Global Report)

Country	Number of coastal poor	% of world's coastal poor	Cumulative %
India	68,226,700	27%	27%
Indonesia	33,768,000	13%	40%
Bangladesh	23,247,500	9%	50%
Vietnam	12,440,000	5%	55%
China	11,730,700	5%	59%
Philippines	11,247,000	4%	64%
Nigeria	8,897,690	4%	67%
Myanmar	6,209,340	2%	70%
Brazil	6,145,760	2%	72%
North Korea	3,899,890	2%	74%
Yemen	3,700,410	1%	75%
Thailand	3,543,730	1%	77%
Mozambique	3,107,610	1%	78%
Turkey	2,832,990	1%	79%
Sri Lanka	2,805,180	1%	80%
Others (90 countries)	50,474,223	19%	100%
Total (for 105 countries)	252,276,723		

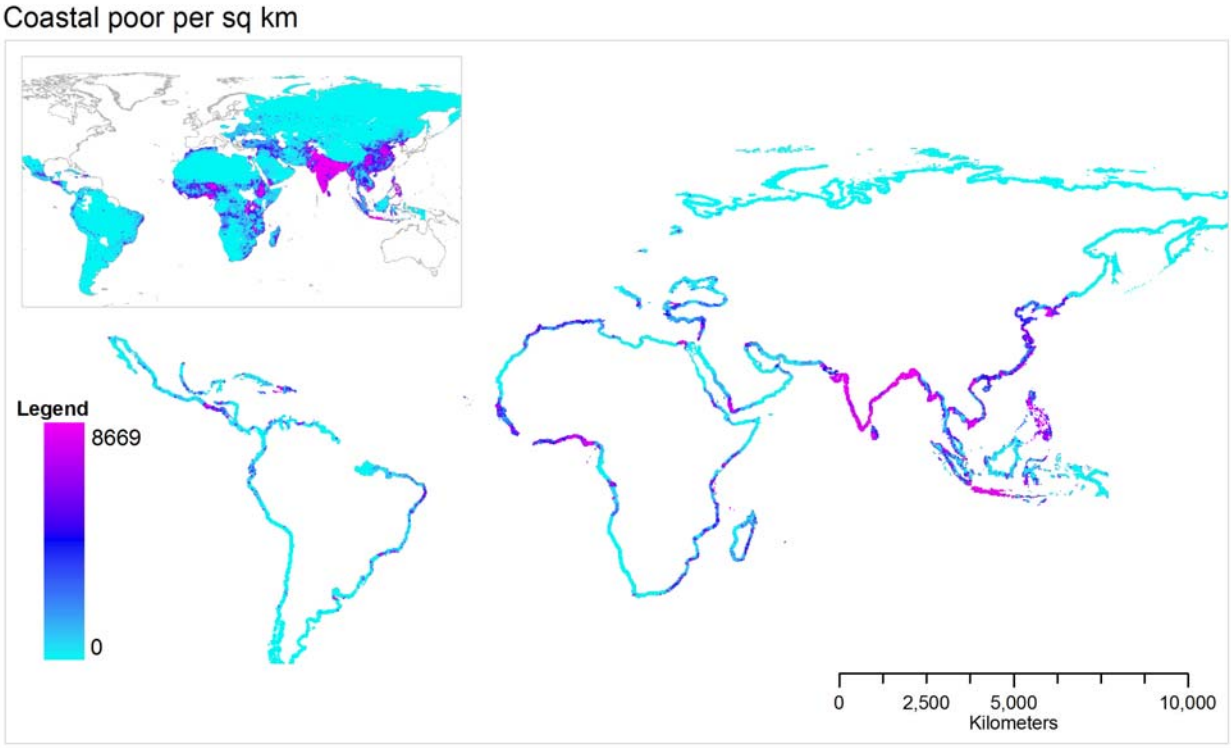


Figure 7.1: Absolute density of poor people within the coastal zones of poor countries (Global Report)

7.2 Global vulnerability analysis

The global analysis examined vulnerability of coastal poor to changes in ecosystem services using existing data sets. Building on analysis of Allison et al. (2005) which looked at the vulnerability of national economies to changes in fisheries as a result of climate change, the exposure, dependency, and adaptive capacity of nations was assessed. This enabled a crude identification of the most vulnerable countries, shown in Table 7.2 which is reproduced from the Global Report (section 4).

Vulnerability was calculated using different measures of exposure, sensitivity and adaptive capacity. Two metrics of exposure were calculated, exposure metric 1 using a composite of total coastal population, its rate of change and number of people involved in fisheries and aquaculture. Exposure metric 2 replaced total population by estimated population living under $1 per day in the coastal zone. Similarly, two metrics of sensitivity were derived, sensitivity metric 1 using fish as % of total protein; and sensitivity metric 2 a composite of fish as % of total protein and mangrove and coral reef cover. The adaptive capacity metric included per capita GDP, life expectancy and civil liberties index.

Given the range of exposure and sensitivity metrics available, four different vulnerability metrics were calculated:

- Vulnerability metric 1: Exposure metric 1, Sensitivity metric 1, Adaptive Capacity metric
- Vulnerability metric 2: Exposure metric 2, Sensitivity metric 2, Adaptive Capacity metric
- Vulnerability metric 3: Exposure metric 2, Sensitivity metric 1, Adaptive Capacity metric
- Vulnerability metric 4: Exposure metric 1, Sensitivity metric 2, Adaptive Capacity metric

The resulting vulnerability scores are presented in the Global Report (Section 4.4). The top 10 countries within each vulnerability metric are presented in Table 7.2. The table also indicates the number of countries for which there was data available to undertake the specific analysis.

Table 7.2: Top 10 countries in overall vulnerability scores

Rank	Vulnerability 1 metric	Vulnerability 2 metric	Vulnerability 3 metric	Vulnerability 4 metric
1	Maldives	Indonesia	Cambodia	Indonesia
2	Cambodia	India	China	Philippines
3	China	Philippines	Bangladesh	India
4	Bangladesh	China	Sierra Leone	China
5	Indonesia	Tanzania	Nigeria	Vietnam
6	Sierra Leone	Mozambique	Philippines	Tanzania
7	Philippines	Bangladesh	Indonesia	Mozambique
8	Angola	Madagascar	Ghana	Thailand
9	Vietnam	Thailand	Senegal	Bangladesh
10	Nigeria	Cambodia	India	Malaysia
No. countries:	118	30	62	50

The top 10 countries most vulnerable to changes in marine and coastal ecosystem services are concentrated in south and southeast Asia, and southeast Africa. Relatively high reliance on fish as a source of protein and low adaptive capacity scores meant west and central sub-Saharan Africa was also vulnerable under metric 1. It must be noted that the analysis may suffer from data loading, i.e. the result may in part be biased by a sub-Saharan focus on data collection related to poverty. Small island developing states, while reliant on fish as a source of protein, had relatively low populations, and little information on adaptive capacity. Therefore these countries did not feature in the overall vulnerability analysis. However, they are highly vulnerable to changes in ecosystem services (see Global Report section 6 for further discussion).

In an attempt to take the analysis further, the Global Report also examines the potential to use sub-national data to assess the vulnerability of the coastal poor to specific changes, namely exposure to potential flooding and damage exacerbated by loss of regulating services provided by mangroves and reef systems (more detail on this analysis can be found in Annex 4 of the Global report). Within the coastal zone, the highest concentrations of poor tend to be found at lower elevations (<10m) suggesting high vulnerability to floods, storm surges and sea level rise (Figure 7.2).

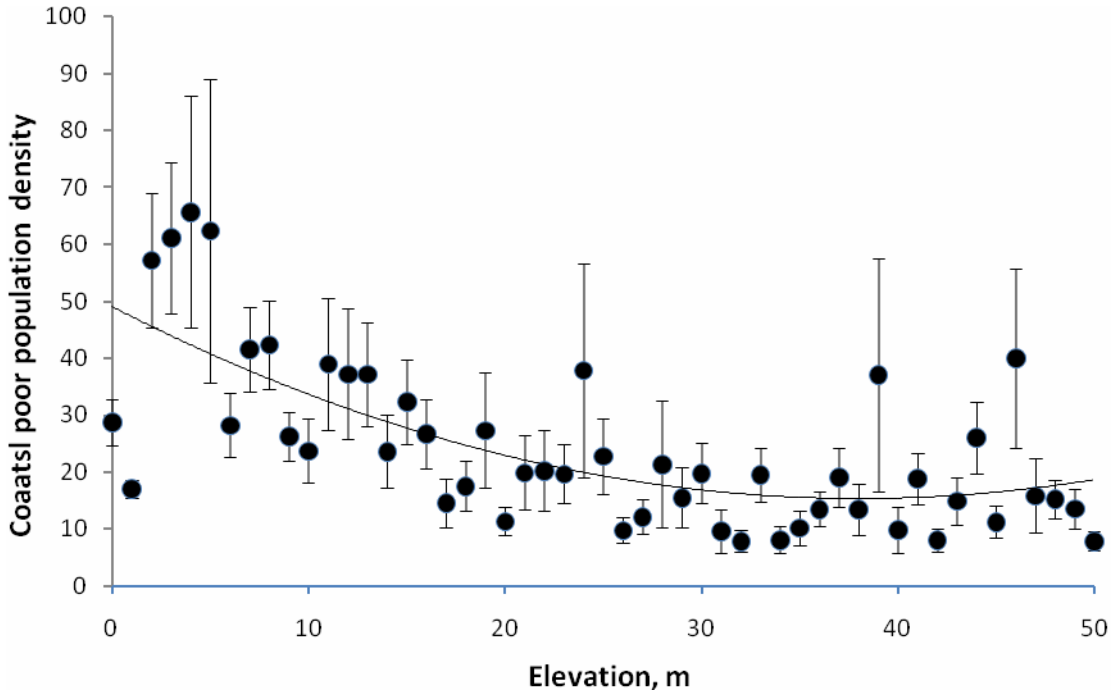


Figure 7.2: Coastal population density distribution along the elevation gradient (Global Report)

The vulnerability of the poor to loss of regulating services associated with coral reefs and mangroves was undertaken based on coastal poor population in the low elevation coastal zone and proximity to coral reef and mangrove ecosystems. Several assumptions needed to be made in order to explore the potential of existing data to indicate, even if crudely, the areas of the world where the poor are more at risk from flooding, taking into consideration the regulating services offered by coral reefs and mangroves. Firstly, we assumed that poor coastal populations within 100km of coral reefs and mangroves would benefit from the services provided by these ecosystems. In order to calculate a vulnerability index of low elevation coastal areas to flooding, two further assumptions were made. The first assumption involved assigning zero to areas over 50m and 1 to elevations of 1m or less. The areas in between were assigned vulnerability values based on a linear inverse vulnerability-elevation relationship. The second assumption involved estimating the amount of protection coral reefs and mangroves provide, hence balancing vulnerability of the coastal poor. Considering that vulnerability to flooding would depend on many other factors, elevation relative to the sea level being one of the major factors, we assumed that coral and mangrove ecosystems combined both would reduce vulnerability by 30%. Thus, vulnerability of low elevation coastal areas to flooding was estimated as follows:

- 0.70*vulnerability due to elevation + 0.15*mangroves presence/absence + 0.15*coral presence/absence.

Thus, if an area has an elevation of 1m above sea level and is not within 100km from mangroves or corals, it would have a vulnerability of 1. Under the same elevation of 1m with either corals or mangroves present, vulnerability would decrease to 0.85. If both mangroves and corals were present vulnerability would further decrease to 0.70.

Figure 7.3 shows the vulnerability index (0-1) with the most vulnerable populations shown in red on the world map.

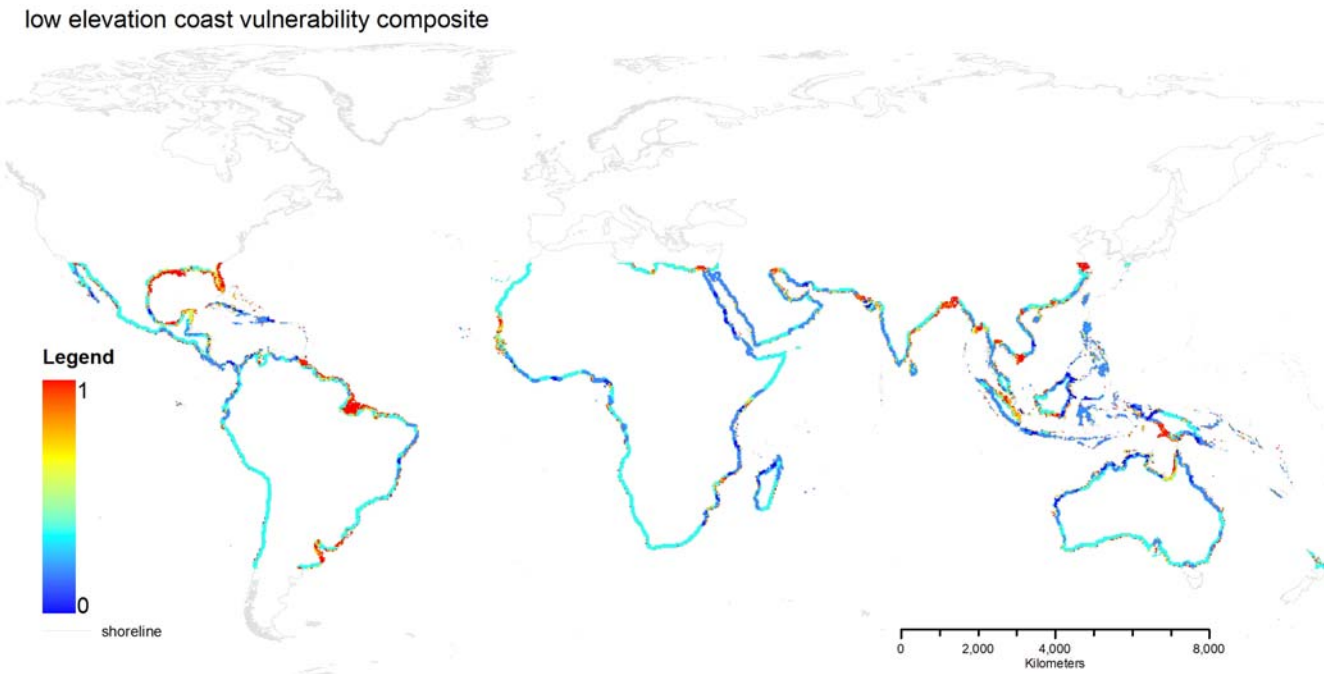


Figure 7.3: Modelled vulnerability to floods, storm surges and climate change based on elevation, and proximity (<100km) to mangrove or coral ecosystems (Global Report)

A review of literature for the WIO reveals the following factors identified as increasing a country's vulnerability to changes in ecosystem services; sub-Saharan African countries, developing countries, conflict countries, poor countries and Small Island Developing Countries are especially vulnerable, as shown in Table 7.3 below and discussed in Box 7.2. The numbers correspond to literature references, a list of which can be found in box

Table 7.3 WIO Regional and National vulnerability to changes in Ecosystem Services

Scale	Who is vulnerable?	Evidence
Regional and national	Sub-Saharan African countries	Brooks et al. (2005)
	Developing countries	McCarthy et al. (2001)
	Conflict countries	Brooks et al. (2005)
	Low GDP countries	UNDP (2004)
	Small Island Developing States	Mimura et al. (2007), Pelling and Uitto (2001)

Box 7.2 Small Island Developing States

The Many Strong Voices project (www.manystrongvoices.org) has undertaken extensive review of available data on the vulnerability of SIDS and Arctic regions with a particular emphasis on the impacts of climate change and the initiatives and projects underway in key regions such as the Caribbean and Pacific. They note that whilst some data are available through global datasets, SIDS in particular are often missing from these datasets, or the kind of information they contain is not specifically relevant, timely or useful. SIDS face pressing problems associated with global change already, have valuable experience of adapting to a range of global threats, but there are important knowledge gaps. In designing a dynamic programme for assessing vulnerability and adaptation in SIDS, a set of gaps in knowledge were identified through a comprehensive consultation process in SIDS:

- Lack of local climate and environmental data, in particular historic data, for sea-level rise.
- Lack of knowledge and awareness of climate change, its causes, its drivers, and its practical implications at the local level in many SIDS.
- Few studies of impacts, adaptation, and vulnerability exist for African and Indian Ocean SIDS.
- Documentation of indigenous, traditional, and local knowledge of climate variability in the SIDS is relatively lacking compared to other regions such as the Arctic—even though the knowledge exists to be documented.
- Ocean temperature changes, and the link to ocean acidification, plus the implications for SIDS is an under-researched area.

7.3 Vulnerable populations and groups within countries and regions

Of course the analysis at a global level masks many important disparities within countries or regions; if we are concerned for the poor and how ecosystem services can help alleviate poverty, then we need to understand who is most dependent on ecosystem services and how they might be affected by changes in ecosystem services flows.

The WIO report identifies coastal, rural and agricultural populations, minority groups and immigrants, refugees and small holder producers as the most vulnerable to changes in ecosystem services across the WIO region, shown in Table 7.4.

Table 7.4: WIO Populations and Groups Vulnerability to changes in Ecosystem Services

Scale	Who is vulnerable?	Evidence
Populations and groups	Coastal populations	Adger et al. (2005), Brooks (2003), Kasperson et al. (2006), McCarthy et al. (2001), Singh et al. (2006), UNEP (1984) UNEP (2006b), Watson et al. (1998), Whittingham et al. (2003a, 2003b)
	Rural & agricultural populations	McCarthy et al. (2001)
	Minority groups and immigrants	Makoka et al. (2005)
	Refugees	UNEP (2006b)
	Small-holder producers	McCarthy et al. (2001)

In many parts of the world, migration and mobility are an important part of the livelihood strategies of rural communities. Major migration flows are from rural to urban areas and from inland to coastal zones. Fourteen out of the world's 17 largest cities are located along coasts and 11 of these are in Asia (UNEP 2004). Coastal cities continue to attract large number of migrants. For example, it is estimated that 1000 people arrive in China's large coastal cities every day, and a similar number move to the coasts in Vietnam and the Philippines (Creel 2003). Migration and population growth in urban areas creates increasing demands for ecosystems services, particularly in terms of buffering against storms and floods which will be likely to increase with climate change.

An equally important emerging issue is migration induced by environmental factors, or situations where people move to other areas because natural resources have been severely degraded or depleted in their home areas (Curran 2002, Cassels et al., 2005, Olgethorpe et al., 2007). People have long migrated in response to environmental factors. In fisheries, for example, migration is a common strategy to deal with seasonal variability of fish stocks (Perry and Sumaila 2007, Ellis and Allison 2001). However, there are concerns about the potential for large-scale forced migrations fuelled by extreme degradation of ecosystems and breakdown in the key life-supporting services they provide.

Particularly alarming are reports of increasing numbers of so-called 'environmental refugees' (UNEP 1985) which, some analysts suggest, are surpassing numbers of refugees displaced by war and prosecution (Myers 2002, Conisbee and Simms 2003). Climate change is likely to increase the scale of forced migration and the problem of environmental refugees. The latest IPCC report reiterates what was already suggested in previous reports, namely that environmental stresses will in some cases lead to relocation within and between countries, exacerbating migration and conflicts (IPCC 2007). But while the scientific basis for climate change is well-established, its effects on migration are not. Except in extreme cases where populations are displaced by sea-level rise, the impacts of climate change on migration are difficult to predict given the different abilities of societies to adapt (Brown 2007).

The term 'environmental refugee' raises important definitional and ethic issues as well as new challenges for international policy. For example, what are the criteria for considering someone an environmental refugee? Should the status of environmental refugee be internationally recognized and special international mechanisms set in place to deal with such individuals or groups? These

questions are of particular relevance for SIDS which face the ultimate threat of part or whole of their territory disappearing as a result of sea-level rise. SIDS may seek international recognition for environmental refugee status as a means to assist their citizens to relocate to other nations (UNEP 2008). However, it is uncertain how the international community will deal with these cases, or whether the term 'environmental refugee' is useful to guide policy towards dealing with migrants from environmentally fragile areas. (Black 2001)

Overall, the links between migration, poverty and environmental degradation are not well understood. Knowledge of the complex relationship between environmental change and migration and how that may impinge in efforts to reduce vulnerability and alleviate poverty is limited. Environmental change can clearly be both a cause and a consequence of migration. However, it is rarely the sole factor that leads people to move. Other social, economic and political factors also play a role and the interplay between them requires further clarification.

7.4 Community, household and individual factors in vulnerability

Members of society who have been identified as particularly dependent on and vulnerable to changes in ecosystem services at the community, household and individual level are outlined in Table 7.5. These members of society are mainly dependent on ecosystem services through livelihood activities. The many factors which characterise them as vulnerable to ecosystem services changes include: limited access to natural resources and reliance on open-access resources; lack of economic capital and facilities; lack of social cohesiveness and opportunities like safety nets; inadequate health and education services; gender-based exclusion; limited capacity and skills; and lack of ecological security in terms of protection from adverse events (UNEP, 2004).

Table 7.5: WIO Communities, Households and Individuals Vulnerability to changes in Ecosystem Services

Scale	Who is vulnerable?	Reference
Communities, households and individuals	Asset-poor households	C-SAFE and WFP (2005)
	Children (girls specifically) and the young	Downing et al. (2002), Kasperson et al. (2006), Makoka and Kaplan. (2005), UNDP (2004), UNEP (2006b), Vincent (2004) Walmsley et al. (2006)
	Chronically ill, sick, HIV/AIDS infected individuals and households and high-altitude communities (lack of malaria immunity).	Allison and Seeley (2004), C-SAFE and WFP (2005), Downing et al. (2002), Kasperson et al. (2006), Makoka and Kaplan (2005), UNEP (2006b), Watson et al. (1998), Whittingham et al. (2003a, 2003b)
	Disabled	Makoka and Kaplan (2005)
	Disadvantaged communities	Butler et al. (2005)
	Elderly and Elderly-headed households	C-SAFE and WFP (2005), Downing et al. (2002), Kasperson et al. (2006), Makoka and Kaplan (2005), Vincent (2004), Whittingham et al. (2003a, 2003b)
	Fishers and fishing communities (Especially small-scale fishers).	Allison and Seeley (2004), Walmsley et al. (2006), Whittingham et al. (2003a, 2003b)
	Island communities	McCarthy et al. (2001), UNEP (1984)
	Isolated communities (especially isolated rural communities)	Kasperson et al. (2006), McCarthy et al. (2001)
	Malnourished individuals	Watson et al (1998)
	Orphans	C-SAFE and WFP (2005)
	Poor or indigent	Brooks (2003), Butler et al. (2003), Downing et al (2002), IISD et al. (2003), Kasperson et al. (2006), McCarthy et al. (2001), UNDP (2004), UNEP (2006b), Vincent (2004), Walmsley et al. (2006), Watson et al. (2008), Whittingham et al. (2003a, 2003b), WMO (2008)
	Rural communities	Brooks et al (2005), UNEP (2006b)
	Women (especially widows and pregnant women) and members of female-headed households	Allison and Seeley (2004), C -SAFE and WFP (2005), Makoka and Kaplan (2005), UNDP (2004), Walmsley et al. (2006), Whittingham et al. (2003a, 2003b)

The groups identified include:

Asset poor households – These characteristics are prevalent across asset poor households all of which relate directly to their ability to access and thus benefit from ecosystem services.

Urban Poor - Factors that make poor urban dwellers vulnerable include the lack of diversity and opportunities; greater control and enforcement of resource use activities that may limit access and use of resources; the often poorer quality of the environment and food; and in some cases the psychological effects of comparison with the urban rich that sets higher standards in terms of consumption, including possession of goods such as mobile phones, televisions, etc.

Chronically ill or Disabled –The burden of illness, including malnourishment or a disability may put additional stresses on households, preventing them from accumulating assets derived from fishing income. Premature death robs fishing communities of the knowledge gained by experience and reduces incentives for longer-term and inter-generational stewardship of resources. If the fishing communities of developing countries that account for 95% of the world's fisherfolk and supply more than half the world's fish are adversely impacted by HIV/AIDS, then the global supply of fish, particularly to lower-income consumers, may be jeopardized (Allison and Seeley, 2004).

Small-scale fishers and fishing communities – These communities often suffer problems in terms of using and benefiting from ecosystem services. For example, the artisanal fishermen of Bamburi Beach in Kenya experience a reduced catch during the rainy season because the increased sediment in the seawater prevents them from locating the fish. Fishing during this period also involves taking higher risks as there is an increase in the number of crocodiles, snakes and other physical dangers. In addition to this the fishermen must compete with the increasing number of fishers who have migrated to the area as well as with fishers who are more technologically advanced as they lack the capital to acquire better fishing gear (Kenya Focus Group 2).

Island Communities – Anecdotal evidence from fisher communities on the island of Rodrigues highlights how the increase in severe weather events such as cyclones and extreme high tides has prevented access to the fisheries resources (Rodrigues Focus Group 2). Despite willingness from the community to change their livelihood activity to a less fisheries-reliant occupation, with no land-based employment opportunities, investment capital or technical skills people are restricted from accessing other ecosystem services.

Rural/Isolated Communities – The rural community of Muntanhane in Mozambique provides an example of how an isolated setting with restricted transport infrastructure to connect with markets has impeded the ability of the community to maximise economic benefits from provisioning services. Fishers in particular are forced to sell their catch to intermediaries who determine the selling price, often well below the market price (Mozambique Focus Group 3). In addition, isolation often means higher prices for industrialised commodities such as cooking oil sugar, etc, although ability to produce some food may be a balance.

Women - The subordinate economic and social position of women in communities and households of low income countries makes them vulnerable to changes in ecosystem services (Allison and Seeley 2004). In the coastal town of Mombasa permits are required to gain access to mangrove forests, however even when a woman has a permit she must have a male escort every time she enters the mangroves. Such a situation could limit their ability to access ecosystem services especially for those women and members of female headed households (Kenya Focus Group 3). Women, as well as children, orphans, the disabled and the elderly are more likely to have physical limitations or special needs that reduce their ability to cope with disasters that impinge on ecosystem services (Hassan, 2000). An example from Tanzania illustrates how women and men can be differentially affected by changes in the environment for resource management. A market was developed for a local octopus fishery which successfully improved the price and increased the earnings of the poor communities involved. However the fishery, which had previously been mostly conducted by women now became attractive to men from the community leading to a reduction in the access that women previously had to this resource (Tanzania Stakeholder Workshop).

These characteristics may combine to define the vulnerability of an individual, household or community, primarily by affecting adaptive capacity. In addition, adaptive capacity will depend on a number of factors, including:

- Recognition of the need to adapt

- Belief that adaptation is possible and desirable
- Willingness to undertake adaptation
- Availability of resources necessary for implementation of adaptation measures
- Ability to deploy resources in an appropriate way
- External constraints, barriers and enablers to implementation

To reflect these dimensions, McClanahan et al. (2008) developed a set of indicators relevant to understanding the vulnerability of fishers to loss of access to provisioning ecosystem services:

- Infrastructure
- Gear diversity
- Social capital
- Occupational multiplicity
- Occupational mobility
- Material assets
- Change anticipation
- Recognition of causality

From these variables McClanahan et al. (2008) derived an index of adaptive capacity with respect to a loss of fishing livelihoods of 29 coastal communities in five nations in the Western Indian Ocean. The eight variables were weighted according to relative importance as judged by experts from across the region. The resultant ranking of communities could broadly have been predicted from national-level development statistics but exceptions include communities in Madagascar (with low development status) which score more highly than communities in richer countries because of high occupational mobility, willingness to leave fisheries and social capital (e.g. Sahasoa, Figure 7.4).

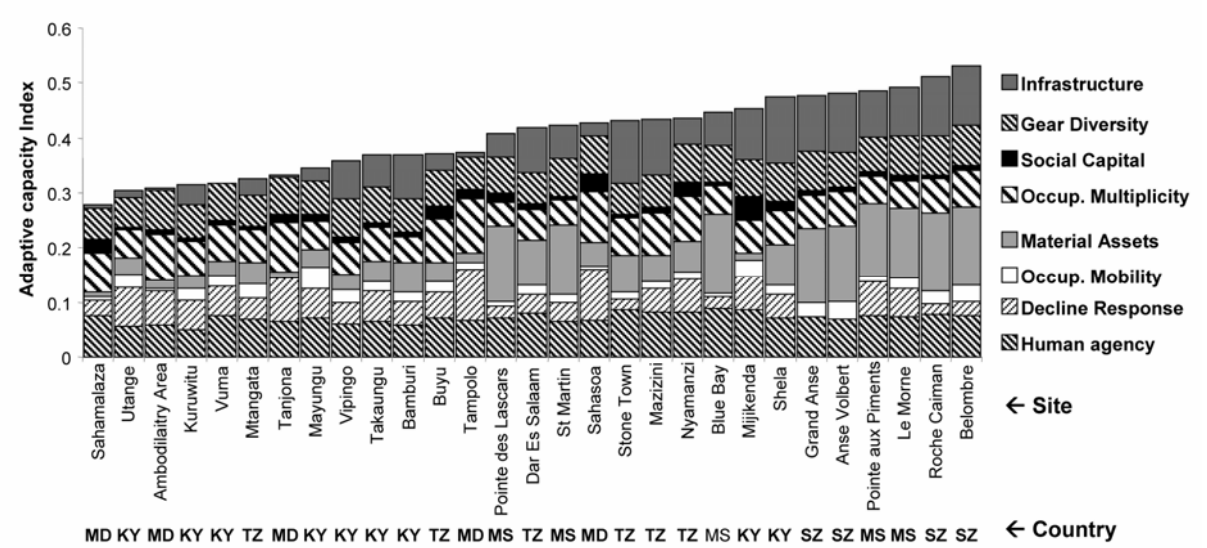


Figure 7.4: Assessment of the adaptive capacity of 29 communities measured as a compound of 7 household and 1 community-level (infrastructure) variables (MD - Madagascar, KY - Kenya, TZ - Tanzania, MS - Mauritius, SZ - Seychelles). From McClanahan et al. (2008)

What this and the analysis resulting shows is that poverty in terms of lack of assets may be an important factor, but it is not the only and perhaps not the most important determinant of adaptive capacity. Once again it necessitates looking at the multiple dimensions of poverty and the interacting factors which make some people more vulnerable than others. However there is clear evidence that poorer households have fewer opportunities to diversify and may be trapped in a situation of growing dependence on limited ecosystem services. Box 7.3 analyses the likelihood that fishers will cease fishing when faced with lower catches, and shows that poorer households were more likely to be trapped in a declining fishery.

Box 7.3 Adaptive capacity of Kenyan fishers related to household socioeconomics
Source: Cinner et al. (In press)

A study of Kenyan fishers' readiness to exit a fishery in the face of declining catches found significant relationship between those who said they would stop fishing in response to a 50% decline in catches and socioeconomic variables at the household level. Fishers from wealthier households (as judged by material style of life, house materials and ownership of appliances) were more likely to say they would exit the fishery. Livelihood opportunities at the household level were also significant; the probability of exit was significantly related to the total number of occupations in the household.

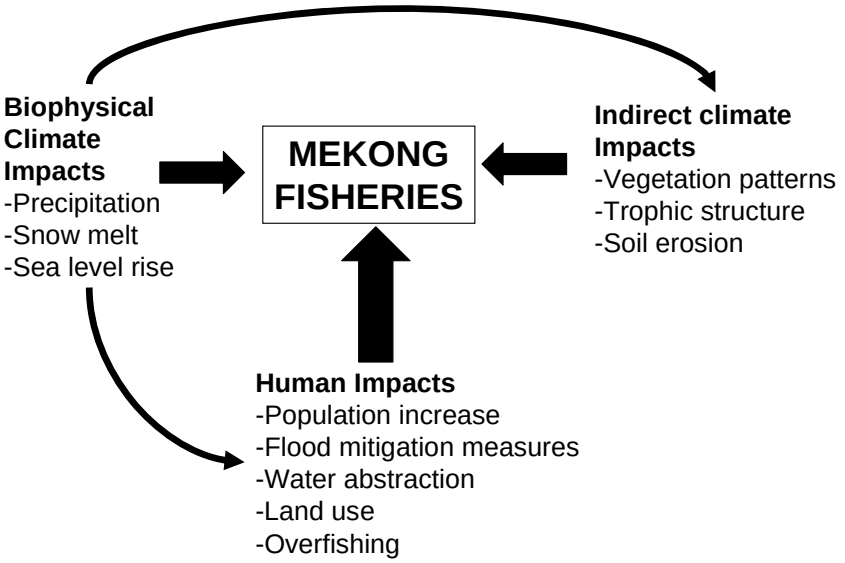
The points show the actual data, lines show the relationships from a binomial logistic regression.

7.5 Multiple scales and multiples stressors

In reality it is often difficult to separate the impacts of one set of changes on either the flow of ES or on peoples' well-being or ability to climb out of poverty. It is often the interaction of multiple factors – or stressors as the global environmental change literature calls them – which have the most profound impacts on peoples' livelihoods and well-being, and determine whether they remain trapped in poverty or are able to reverse vicious circles of poverty and resource degradation. Although social ecological systems may be able to withstand or cope with one shock or disturbance, it is the repeated or series of shocks which undermine stability, and which reveal the underlying sources of vulnerability or resilience within the system. O'Brien and colleagues (2000, 2004) have examined the combined impacts of climate change and globalisation, demonstrating how different patterns of 'winners' and 'losers' emerge when multiple stressors are assessed, compared to simplistic analysis of single events or impacts. From our analysis we know that global economic pressures – particularly food and fuel price rises, and volatility of markets for fisheries – combine with events such as storms, or illness within a family, to exacerbate vulnerabilities within households, communities and regions. Box 7.4 below shows the multiple and interacting stressors, and how climate change interacts with social and economic factors to impact on Mekong Delta fisheries.

Box 7.4: Multiple impacts on Mekong delta fisheries

The lower Mekong delta supports over 1000 fish species, a capture fishery of 1.5 million tonnes and fishery-based livelihoods for 40 million people. These fisheries are threatened by a number of climate-mediated processes including changing precipitation, snow melt, rising sea level, which have impacts on various aspects of ecology of the delta as well as on human settlements.



In addition to these interacting climate impacts, the overwhelming impacts on fisheries in the delta are from human activities including overfishing, land use changes, and hydrological disruptions. Future increased flooding may have the potential to increase fishery yields but planned flood mitigation measures to protect agriculture may in fact result in reduced flooding and reduced fisheries productivity (Easterling et al., 2007).

Box 7.5 below provides an example from Macaneta in Mozambique to illustrate how multiple stressors interact and make poor people more vulnerable to changes in the flows of ecosystem services.

Box 7.5: Multiple stressors affecting coastal livelihoods in southern Mozambique

Fishing communities are struggling to cope with a complex mixture of human and natural stressors whose impacts on livelihoods are hard to identify separately in data-poor environments such as Mozambique. On a thin sand spit separating the Incomati River from the Indian Ocean north of the capital Maputo, the small settlement of Lhanguine (Macaneta, Marracuene district) grew out of a temporary fishing camp where Mozambicans sought refuge during post-independence (1973) civil war. This added to long-term pressure on the local fishery and marginal coastal soils. Villagers attribute crop decline since the 1970s and particularly the 1990s to this but also rising temperatures, declining rains and shifting cyclone patterns, which hit farming but also fishing. Saltwater intrusion from the sea into the soils of flood plain farms has led to the collapse of much of the previous rice farming in the area, although communist state policies also contributed by disrupting markets and distribution. River flow rates have been altered by upstream dam operations in South Africa, and water off-take by sugar cane farms in Mozambique. Droughts in southern Mozambique are expected to rise, while extreme flooding becoming more common to the north is also experienced in the south. After Mozambique's freak rains in 2000, the Incomati broke over the top of the coastal sandbar at Lhanguine for the first time in local living memory, damaging infrastructure, farms and property and creating conditions for human diseases. As nearby Maputo's population expands rapidly and investors and tourists arrive from South Africa, pressure on resources continues to rise. Reliance on fishing for income is rising and fuel and food prices spiral upwards. Amid anecdotal reports of declining catch per unit of effort, fishers are adopting more damaging fishing practices and catching less traditional target species, including top predators needed for ecosystem health. Apart from erosion, development is constrained by water scarcity. Local and international investment has continued nevertheless, and residents of Lhanguine are to be resettled against the wishes of many under a deal between developers, traditional chiefs and government officials. Land laws are expected to clarify rights and development zones but a history of internal migration, and agendas set by outsiders complicate questions of equity and legitimacy in development plans.

8. Dynamics and Drivers of Change

8.1 Changes in coastal and marine ecosystem services and poverty

The relationship between ecosystem services and poverty is evolving rapidly in the face of trends at a range of scales affecting the economic, environmental and social environment of poor coastal people. A static view of this relationship is likely to miss the dynamics of each of the linkages identified in the conceptual framework. It is important, therefore to address the changing nature of coastal poverty and ecosystems in the light of various direct and indirect drivers.

Changes over time can be in the form of gradual trends, such as national population that can realistically be modelled and projected over the short term, or as sudden step changes, for example changing economic conditions as a result of a country's accession to the WTO (Vietnam National Workshop). The rate of change can also be accelerating or decelerating and some changes such as climate change may be experienced as an increase in variability or unpredictability as opposed to a clear linear trend in average conditions. Although crude trends in some key variables are available (e.g. Table 8.1) there are few time-series long or detailed enough to categorise the nature of changes (Global Report). Thus there is a danger of assuming linear trends and failing to account for sudden step-changes or 'even tipping points'.

Table 8.1: Indicative changes in the coastal zones of non-OECD countries during the 1990s

	Year			Mean annual rate of change
	1990	***1995***	***2000***	
Millions living in coastal zone[1]	437.8	480.8	523.0	1.9%
% coastal population urbanised[1]	48%	49%	51%	0.2%
Tonnes of fish exports[1]	6,757	12,124	14,077	10.8%
Coverage of Mangroves (Ha)[2]	16925		15740	-0.7%

[1] *data for non-OECD coastal countries*
[2] *data for all world*

Human population growth, migration, and development are a continual background trend (Table 8.1). The rate of population growth is now slowing in many developing countries (Watkins 2006) but populations continue to increase, presumably with increasing demand for ecosystem services.

Table 8.2 summarises responses of participants to the question "What are the main changes occurring in marine and coastal ecosystem services to the poor" along with an indication of how participants ranked such changes. Local declines in ecosystem services provision were described by all participants in terms of resource degradation, and coastal erosion. Socioeconomic changes included inflation, tourism development, increasing poverty, and changes in approaches to resource management, including increasing awareness of resource management and implementation of tools but also, in Tanzania, growing resistance of communities to conservation measures.

Degradation of coastal and marine ecosystems and reduced productivity was reported at all scales from the global assessment to local focus groups. The change in some coastal and marine ecosystems have been described globally with the aid of remotely sensed data or modelling in terms of aerial extent or level of degradation or threat. For example an estimated 300,000 ha, or 17% of the mangroves were lost between 1980 and 2000 (Global Report) while twenty percent of the world's coral reefs are estimated to have been destroyed with a further 50% at risk of imminent or long term threats of collapse (Wilkinson, 2004).

Table 8.2. Key trends affecting poor people and their relation with coastal and marine ecosystems as identified by national workshops. Numbers and shading indicate the maximum weighted score based on ranks from participatory scoring exercises. Weighted Score = 1 + (Rank-1)/(number of ecosystem services identified-1)

Scale	Source	Mozam.	Phil.	Tanz.	Vietn.	Mean Rank
Local	*Overexploitation/destructive exploitation*	**1.0**	**0.8**	**0.8**	**1.0**	**0.9**
Local	*Habitat/Biodiversity degradation*	**0.9**	**0.9**	**0.6**	**0.9**	**0.8**
Local	*Reduced production*	**0.8**	**0.8**	**0.4**	**0.8**	**0.7**
Global	*Climate change*	**0.9**	**0.5**	0.0	**0.7**	**0.5**
Local	*Pollution*	**0.8**		**0.6**	**0.7**	**0.7**
Local	*Erosion*	**0.9**		**0.4**	**0.6**	**0.6**
National	*Establishment of MPAs*	**0.8**		**0.5**	0.2	**0.5**
Local	*Population/No resource user growth*	**0.6**	0.0	0.2	**0.6**	**0.4**
Global	*Inflation of food & fuel*	**0.7**		**0.4**	0.2	**0.4**
National	*Natural disasters*	**0.9**			0.2	**0.6**
National	*Tourism/beach development*	**0.5**		**0.3**	0.2	**0.4**
Local	*Water shortage and quality decline*	**0.8**			0.2	**0.5**
National	*Increasing awareness/education*			**1.0**		**1.0**
National	*Migration/urbanisation*	**0.7**			0.2	**0.5**
Local	*Local resistance to conservation*			**0.9**		**0.9**
Local	*Conflict with industrial fisheries*	**0.5**			0.2	**0.4**
National	*Increasing poverty*		**0.6**	0.1		**0.4**
National	*Privatisation of coast*		0.0	**0.3**		0.2
National	*Industrial/infrastructure development*			**0.3**		**0.3**
Local	*Diversifying livelihoods*			0.2		0.2
Local	*Cultural transformations*			0.1		0.1
National	*Economic development*		0.0			0.0

How social and ecological systems might respond to these changes is key to understanding the relationship between ecosystem services and poverty alleviation in a dynamic sense. In other words it is not enough simply to observe or extrapolate these trends, whether they be steady and predictable or highly unstable and uncertain; the impacts of changes on different ecosystem services and on the capacities of different sectors of economy and society are a major concern. Some of these linkages are well established, but many are unknown and highly complex. Thus we cannot not make simplistic assumptions about the loss of habitat on species populations, and the resultant impacts on society. For example, ecological theories of resilience warn that ecosystems can be pushed beyond thresholds and undergo a 'phase shift' to an alternative (degraded) state. Feedbacks within the system prevent recovery to the original state even if stressors are reduced (Scheffer et al., 2001). The quality of an ecosystem or social-ecological system which allows it to experience disturbance without undergoing a phase shift is called 'resilience', and can be undermined over time due to pressures without any obvious change (Folke, 2006). Coral reefs in the Caribbean appear to have undergone a phase shift over a large scale from a coral-dominated state to an algal dominated state due to the erosion of resilience, overfishing, disease and hurricane impacts over several decades (Hughes et al., 2005). Although resilience is an increasingly popular framework, the practical observation of resilience or knowing where thresholds in behaviour might lie is very challenging. Thus, although the assessments identified an almost ubiquitous decline in coastal and marine ecosystems, little rigorous information exists on how far such degradation is approaching irreversible tipping points or large-scale phase shifts or collapse. There is a need to understand how concepts of resilience can be used to understand coastal and marine ecosystem services to help avoid passing thresholds and irreversible loss of important ecosystem services. We discuss the implications of a more-resilience based approach to understanding and managing change in section 9.3.

8.2 Drivers of change

The drivers of change are also varied and operate at a range of scales from local resource governance and use to national policy to global trends such as international markets and global climate change. Some drivers have direct influence on the coastal poor or ecosystems, while others have a more indirect effect by influencing the political, social or environmental climate in which the poor seek to benefit from ecosystem services. Direct drivers affecting ecosystem services flow include

pollution or destructive fishing practices, those affecting ecosystem services access include privatisation of land, while changes in culture or religion affect local valuation of ecosystem services. Indirect drivers are, for example, institutions and policies that stimulate one or more direct drivers. The diverse and interacting drivers of change present complex problems for understanding the dynamics of human development. Linear analysis of individual processes is not sufficient and needs to be expanded to multi-scale, interdisciplinary analysis of the coast as a complex system.

Table 8.3. Key drivers affecting poor people and their relation with coastal and marine ecosystems as identified by national workshops. (Figures presented calculated in same way as Table 8.2)

Driver	Direct?	Kenya	Mozam.	Phil.	Tanz.	Vietn.	Mean	Frequ-ency
Overexploitation/destructive exploitation	**Direct**	**0.9**	**1.0**	**0.7**	**1.0**	**1.0**	**0.9**	5
Population/No resource user growth	*Indirect*	**0.9**	**0.9**	**0.9**	**0.8**	**0.9**	**0.9**	5
Poverty/lack of alternatives	*Indirect*	**0.9**	**0.9**	**0.6**	**0.8**	**0.6**	**0.7**	5
Lack of policies/laws/planning	*Indirect*	**0.6**	**0.6**	**0.7**	**0.3**	**0.6**	**0.6**	5
Climate change	*Indirect*	**0.7**	**0.8**	0.2	0.0	**0.8**	**0.5**	5
Lack of enforcement	*Indirect*		**0.6**		**0.9**	**0.9**	**0.8**	3
Tourism/beach development	**Direct**	**0.6**	**0.6**		**0.5**	**0.6**	**0.6**	4
Lack of knowledge/awareness	*Indirect*	**0.4**	**0.6**	0.2	0.2	**0.7**	**0.4**	5
Industrial/infrastructure development	**Direct**	**0.5**	**0.3**	**0.6**	**0.5**	0.2	**0.4**	5
Vested interests/lack political will/corruption	*Indirect*	**0.5**	0.1	**0.9**	**0.4**	0.2	**0.4**	5
Migration/urbanisation	*Indirect*	**0.8**	0.1		**0.7**	**0.4**	**0.5**	4
Global markets/trade	*Indirect*	0.0		**0.8**	**0.6**	**0.6**	**0.5**	4
Economic development	*Indirect*	**0.6**		**0.6**		**0.7**	**0.6**	3
Poor NR govenance	*Indirect*	**0.8**	**0.3**		**0.8**		**0.6**	3
Lack of local empowerment	*Indirect*	**0.9**		**0.6**	**0.3**		**0.6**	3
Pollution	**Direct**	**0.4**	**0.6**			**0.7**	**0.6**	3
Lack of sectoral cooperation	*Indirect*	**0.4**	**0.6**			**0.6**	**0.5**	3
Local livelihoods	**Direct**	**0.5**	**0.8**			0.2	**0.5**	3
Increasing awareness/education	*Indirect*	**0.4**		0.2	**0.8**		**0.5**	3
Technology for exploitation	**Direct**			0.2	**0.9**		**0.5**	2
Industrialised fisheries	**Direct**				**0.9**		**0.9**	1
Land use change/deforestation	**Direct**	**0.7**					**0.7**	1
Inflation of food & fuel	*Indirect*				**0.7**		**0.7**	1
Privatisation of coast	**Direct**				**0.6**		**0.6**	1
Lack of capacity	*Indirect*		0.1		**0.3**	0.2	0.2	3
Habitat/Biodiversity degradation	*Indirect*					**0.6**	**0.6**	1
International/national politics	*Indirect*	0.2			**0.4**		**0.3**	2
Traditional beliefs/structures	*Indirect*	0.2			0.2		0.2	2
Drive for local management	*Indirect*	0.1		0.2			0.2	2
Conflict/resistence	**Direct**			0.2			0.2	1
Lack of local services	*Indirect*	0.1					0.1	1
Establishment of MPAs	**Direct**	0.1					0.1	1
Ecosystem restoration	**Direct**	0.1					0.1	1
Cultural transformations	*Indirect*	0.0					0.0	1
International aid	*Indirect*	0.0			0.0		0.0	2

Table 8.3 summarises the drivers identified by the national workshops in response to the question "what are the most important drivers of change with respect to coastal poverty and ecosystem services?" with an indication of their relative importance according to the participants and the number of workshops in which they were mentioned. Local-scale direct drivers of overexploitation, population pressures and poverty were ranked highly in most workshops, but larger-scale processes were also identified including climate change. The ranking of different drivers is somewhat confused by the

existence of direct and indirect drivers. Various aspects of governance were highlighted including institutions, capacities and knowledge needs for resource management, and political influences at a range of scales. Tourism and industrial development were identified as important national-scale drivers of change leading to privatisation of the coast and exclusion of local people as well as causing large scale degradation and conversion of coastal ecosystems.

The drivers prioritised in workshops focus on local impacts, including negative cycles of ecosystem degradation as a result of direct use by increasing numbers of poor stakeholders with limited alternative livelihood options. At the local scale such drivers dominate, but multi-scale analysis is necessary to understand larger scale political, economic and environmental processes which are increasingly recognised for their indirect effects. Examples include the lack of accountable national governance of coastal zones in East Africa resulting in large-scale and poorly planned infrastructure development (Tanzania National Workshop p6, Mozambique National Workshop 3.3-4, WIO Report p41), the impact of international markets on the development of shrimp farming in Asia (SEA Report) and the impacts of climate change on coral reefs in the WIO (Graham et al., 2008). Attempts to alleviate poverty, conserve ecosystem services and reduce the vulnerability of the coastal poor on a large scale must engage with such large scale drivers.

8.3 Climate Change

Climate will be a major driver of changes affecting all aspects of ESPA covered in this report. The condition and extent of particular ecosystems or species is likely to be directly affected (e.g. coral reefs through thermal bleaching of corals) with impacts on the potential production of ecosystem services (Figure 2.1a). Changing patterns of ecosystem services will produce impacts but also opportunities. For example, altered distribution of high value species may make them available to different communities than in the past (Figure 2.1b). In terms of poverty alleviation, such changes are challenging as it is usually the poor who have the lowest adaptive capacity to maintain their wellbeing and take advantage of opportunities in the face of change (Box 7.3). The value of services for the poor (Figure 2.1c), particularly regulating services may change as a result of increased disturbance. For example the increased risk of storm surges will increase the reliance on the regulating services of mangroves, reefs and marshes to protect from erosion and inundation. The analysis presented in section 7.2 identifies, at a global scale, coastal communities most vulnerable to impacts of climate change such as storm surges and flooding. Finally, impacts of climate on non-coastal systems may be transmitted through social and political systems to have major effects on coastal areas (see Boxes 7.4 and 7.5). For example the reduction of inland ecosystem services (e.g. through drought) may increase the human population and pressure on ecosystems at the coast due to refugees concentrating on the coast.

A number of recent studies have highlighted the potential impacts of climate change on fisherie and identified a wide range of potential indirect ecological, direct and indirect socioeconomic impacts on fisheries and aquaculture, shown in Table 8.5 (Allison et al. 2005). Many of these are the result of biophysical effects on aquatic ecosystems (see for example Box 8.1 for a summary of climate change and coral bleaching). However, the combination of climate change with other factors will have the most profound impacts on poor people dependent on fisheries (Daw et al., 2008). Brander (2008) for example argues that the most effective means of adapting to future climate change impacts is to deal with familiar problems such as over-fishing and marine pollution, as it is these factors which make ecosystems sensitive – or vulnerable – to climate change. Once more, this supports a resilience-based approach to dealing with change and threats to ecosystem services.

Analysis by McClanahan et al. (2008) for the WIO, has analysed susceptibility of coral reefs in the region to coral reefs and combined this with measures of adaptive capacity of fishing communities (see Box 7.4) to build up a picture of where and when climate change induced bleaching could have most significant impacts and what the most appropriate policy response might be for different locations. Such interdisciplinary analysis can yield insights that are potentially very useful to help define successful responses to climate change in coastal and marine systems.

Table 8.5 : Potential impacts of climate change on fisheries (Daw et al. 2008, adapted from Allison et al 2005)

Type of changes	Physical changes	Processes	Potential impacts on fisheries
Physical Environment (Indirect ecological)	Increased CO_2 and ocean acidification	Effects on calciferous animals e.g. molluscs, crustaceans, corals, echinoderms & some phytoplankton	Potentially **reduced production** for calciferous marine resources and ecologically related species and **declines in yields**
	Warming upper layers of the ocean	Warm water species replacing cold water species	**Shifts in distribution** of plankton, invertebrates, fishes birds, towards the north or south poles, reduced species diversity in tropical waters
		Plankton species moving to higher latitudes	
		Timing of phytoplankton blooms changing Changing zooplankton composition	Potential mismatch between prey (plankton) and predator (fish populations) and **reduced production and biodiversity** and **increased variability in yield.**
	Sea level rise	Loss of coastal fish breeding and nursery habitats e.g. mangroves, coral reefs	**Reduced production and yield** of coastal and related fisheries
Fish stocks (Indirect ecological)	Higher water temperatures Changes in ocean currents	Changes in sex ratios Altered time of spawning Altered time of migrations Altered time of peak abundance	Altered timing and **reduced productivity** across marine and fresh-water systems
		Increased invasive species, diseases and algal blooms	**Reduced productivity** of target species in marine and fresh water systems
		Changes in fish recruitment success	Abundance of juvenile fish affected leading to **reduced productivity** in marine and fresh water
Ecosystems (Indirect ecological)	Reduced water flows & increased droughts	Changes in lake water levels Changes in dry water flows in rivers	**Reduced productivity** of lake fisheries **Reduced productivity** of river fisheries
	Increased frequency of ENSO events	Changes in timing and latitude of upwelling	**Changes in distribution** of pelagic fisheries
		Coral bleaching and die-off	Reduced **productivity** coral-reef fisheries
Disturbance of coastal infrastructure and fishing operations (direct)	Sea level rise	Coastal profile changes, loss of harbours, homes. Increased exposure of coastal areas to storm damage	**Increased vulnerability** of coastal communities and infrastructure to storm surges and sea-level Costs of adaptation lead to **reduced profitability**, risk of storm damage **increases costs** of insurance and/or rebuilding.
	Increased frequency of storms	More days at sea lost to bad weather, risks of accidents increased	**Increased risks** associated with fishing, making it less viable livelihood options for the poor
		Aquaculture installations (coastal ponds, sea cages) more likely to be damaged or destroyed	**Reduced profitability** of larger-scale enterprises, insurance premiums rise.
Inland fishing operations and livelihoods (indirect socio-economic)	Changing levels of precipitation	Where rainfall decreases, reduced opportunities for farming, fishing and aquaculture as part of rural livelihood systems	**Reduced diversity of rural livelihoods**; greater risks in agriculture; greater reliance on non-farm income. Displacement of populations into coastal areas leading to influx of new fishers.
	More droughts or floods	Damage to productive assets (fish ponds, weirs, rice fields etc) and homes.	**Increasing vulnerability** of riparian and floodplain households and communities
	Less predictable rain/dry seasons	Decreased ability to plan livelihood activities – e.g. farming and fishing seasonality	

Box 8.1: Coral bleaching impacts on fisheries in the Western Indian Ocean (Daw et al., 2008)

Coral bleaching is a biological phenomenon in which stony corals and related organisms, loose the symbiotic algae normally found in their tissues as a result of stress (including unusually high water temperatures). The corals resultantly appear white and may recover, or die if bleaching is severe or prolonged. Coral reefs in the Western Indian Ocean region experienced very severe bleaching and mortality due to the El Nino of 1998/9 and bleached again in 2005. Inner reefs of Seychelles showed severe ecological consequences. Live coral cover dropped from 27% to 3%, and coral-feeding fish species disappeared (Graham et al 2006). However, fisheries landing statistics and surveys of the biomass of targeted species did not demonstrate an rapid impact of the bleaching on fisheries (Grandcourt and Cesar 2003, Graham et al 2007). This may have been due to the fish habitat that was still provided by the structure of the dead corals. These subsequently began to erode leading to a loss of structure, and ecological studies in 2005 found the abundance of small fish had reduced. This may indicate a time lag in the impacts of bleaching on commercially important fish; erosion of dead corals eventually impacting recruitment of commercial fish species (Graham et al 2007).

9. Governing trade-offs

This section seeks to understand the trade-offs inherent in different courses of action and how these can be evaluated in order to better inform management of ecosystem services and particularly to identify strategies to optimise benefits for both ecosystem services flows and poverty alleviation, if and where they exist. Conventionally the literature leads us to expect trade-offs – often expressed as direct conflicts – between the maintenance of ecosystem services, and the attainment of greater welfare for human beings. For example, conventional economics suggests that conversion of natural habitats to agriculture, harvesting of forests for timber, drainage of wetlands for cultivation, produce direct consumptive benefits and economic yields. However, an ecosystem services approach and a multi-dimensional understanding of well-being demonstrate a wider set of benefits accruing to society as a whole normally excluded from economic analysis. Thus management strategies which are able to evaluate and take account of trade-offs may demand new systems of governance which give attention to resilience and adaptive management.

9.1 Existing knowledge on trade-offs

The MA defines trade-offs as 'management choices which intentionally or otherwise change the type, magnitude and relative mix of services provided by ecosystems' (Chopra et al., 2005:604). This definition sees trade-offs as being quite narrowly concerned with decision-making. However, in focusing on ecosystem services and poverty alleviation the central concern is often about the balance and distribution of benefits between two goals; enhancing ecosystem services or ecosystem health, and human well-being or poverty alleviation. Brown (2004) highlights trade-offs as the winners and losers of different courses of action. Understanding trade-offs is about weighing and evaluating the pros and cons of different courses of action; understanding how benefits and costs to ecosystems and society can be balanced. Trade-offs can occur between different users, within the same country, community or even households, as well as between different countries in terms of winners and losers from particular course of action. There may be trade-offs between different aspects of ecosystem services; and between long-term and short-term goals, and between different priorities for society, such as economic growth versus social and cultural values, and ecosystem health.

Examples of trade-offs between different ecosystem services include those between provisioning and recreation and biodiversity through establishment of no-take areas and MPAs, and in various coastal tourism initiatives. The WIO Report highlights conflicts between tourism and access by poor fishers to marine and coastal provisioning services. Coastal development for tourism can potentially undermine regulating services such as storm and flood protection by modifying natural defences, building marinas and other coastal structures.

These changes also represent trade-offs between different users, in that they create a shift in the distribution of benefits between different local people; from fishers to tourism entrepreneur perhaps; but also between local and global communities. Tourism was seen to provide benefits to the wealthy, to international visitors and to national coffers, but that the costs are often borne by the poor, both directly as a result of loss of access to provisioning services, and indirectly. For example, anecdotal evidence reports rises in prices of various goods and food due to increased tourism which has greatest adverse impacts on the poor (SEA Report p48). Tourism was also seen to accelerate the privatisation of coastal and marine resources and to result in lack of direct access – for example to beaches or landing sites (see section 4).

In addition to tourism, the changes which were articulated most strongly as trade-offs and even conflicts were those associated with the introduction and adoption of aquaculture in coastal regions. Clearly there are important trade-offs in terms of provisioning and regulating services if aquaculture involves significant modification of habitats. But aquaculture was also seen as involving trade-offs between users. Thus mangroves provide provisioning services mainly to local subsistence and small scale users which may be lost when coastal systems are modified for aquaculture, and the poor lose access to mangrove resources, while those with capital profit from aquaculture (e.g. Vietnam Focus Group; SEA Report p44).

Trade-offs between different societal goals are also embedded within the decisions and priorities for development and conservation, particularly evident in industrial fishing strategies and in decisions about the siting and management of MPAs.

Investments and policies to support industrial fishing may involve trade-offs between food security or self-sufficiency and foreign exchange earnings (WIO Report). These may have important knock-on effects in terms of health, highlighted in a recent paper by Brunner et al. (2008). Their analysis shows how differences in fish consumption contribute to within country and international health inequalities, and that policies producing fish meal for aquaculture and other non-food uses are likely to contribute to declines in availability of fish for consumption by the poor and therefore increase these health inequalities.

9.2 Evaluating trade-offs

One of the key strengths of a focus on ecosystem services is the simultaneous consideration of the multiple benefits ecosystems provide to society. This is expected to convince decision-makers of the value of ecosystems beyond single goods and services and encourage their sustainable management. Due to the complexity of how ecosystems function, it is difficult to clearly separate the benefits obtained directly and indirectly from ecosystems. This is because ecosystems provide 'bundles of ecosystem services' that are interdependent and often cannot be meaningfully disaggregated. This poses challenges to economic valuation of ecosystem services, which is the preferred tool for supporting the case for promoting conservation and sustainable use of ecosystems under threat from conversion and degradation fuelled by economic development. The DIVERSITAS-ECOservices programme (see www.ecoservices.asu.edu) has a programme of research examining these issues. Valuation of ecosystem services is currently the focus of a number of science initiatives, including the European Community 'The Economics of Ecosystem and Biodiversity' project which aims to understand the impacts of biodiversity loss on ecosystem services and human well-being and to quantify the economic scale of these impacts. The interim results of this study provide some useful findings, and also highlight the limits and applications of economic valuation in understanding linkages between ecosystem services and human well-being and how such information might inform policy. They outline a set of principles for best practice in valuation of ecosystem services, shown in Box 9.1.

Box 9.1: Principles of best practice in valuation of ecosystem services

These principles build on the recommendations made at the Workshop on the Economics of the Global Loss of Biological Diversity organized in the context of this project in Brussels in March 2008 (ten Brink and Bräuer 2008).

1. The focus of valuation should be on marginal changes rather than the "total" value of an ecosystem.
2. Valuation of ecosystem services must be context specific, ecosystem-specific, and relevant to the initial state of the ecosystem.
3. Good practices in "benefits transfer" need to be adapted to biodiversity valuation, while more work is needed on how to aggregate the values of marginal changes.
4. Values should be guided by the perception of the beneficiaries.
5. Participatory approaches and ways of embedding the preferences of local communities may be used to help make valuation more accepted.
6. Issues of irreversibility and resilience must be kept in mind.
7. Substantiating bio-physical linkages helps the valuation exercise and contributes to its credibility.
8. There are inevitable uncertainties in the valuation of ecosystem services, so a sensitivity analysis should be provided for decision makers.
9. Valuation has the potential to shed light on conflicting goals and trade-offs but it should be presented in combination with other qualitative and quantitative information, and it might not be the last word.

The Economics of Ecosystems and Biodiversity – Interim Report, European Communities, 2008
http://ec.europa.eu/environment/nature/biodiversity/economics/pdf/teeb_report.pdf

Numerous studies have attempted to value the benefits of coastal and marine ecosystem services, including the MA itself. Such studies are often used to highlight the magnitude and wide range of values of coastal and marine ecosystem services; for example the TEEB project again highlights the multiple values of coral reefs, shown in Box 9.2. However valuation alone does not go far enough in understanding the distributional issues (to whom in society benefits accrue), nor the ecological impacts of different courses of action. It helps us to identify how values might change under different

courses of action (see point 1 in Box 9.1 above) but not necessarily to understand all the trade-offs. It is a toll used to inform a set of decisions about trade-offs and alternatives for society.

Box 9.2: Multiple values of coral reefs

Coral reefs provide a wide range of services to around 500 million people. Some 9-12% of the world's fisheries are based directly on reefs (Mumby et al. 2007), while a large number of offshore fisheries also rely on them as breeding, nursery or feeding grounds (Millennium Ecosystem Assessment 2005c). Tourism generally is the dominant benefit. Reef recreation has been estimated at US$ 184 per visit globally (Brander et al. 2007), at US$ 231-2,700 per hectare per year in Southeast Asia (Burke et al. 2002) and at US$ 1,654 per hectare per year in the Caribbean (Chong et al. 2003). Coral reefs provide genetic resources for medical research, and ornamental fish and pearl culture are extremely important for the economies of some insular states, such as French Polynesia. The reefs protect coastal areas in many islands: this vital service has been estimated to be worth US$ 55-1,100 per hectare per year in Southeast Asia (Burke et al. 2002).

The Economics of Ecosystems and Biodiversity – Interim Report, European Communities, 2008
http://ec.europa.eu/environment/nature/biodiversity/economics/pdf/teeb_report.pdf

A whole set of other trade-offs exist across scales, for example in the impacts of agriculture and land use change on coastal and marine ecosystem services. These trade-offs are beginning to be analysed and evaluated through projects such as 'Watershed analysis for the Mesoamerican reef' project co-ordinated by WRI and the Mesoamerican Reef partnership (see www.wri.org/project/watershed-based-analysis-threats-coral-reefs). This uses a series of scenarios to examine the land-based threats to reef systems, integrating sediment and nutrient run off modelling with analysis of agricultural practices and trade policies. The initiative also provides technical training and policy support in the region; a good example of the type of analysis of trade-offs necessary to inform policy affecting coastal and marine ecosystem services.

9.3 Governance of resilience

Coping with the types of change that are currently taking place and which are likely to happen in the near future – changes associated with climate change, with ecosystem degradation, with human population change and migration, and with economic instability – requires a profound shift in how resources are managed and how changes are dealt with. The world has always been an uncertain place, but it is ever more so, and more risky for poor people. A resilience approach to understanding the trade-offs between different courses of action and their implications for ecosystem health and biodiversity, for society as a whole and for the poor within society would require some important changes in how coastal and marine ecosystems are governed. This would require a greater emphasis on adaptive management, whereby change is monitored and expected, not resisted. In turn this requires greater integration of knowledges and greater involvement of stakeholders in priority-setting, decision-making and monitoring of change. This requires new scientific knowledge, for example to understand processes, linkages and likely changes, but also greater investment in practices already introduced such as co-management. The following section assesses whether knowledge exists in the regions to support this kind of approach to integrating ecosystem services and human well-being.

10. Knowledge Assessment

This section draws on the global analysis, the SEA and WIO regional reports and stakeholder consultations in order to determine whether i) knowledge is limiting, ii) knowledge is available but not disseminated to the stakeholders and decision-makers who need to apply it, or iii) available and widely disseminated but not applied because of economic, cultural and political structures.

10.1 Knowledge gaps (is knowledge limiting?)

A wide range of knowledge gaps were identified in the three assessments, including generic gaps global in scope as well as regionally and context specific gaps. These were grouped into different headings, which are presented below. There is clearly a need for concerted efforts to establish baseline data on biophysical, ecological, social and economic conditions. In many instances these data are not comprehensive, rigorous or accessible within the regions. Their collection has been unsystematic, haphazard and the data incomplete or not comparable. Such initiatives could be established in existing regional and local institutions, supported or assisted by international collaboration and funding (see 11.1). There is a need for data on the values and uses of ecosystem services and the trade-offs inherent in different management and use strategies. This information is critically needed to inform policy making. However a shift to adaptive management principles and institutions capable of learning from experience (see section 9.3) may become increasingly important in light of data gaps and uncertainties that cannot be cost-effectively filled by research (see Brown, 2006).

10.1.1 Baseline data and time series on ecosystem services and poverty

The global analysis and regional reports found that baseline data on ecosystem services and coastal poverty, including time series data, are often incomplete, inconsistent or lacking. This limits the ability to identify trends at the global, regional and national scale, understand dynamics of changes or project impacts of changes on the livelihoods and well-being of the coastal poor. Examination of the links between poverty and ecosystem services in developing countries is contingent on more fundamental information, and the absence of such information is often an impediment to conducting other types of research.

Quantification of coastal and marine ecosystem services

Except for limited knowledge on fish stocks, adequate data is lacking for most developing countries at the national scale. Quantifying the flows of ecosystem services is crucial to establish whether these are used sustainably presently or at projected levels under different scenarios. This information can potentially inform policy and management and help raise public awareness regarding important changes in ecosystem services. Crucial is the way in which this information is disseminated to the public and decision-makers (WIO Report:45, Global Report:38, 40; Philippine National Workshop:6; Tanzania National Workshop:11)

Ecosystem structure, status and flows of specific ecosystem services

Relationship between ecosystem structure, status and flows of specific ecosystem services is not known. Limited data indicating coverage of different ecosystems of likely importance to the poor are available but information discriminating variations in the ecological structure (i.e. species distribution) and status of the coastal and marine ecosystems (i.e. degree of conservation/degradation) is often lacking. There is also a poor understanding of how structure and status of ecosystems affects the flows of ecosystem services. Both of these are required to establish levels of ecosystem services provisioning (WIO Report:45; Global Report:38).

Data on coastal population and coastal poverty

Such data are limited and often outdated in most developing countries. Together with improved information on ecosystem services, these data would enable a more robust identification of key 'hot-spots' in terms of reliance of the poor on ecosystem services and future trends, including change impacts. Country-level estimates of coastal population using the LECZ are available, but only up to 2000. Poverty data at the national and sub-national level for coastal zones are available for some countries, but these data have generally been one-off assessments, which have not been updated (Global Report:38; Vietnam Country Report:9; Philippines Country Report:87, Philippines National Workshop:6).

10.1.2 Dynamics of linkages between poverty and ecosystem services

Further investigation is required to quantify the links and relationships and how changes in one impact on the other. Also important is to investigate these links in urban and peri-urban contexts, where an increasing proportion of the population in developing countries is concentrated (see Box 2.1 and Table 8.1).

Quantifying links and relationships between ecosystem services and poverty

The assessment confirmed the importance of provisioning services for the poor. Supporting and regulating services are also valued, but their role in poverty alleviation is not clear. Several components of the assessment identified this as a key research gap. (Vietnam Country Report:84; Philippines Country Report:64; SEA Report:38, 39; WIO Report:45).

Poverty and ecosystem services in urban and peri-urban areas

The urban and peri-urban coastal poor are dependent on ecosystem services in different ways. For example, the key issues may be related to regulating and supporting services, such as to exposure to health risks resulting from inadequate sanitation and pollution in addition to reliance on provisioning services from fishing and gleaning (Mozambique Focus Group 1, Philippines Focus Group 1 and 5). There is an urgent need to broaden our understanding of the links between poverty and ecosystem services in urban and peri-urban areas.

10.1.3 Valuation of coastal and marine ecosystem services

Valuation of ecosystem services is a potentially valuable tool to inform decision-making and to identify trade-offs (as discussed in Section 9). However, valuation knowledge needs to be expanded to include the full range of ecosystem services, including non-monetary values and pro-poor perspectives. This is important, since not all policies can be grounded on purely economic grounds and need to consider how the poor value ecosystem services.

Economic valuation of ecosystem services

There is a perceived lack of site specific valuation studies of ecosystem services, particularly beyond provisioning services (Vietnam National Workshop and Philippines National Workshop). This is consistent with calls for more studies on valuation of multiple ecosystem services, which is also capable of tracking site changes in value across different states of ecological disturbance (before and after scenarios) and gives consideration to how benefits are distributed across different stakeholders (Turner et al. 2003). This may contribute to draw attention to the need for new institutional arrangements to better realise benefit streams from multiple ecosystem use and non-use services for the coastal poor (see also section 10.1.6).

Pro-poor valuation of ecosystem services

The focus group discussions organised as part of this study showed that the coastal poor recognise and value a wide range of benefits from ecosystem services, with a focus on provisioning services. Construction of values is likely to be affected by institutional arrangements such as resource use regulations and markets mediating access to and benefits from ecosystem services as well as the cultural context (Vietnam Country Report:87; Philippines Country Report:64, SEA Report:38). It is necessary to improve our understanding of how the coastal poor value ecosystem services, particularly beyond provisioning services, how these values change across different occupational groups and over time, and how they feed back into management.

10.1.4 Ability to explain and predict trends and relationships

An important difficulty noted by the assessments is our limited ability to explain trends and relationships in complex social-ecological systems. This is partly influenced by the scale of the analysis and data used, a good example being the difficulty to explain the causes behind some of the trends identified in the global analysis (Global Report:41). This requires finding intermediate-scale forms of analysis capable of bridging smaller-scale analysis with wider scale ecosystem services analysis (Global Report:5). Also important is to further improve analyses that take into account multiple drivers of change.

Interaction between multiple drivers

Drivers of change interact across spatial and temporal scales and their cumulative and multiplying effects is not well understood (WIO Report:45). A specific knowledge gap identified for SE Asia is understanding the relationship between population growth and resource degradation, and its implications for poverty alleviation (SEA Report:39; Philippines Country Report:49).

Ecosystem health and flows

Assumptions are often made with regards to the state of the ecosystems upon which natural resource policies are based (e.g. fisheries strategy based on assumptions that large stocks of commercially valuable fish species exist and that they can be exploited by artisanal fishers equipped with improved fishing means in Mozambique). Ecological research into the flows of particular ecosystem services are lacking in some countries (e.g.Vietnam National Workshop).

There is a need to predict changes in ecosystem health and flows and the associated impacts on the communities that depend on the services provided by them. Research could help to determine the extent of the changes occurring, possible scenarios under increasing climate variability and change, the likelihood of irreversible changes beyond the capacity of natural systems and communities to adapt, acceptability of changes under different scenarios, and options for ameliorative measures (Vietnam National Workshop).

Where habitat loss has affected ecosystem services and subsequently impacted the communities dependent on them an investigation into the feasibility, costs and expected benefits of habitat restoration as a means to increase the flows of ecosystem services could be conducted. This research may be combined with pilot projects in selected areas to demonstrate the process and its benefits (Mozambique Focus Group 1).

10.1.5 Vulnerability, resilience and adaptive capacity

There is evidence of shifting patterns of dependence on ecosystem services and shifting vulnerabilities to change in ecosystem services, related, for example, with increased migration to coastal areas and cities, new sources of vulnerability such as those posed by climate change and conflict. Understanding these changing vulnerabilities is a key knowledge gap.

Reliance of the poor on ecosystem services

Quantitative information about the reliance of the poor on ecosystem services is generally missing from national statistics and poverty assessments. Measuring the reliance of the coastal poor on these services is needed in order to relate the availability of ecosystem services to poverty and to quantify the impact of changes in ecosystem services flows and access on the poor (Global Report:38)

Vulnerability of the poor to changes in coastal and marine ecosystem services

At the global level, development of targeted metrics is necessary to identify which nations are more vulnerable to changes in ecosystem services, including the extent of their adaptive capacity (Global Report:40). These need to be accompanied by studies at sub-national levels aimed at providing a more fine-grained understandings of how the poor deal with environmental change or changes in access to resources (SEA Report:47). Examples raised by the assessments include the case of fishers displaced by the establishment of MPAs (Philippines Focus Group 3) and the impacts of the growth in sea transportation (Philippines Focus Group 3), infrastructure projects (Philippines Focus Group 1) and coastal development (Tanzania National Workshop) on coastal communities.

Impacts of climate change on the coastal poor

Further understanding the linked ecological and socio-economic impacts of climate change on coastal and marine ecosystems and the poor is needed. This includes studies that examine resilience to climate change, especially the links between ecological and social resilience (Mozambique National Workshop:14; Philippines National Workshop:6; Tanzania National Workshop:11; Kenya National Workshop:9), and requires integrating perspectives from the natural and social sciences.

Resilience to environmental shocks and disasters

In countries prone to natural disasters such as floods and storms as well as man-made ones such as oil spills and pollution, the resilience of coastal communities and ecosystems to these events was identified as an important knowledge gap (Vietnam Country Report:50, WIO Report:36-37). This forms a separate area of research in-as-much as it deals specifically with catastrophic events with severe impacts on ecosystem and the poor, while climate change research deals with both more gradual and abrupt changes.

10.1.6 Linkages beyond the coastal zone

Coastal zones are linked with adjacent inland areas through river and sediment flows, pollution, human migration, trade and employment. Research is needed to identify and characterise these linkages and their influence on inland and coastal poverty.

Trade-offs between upstream and downstream ecosystem services uses and users

Inland users also have rights to ecosystem services and their actions have downstream impacts on coastal ecosystems and communities. How to manage the trade-offs between upstream and downstream resource users and users requires further investigation. Also important is to understand the role of coastal ecosystem services in supporting the well-being of the inland poor, for example though provision of fish or temporary work in tourism.

Migration and the coastal environment

Migration from inland to the coast and along coastal areas often forms an important part of the livelihood strategies of communities,. The factors that influence migration to the coast have received some attention, but its role in poverty alleviation is not clear. For example, is migration an option available to members of poorer households? The relationship between environmental change, in particular climate change, and migration also needs further research. Is migration in the context of climate change evidence of adaptation or failure to adapt? Equally important is to understand the role of migration in coping and adaptation strategies. In areas experiencing environmental degradation, why do some people move while others stay? Despite receiving increasing attention, the notion of environmental refugee requires further clarification. Scientifically sound estimates of the number of people displaced by environmental stresses and shocks as well as future projections are needed.

Interaction between terrestrial and marine-based livelihood activities

The coastal poor often depend on a combination of terrestrial and marine-based livelihood activities, but how these activities interact in terms of livelihood strategies and vulnerability of poor people are not well understood. For example, to what extent do changes in agricultural productivity due to drought lead to a greater reliance on marine resources? (Rodrigues Focus Group 1)

10.1.7 Governance and institutions

How ecosystems are governed is fundamental to the benefits that the poor can derive from ecosystem services. Decisions on ecosystem use are often not accountable to the poor, many of the benefits are captured by external groups and even when benefits are captured locally, they often fail to filter down to the poor. Several institutional arrangements with potential to facilitate a more equitable capture of benefits from ecosystem services and inclusion in decision making were cited in the regional reports and stakeholder consultations. Several knowledge gaps in relation to such arrangements and their contribution to poverty alleviation also emerged

Ecological and socio-economic impacts of MPAs

MPAs are considered one of the key policy options to protect and enhance marine ecosystem services but more research is needed about their ecological and socio-economic impacts. Ecological and resulting economic benefits from stock recovery and spill-over catches have been emphasised, but the evidence is still inconclusive and requires locally specific investigation (WIO Report:29).

The socio-economic impacts of MPAs deserve further examination. This includes how different groups are impacted, for example as a result of spatial and gear-based restrictions. The ability of households to absorb MPA impacts may also be different and may depend on various factors (i.e. assets, availability of alternatives, etc) all of which will affect their capacity to mitigate or offset negative impacts. Such studies can help to determine which households are more vulnerable to the changes in resource use and access introduced as part of MPAs.

Little is known about the distribution of economic benefits from MPAs beyond some anecdotal evidence. The extent to which the poor in coastal communities can or do benefit from potential spill-over catches and alternative livelihood activities is unclear. For example, there is little information regarding what proportion of the economic benefits generated by tourism supported by MPAs goes to the poor (Philippines Country Report:48; WIO Report:29; Mozambique National Workshop:13).

The factors that influence the behaviour, motivations and attitudes of coastal dwellers towards resource use and conservation rules and regulations are not well understood. This includes the factors that enable compliance with MPA and fisheries regulations (Philippines Country Report:48; WIO

Report:29; Tanzania National Workshop:12; Rodrigues Focus Group 4; Vietnam Focus Group 2) and under what conditions alternative livelihood options help to reduce fishing effort (Kenya National Workshop:9).

Critical examination of tourism as a way out of poverty for the coastal poor

Tourism is becoming an important sector in coastal areas of the developing world. The stakeholder consultations, in particular, identified the extent to which tourism benefits the poor as an important knowledge gap. For example, there were concerns about which modes of tourism offer greater chances to alleviate poverty; how do locally-run operations and employment through hotels map onto aspects of wellbeing and aspirations of poor people; and who benefits from the employment opportunities generated by tourism (Kenya Focus Group 1, Rodrigues Focus Group 4). This calls for studies of tourism revenues and leakage from the local area, employment generation and accessibility to the poor, and how the expansion of tourism impacts on the provision of other ecosystem services upon which the poor rely.

Successful co-management in various ecological and cultural settings

Co-management is a relevant policy option to manage ecosystem services for poverty alleviation. This approach has been tested with some success in SE Asia, particularly in the Philippines. However, it is only beginning to be implemented in the WIO. Mozambique stakeholder discussions identified a lack of understanding of factors associated with successful co-management. The more extensive experience of co-management in SE Asia can provide lessons for countries like Mozambique, but further research is needed to understand how cultural and other differences affect the transferability of approaches (several Mozambique Focus Groups; Mozambique National Workshop).

Managing ecosystems for multiple ecosystem services

More is known about the management of ecosystems for a single service, such as fisheries, than for provisioning of multiple ecosystem services. Managing complex ecosystems for multiple ecosystem services of importance for poverty alleviation requires more research (WIO Report:45). Currently there is uncertainty in the impact of management actions on ecosystems, how this in turn affects ecosystem services provision and there is a lack of political processes which allow trade-offs and conflicting interests to be balanced.

10.2 Capacity Constraints (what capacity is there to generate and apply knowledge?)

Institutional analyses were undertaken in Mozambique, Tanzania, Kenya, Vietnam and Philippines as part of this study. These were based on expert knowledge and therefore may be prone to certain biases and their findings should be taken as indicative only. They are not representative of the global situation or necessarily of their respective regions. However, they do provide more in-depth insights and add to the perspectives gathered from the national stakeholder workshops and literature. The analyses clearly demonstrate that countries have different capacities, capacity constraints and needs.

The analyses found that capacity for generating and applying scientific knowledge on issues relevant to ESPA already exists in the study countries, and in different sectors, including government, NGOs, academia and donors. In some cases, capacity is constrained by lack of personnel, training and financial resources to undertake research on ESPA-related issues and apply findings to policy and management. While these pose serious limitations, they are not always the main capacity constraint. Often, key constraints are related to weak prioritizing and mainstreaming of linking ecosystem services and poverty alleviation, unequal distribution of capacity among different sectors and organisational scales, and lack of coordination between institutions dealing with different aspects of ecosystem services and poverty alleviation.

There are institutions that span ecosystem services and poverty alleviation in all countries included in the analyses, both in research and practice. Institutions that span poverty and ecosystem services tend to be found in the fields of natural resource management and conservation, and include both government agencies and NGOs. Many are involved in ecosystem services activities and incorporate poverty aspects, but are not specifically focused on poverty alleviation. The link between ecosystem services and poverty is mainly in terms of supporting and diversifying resource-dependent livelihoods to relieve pressure on coastal ecosystems. The contrary is less common: fewer institutions concerned directly with poverty alleviation incorporate ecosystem services in their work. This indicates that ecosystem services are far from being mainstreamed into poverty alleviation strategies (WIO Report), which was one of the MA recommendations.

Capacity for research and practice on coastal and marine ecosystem services and poverty alleviation is often concentrated in NGOs. In Mozambique, for example, most of the efforts aimed at developing alternative livelihoods for communities affected by MPAs are undertaken by international NGOs with in-country offices and staff. In the Philippines, much of the capacity for promoting community-based management of marine resources is found in NGOs. However, NGOs tend to work on a small-scale, often on pilot activities and on a project basis. This is clearly important for innovation, but the ability of NGOs to scale-up successful experiences may be limited while their long-term commitment cannot be guaranteed. Moreover, NGOs may absolve government from certain tasks and responsibilities.

Government has important responsibilities with regards to promoting the sustainable management of ecosystem services for poverty alleviation. Most countries are endowed with appropriate government agencies to deal with ecosystem services and poverty alleviation. Some have initiatives at the national level towards poverty relief. However, coordination among government institutions and between them and other actors such as NGOs is often poor, which contributes to a fragmented approach. At times, coordination is hindered by rivalry between sectors, such as MPAs and fisheries development. There is also a disjunction between discourse and practice at different organisational scales. While senior officials in central government may be proficient at relating ecosystem services to poverty alleviation, this is not effectively translated into practice at lower scales of government, where technical capacity often lacks.

In some countries there is a high degree of dependence on consultancy for research informing policy and practice. This often occurs in the context of specific donor-funded projects (Mozambique Stakeholder Workshop:13). Resorting to consultancy often contributes to knowledge leaking out of the country and from the public to the private sector, and not being widely available and shared. In data-poor countries, knowledge is a valuable commodity that is monopolised by consultants and consultancy firms, both national and international. As a result, the knowledge generated with public and international development funds is often privatised. This problem is aggravated by poor long-term data management and archiving. After only a few years of having commissioned a report, some institutions no longer have copies of it. These issues apply particularly to Mozambique, where they were raised at the National Workshop.

Academia is well-positioned to undertake research on ecosystem services and poverty issues, but often has limited capacity to apply it. Its impact depends on the extent to which research is demand driven and feeds into policy and practice. In the Philippines, the University of the Philippines (UPV) and the Silliman University - Angelo King Centre for Resource and Environmental Management (SUAKREM) have extension and training programmes that contribute to translating research findings into science-based interventions. Similar direct links between research and practice were not reported in other countries. This is perhaps a model to adapt and replicate elsewhere. However, integrative research dealing with complex ecosystems, the range of services they provide and poverty alleviation in coastal and marine systems is still relatively rare. Despite the need for interdisciplinary science being amply recognised, there is still a high degree of segregation between natural and social sciences.

In some countries, while there is scientific capacity in academia to undertake research on ESPA-related issues, such capacity is often concentrated on a few university departments and scientists. Mozambique, for example, possesses only one leading university, the Eduardo Mondlane University (UEM) based in the capital Maputo. Its department of Biological Sciences offers training in marine ecology to masters' level and some of the research by staff and students is concerned with resource use. However, most is in the ecology of coastal and marine organisms. Several private universities have arisen in recent years, thus moderately expanding the higher education coverage. However, these do not generally have departments relevant to coastal and marine ecosystem services and focus mostly on teaching, with little capacity and resources for research. A long-term investment in capacity building in the specific case of Mozambique involves improving graduate and post-graduate training in coastal and marine ecosystem services and links to management, including resource use and poverty.

10.3 Knowledge management (how is available knowledge disseminated?)

The problems of limited knowledge are often compounded by inadequate systems to handle, archive and interpret important data, as well as to make it widely available to users. Available knowledge is often dispersed among different institutions, consultancy firms and individuals. In Mozambique, for example, the lack of an institution to centralise data and information relevant for ecosystem services

and poverty alleviation was identified as an important need in the National Workshop. The lack of adequate data management and archiving systems limits the identification of gaps and can result in duplication of research efforts since there is no clear picture of what research has been done in the country, and restricts the outreach of research efforts (Mozambique National Workshop:19).

Scientific research is often not sufficiently demand-driven, which limits its role in informing policy and management. Much of it is not explicitly designed to be relevant for policy or action (Kenya National Workshop:9). The balance between policy-relevant and other types of research needs to be carefully considered in a new research agenda. Clearly, research aiming to inform the management of coastal and marine ecosystem services for poverty alleviation needs to have a strong policy and management-relevant dimension. Action-research and other forms of participatory research seeking to involve users in defining research needs and questions, collecting and analysing data and using it to inform decision-making can play an important role in making research more demand-led.

The communication of research findings to potential users is another crucial aspect of the extent to which scientific knowledge is applied. Many research outputs are too technical for non-scientists (Philippines National Workshop) and often do not discuss the implications of findings for policy and management (Vietnam Country Report:84). Clear communication of research findings to users vastly improves the likelihood of results feeding into action. However, availability of relevant scientific knowledge in an accessible format does not always ensure it is used to inform decisions about natural resources.

Ability to interpret scientific knowledge and use it to inform policy and management also requires institutions being equipped with qualified human resources, which are lacking in many countries. In Mozambique, for example, the more remote district governments struggle to attract and retain graduates due to their isolation and lack of facilities. The supply of graduates is still small and most prefer to remain in the larger urban areas rather than to move to rural districts.

The contribution of different knowledge systems to promoting the sustainable management of ES for poverty alleviation is generally not maximised. Extensive local and indigenous knowledge on ecosystems and their management often exists, but in many countries it is not documented and/or routinely integrated in policies and projects (Philippines Country Report:49, 50; SEA Report: 38; Mozambique National Workshop:13. Indigenous knowledge on marine ecosystems has received even less attention from managers and researchers given the dominance of science-based management approaches, for example, in fisheries. Local and indigenous knowledge, however, also have some limitations related, for example, with the problem of ‘shifting environmental baselines’ (Bunce et al. 2008, Pauly 1995, see also Box 6.1). In addition, there ethical issues related to sensitive local knowledge, for example, related to the location of fishing grounds and spawning aggregations (Maurstad 2002).

10.4 Interface between science, policy and management (how is knowledge applied?)

Resource management decision-making is a political process in which power, incentives, values and interests of different stakeholders are weighed up in a (more or less transparent and accountable) process. The concerns of marginalised coastal poor people are inevitably liable to be poorly represented in such a process. Thus it is unsurprising that policy making and management is not routinely informed by research. This was highlighted in the Tanzania National Workshop as well as in the Vietnam country assessment. Decisions relating to natural resources are frequently based on political criteria rather than on scientific evidence and at worst on narrow vested economic interests. In Vietnam, this is partly related to lack of up-to-date and usable information. However, even high quality scientific research cannot provide the answers to political questions, and even if adequate information recommends the benefits of certain actions, political interests and economic limitations often take precedence over scientific evidence.

Scientific research can, in the presence of suitable governance structures, inform decision makers and stakeholders of likely impacts of actions and help to make trade-offs explicit and transparent. For example, targeted research could help to determine whether subsidies for artisanal fishers leads to resource exploitation and impacts on the ability of communities to dynamically adapt to changes in ecosystems (Rodrigues Focus Group 4). Social science studies of governance processes can also help to understand how knowledge is used and how governance processes can be improved to allow the application of available knowledge. Likewise studies highlighting the economic values of

ecosystem services – to the national economy and to specific economic sectors of social groups – can make a powerful argument to central government and treasuries about the need to invest in effective environmental management.

Decision-making more often than not involves trade-offs. While discipline-specific research may support a specific policy or action, it does not always identify trade-offs. For example, research suggests that rehabilitating fisheries in the Philippines requires reduction of fishing effort, however, unless accompanied by viable alternative livelihoods, this is unacceptable to fishers and will result in displacement and increased poverty (Philippines Country Report: 83) or will be politically impossible to implement. Improving the use of research by decision-makers, therefore, requires more explicit attention to be given to potential trade-offs, by incorporating disciplinary research into more holistic understandings. There are few examples of the types of decision-making frameworks which incorporate quantified and qualitative data from natural and social sciences in order to evaluate trade-offs and make informed choices based on that information, within the two regions studies. These frameworks are only just beginning to emerge and there is still much research to be done on this topic. Examples include the frameworks developed by WRI for watershed management (see Section 9.2) .

Finally the mainstreaming of concerns about Ecosystem Services, which was highlighted by the MA has not be implemented in any comprehensive way. The analysis of PRSPs in the WIO region (WIO Report pp32-33) highlights that whilst not all countries have completed the PRSP process, there is no uniform treatment of ecosystem services in PRSPs. Furthermore marine and coastal ecosystems services are especially poorly presented, so if these concerns are to be centralised within decision-making and development policy, and to compete for funding from governments, then their role in poverty alleviation and national wealth generation needs systematic analysis rather than lip service within formal development plans such as PRSPs**.**

11. Recommendations

11.1 Use and management of knowledge

A considerable body of knowledge relevant to the ESPA programme already exists in different resolutions, from global to local. Much of it was not generated within the conceptual framework of ecosystem services and human well-being, but can be interpreted in ways that inform the specific linkages between ecosystem services and poverty alleviation. The conceptual framework developed specifically for this study (Figure 2.1), provides an example of how existing evidence can be interrogated in order to illuminate those linkages. In this case, the framework was used to identify gaps in knowledge and capacity, but it can also be used to inform policy and action aiming to enhance the benefits from ecosystem services to poor people in coastal areas. This reflects and party addresses a concern that emerged in the stakeholder consultations, namely that better use must be made of existing knowledge. Some specific recommendations substantiated by the stakeholder consultations include:

- 'Democratizing' existing knowledge by making it available to those interested in using it. Options include creating **national resource centres**, which in addition to archiving data and building a widely accessible knowledge base, could also link with regional and international networks to source up-to-date information on issues that cut across national boundaries.

- Improving dissemination of research. Existing knowledge relevant and useful for decision makers dealing with ecosystem services and poverty needs to be better communicated and targeted to different audiences. This may involve **communicating research findings in non-technical language** and ensuring that decision makers know this information exists.

- Promoting a culture of knowledge and experience sharing across different institutions working on issues related to poverty and ecosystem services. **Interagency working groups** aimed at integrating ecosystem services and poverty alleviation perspectives in key sectors and policies **such as PRSPs** are one option.

- Integrating knowledge across scales and disciplines is needed to understand the influence of complex, interacting drivers operating at multiple-scales. This requires supporting the development **interdisciplinary research capacity and linkages between knowledge institutions** focussing on different scales.

- Provide incentives for knowledge transfer, archiving data and building local research capacity by **incorporating such requirements into research funding**.

11.2 Research

Knowledge gaps highlighted in section 10 suggest various priority research topics. These are listed below along with potential research questions.

Shifting vulnerabilities in a changing world

This Situational Analysis reveals a set of new stressors and shifting vulnerabilities as well as opportunities, which characterise the relationship between coastal and marine ecosystem services and the poverty and well-being of poor people who depend on them. These shifting vulnerabilities relate to where poor people live – for example increasing number of people concentrated in urban coastal areas in many countries and regions; how people construct their livelihoods – related to patterns of diversification and specialisation and movements in and out of fishing; processes of globalisation and changing access and exploitation, particularly penetration by global markets (e.g. aquaculture transforming coastline, and industrial fishing exploiting sea, each of which potentially puts poor people at risk); and global environmental change, particularly climate change. At present there exists most information on direct use of provisioning services by people who live within coastal and marine systems, however with rapidly changing contexts, information is needed on how other services associated with coastal and marine systems affect human well-being, particularly of the poor and most vulnerable, and how changing patterns of risk impact on the opportunities and ability to alleviate poverty. This includes for example, regulating services such as coastal protection and the exposure of slum dwellers; and changing cultural values associated with ecosystems as people move away from

subsistence to greater reliance on markets. The analysis here identifies the need for research to analyse the multiple stresses and changes in the sources of vulnerability on coastal and marine ecosystem services and the poor. Specific research questions and topics addressing this goal include:

- Where are the coastal poor and how are they characterised?
- Quantification and characterisation of shifting dependences on coastal and marine ecosystem services
- What is the impact of migration on coastal and marine ecosystem services and poverty?
- What is known about the possible impacts and responses to climate change in coastal areas and on coastal and marine social ecological systems?
- What do climate and demographic projections suggest for future pressures on ecosystem services and opportunities for ecosystem services to contribute to poverty alleviation?

This research might take a regional approach to analysing shifting vulnerabilities and opportunities, for example by modelling changes in population and its impacts. There should also be a specific focus on rapidly expanding urban and industrial coastal areas (it would be interesting to compare Africa and SE Asia in this regard). Furthermore an explicit recognition of climate change as providing new and profound hazards to poor people and coastal and marine ecosystem services is necessary. Research should link into regional and national adaptation strategies; inform disaster preparation, risk reduction strategies; and make links to global change science communities (for example through the Earth System Science Partnership, IGBP and IHDP programmes).

Research should be linked or require capacity building endeavours in integrated modelling and interdisciplinary analysis of impacts of multiple stressors, linkages between biophysical, ecological social and economic vulnerability. It should facilitate methodological innovations in devising new approaches to assessing vulnerability and resilience, and should support development of linkages between research and policy institutions across scales to match scales of new global stressors. It should also feed into efforts to strengthen national and regional capacities for data management and sharing.

New cost-effective means of monitoring changes and consolidating data are required; there are possibilities using information and communications technology including mobile phones at local scales. Applications for such technology are already being developed to rapidly collect and disseminate public health data in developing countries (e.g. www.datadyne.org) and could be explored for data on impacts to and changes in coastal ecosystems.

Linking environmental change across terrestrial, coastal and marine social-ecological systems

Many of the drivers of change within marine and coastal social-ecological systems lie outside the strict boundaries of the coastal zone and seascape. They concern global economic processes, markets and trade; economic policy and environmental governance; and land use and resource management in terrestrial systems. Therefore there is a critical need to understand the interactions between drivers and impacts of change across coastal, marine terrestrial and global systems in order to better devise and implement integrated policy and responses to support ecosystem services and poverty alleviation. Specific research questions identified:

- How does variability in terrestrial systems impact on the dependency of the poor on coastal and marine ecosystem services? For example how do increasing drought or flood risks affect movements in and out of fishing or the patterns of exploitation of ecosystem services?
- How can ‘whole island’ approaches (or ‘reef to ridge’) be implemented in SIDS? What are the key constraints and opportunities for integrated governance to support ecosystem services and poverty alleviation? How can this help the poor?
- How can watersheds be better managed to account for impacts on coastal and marine ecosystem services?
- How can small countries anticipate and respond to large-scale environmental and economic drivers? What is the role for early-warning systems – what is the technical capacity and needs and the effectiveness of different systems?

Priority locations for such research are, first, Bangladesh, a country which is subject to coastal processes and higher watershed processes (meltwater, floodwater etc.); secondly, Small Island Developing States as focus for ‘whole island’ and integrative approaches. Other research should be at

a watershed scale (to study examples of upstream/downstream impacts of agriculture and land use, hydrology and water management on coastal and marine ES and poor). Particular attention to shared watersheds e.g. South Africa / Mozambique, would enable the political, ecological, social and economic ramifications of these integrated approaches and multiple stressors to be analysed.

Research in this area could go hand-in-hand with capacity building in integrated assessments and modelling capacities. It could link with the research of IGBP LOICZ programme but with a greater focus on poverty (e.g. impacts of migration, triggered by global change). It could support the development of regional working groups on transboundary issues such as watersheds.

Expanding the benefits from ecosystem services for the poor

The Situational Analysis shows that poor people value provisioning services above other ecosystem services because provisioning services constitute a source of cash, and cash is what poor people value because it fulfils many needs. Although many claims are made about the opportunities to use Payments for Ecosystem Services (PES) schemes as a source of income for poor people, there is little evidence or records of successful PES initiatives in coastal areas of developing countries. There are many unsubstantiated assumptions about the nature of benefits of these kinds of payments; that they will change peoples' behaviour and values, or reduce vulnerability and increase resilience, but these are not backed by rigorous analysis or data. There are limited findings which indicate that poor people may benefit from community-based natural resource management of coastal and marine systems (for example Marine Protected Areas) but these seem to be context specific. There is a need to move beyond these limited models and explore more radical re-alignment of co-management and property rights regimes in favour of the poor, and to explore a broader set of ecosystem services rather than a concentration on provisioning services. Research is therefore necessary to provide timely and relevant information to increase the opportunities for coastal and marine ecosystem services to alleviate poverty by expanding the 'basket' of ecosystem services used. Specific topics identified include:

- What evidence exists to show that PES for coastal and marine ecosystem services provide benefits for the poor or constitute potential pathways out of poverty?
- How can markets add value to ecosystem services and enhance benefits for poor?
- How can property rights, institutions and rules of use and access be changed to enhance benefits of ecosystem services for poor?
- How do PES schemes change motivations, behaviours and other values of coastal and marine ecosystem services?
- What are the options for alternative livelihoods and economic benefits from ecosystem services beyond PES?
- How do diversification and specialisation strategies alleviate vulnerability and increase resilience of coastal poor?

There is scope to undertake this research across locations to distil country or regional lessons and comparisons. Research should concentrate in areas where ecosystem services are severely degraded. There are opportunities particularly to build research and practice linkages through action-research. This might require working with bridging or boundary institutions. There is also scope to institutionalise learning processes and to scale-up successful experiences. Once more, ESPA as a programme could be instrumental in promoting regional exchanges e.g. on co-management experiences in South East Asia.

Critical examination of tourism as a way out of poverty for coastal poor

Coastal tourism is increasing worldwide, and is often seen as providing a source of income for national economies and also as an alternative or complementary source of livelihood for the poor in developing countries. This Situational Analysis shows this to be the case in both regions studied; however it also exposes many of the trade-offs inherent in tourism development and the potential impacts on coastal and marine ecosystem services, and the ability of the poor to access and benefit from ecosystem services. In some cases, rapid, unplanned, or inappropriate tourism may increase vulnerability of ecosystem services and the poor. Furthermore given current global economic outlook, as well as increasing fuel prices, it seems possible that long-haul tourism may become more expensive and that the global rise in international tourism may slow, raising the question of how sustainable tourism is as

a development strategy. Research is necessary to substantiate or refute the claims and to provide a reality check on the opportunities and constraints of tourism to conserve ecosystem services and alleviate poverty and to identify strategies to ensure that the poor access benefits from tourism. In particular research should address the following questions:

- What aspects or types of tourism are good for ecosystem services and poverty alleviation?
- What are the sustainability and vulnerability implications of tourism development for ecosystem services and poverty alleviation?

Regional foci for this analysis would be eastern Africa; and small islands (Caribbean, South Pacific, SE Asia). There is also need for a global economic analysis of impacts of recession and fuel price rises, and potential greater taxation on air travel, on tourism numbers and destinations. In addition an assessment of the growth and potential impacts of regional and domestic tourism (e.g. within SE Asia, or between South Africa and Mozambique) is recommended. Findings from this research should provide data direct to economic planning and tourism development units within governments. Findings should also be disseminated to networks of small-scale tourism stakeholders to help marginalised communities to access resources they need to benefit from tourism. Research could also help to build awareness of national tourism agencies and could actively engage the private sector through critical reflection, and activities such as scenario building workshops.

Exploring opportunities to increase the flow of ecosystem services to the poor

Provisioning services
Poor people focus on and prioritise provisioning services from marine and coastal systems as they are a crucial source of food and income in the short term. In particular the production of fish and other harvestable organisms was highlighted as a key provisioning service in all assessments. To contribute to poverty alleviation, the benefits of these ecosystem services would need to be increased, in order to improve the livelihoods of increasing coastal populations. In many countries there is still a policy rhetoric of increasing production of fisheries and aquaculture, but it is often unclear whether the flow of this ecosystem services can be sustainably increased, It is also hard to know whether benefits would be captured by local elites, or whether such developments would improve the wellbeing of the poorest. Research is necessary to provide guidance on a case by case basis on whether options exist to increase either the flows or benefits to poor people from coastal provisioning ecosystem services. For example:

What is the potential for increasing flows or benefits through:
- expansion or intensification of fisheries including exploiting offshore resources
- development of aquaculture
- more conservative management of marine resources (including MPAs)?
- improved market access
- adding value to marine products

An assessment of each identified option in terms of:
a) sustainability in the face of global and regional change
b) trade-offs with other ecosystem services (for example aquaculture trading off with ecosystem services from intact mangrove stands)
c) accessibility to and ease of adoption by the poor
d) impacts on holistic wellbeing (e.g. income may be increased by industrialisation of a fishery but at the expense of clean environment and social capital associated with more traditional uses)

Such assessments could be conducted at coastal sites in a range of conditions to provide learnings applicable to different situations.

The assessments could provide direct recommendations for each study site as to whether increasing the flows or benefits from provisioning services is a realistic goal, or if poverty alleviation strategies must rely on alternative resources (i.e. decoupling livelihoods from coastal ecosystems). They could also bring together a set of illustrative cases for the study sites which policy makers and stakeholders in other regions can use to assess options. Such assessments could build capacity in a number of ways, including increased awareness amongst national policy makers of the trade-offs involved in development strategies, and increased capacity (through collaborative involvement in the programme) of local researchers and agencies to assess the feasibility and social impacts of development options.

Regulating services
The coastal poor indirectly rely on supporting and regulating services to decrease their vulnerability. Important processes determine the coastal protection service. Barbier et al (2008), for example highlight the production function of coastal protection from mangroves is not linear with the area of habitat, while Aburto-Oropeza et al. (2008) found that supporting services to fisheries appears to be related to the length of mangrove fringe rather than area. Research is therefore needed to suggest how the coastal zone should be managed in order to optimise the provision of ES without compromising the resilience of the system. What level of loss of ecosystems is feasible or acceptable and therefore what are the minimum standards of ecosystem protection required to maintain the ecosystem services that the poor rely on to survive future impacts and shocks resulting from climate change?

11.3 Capacity and Training

There is considerable value in undertaking more comprehensive institutional analyses as part of a future ESPA programme in order to better target capacity building investments for long-term impacts. Mapping and assessing capacity could help to identify 1) what capacity exists and where (in which sectors and institutions); 2) where is it lacking and most needed; 3) and which measures could best build capacity for the sustainable management of ecosystem services for poverty alleviation.

General measures to build research capacity include:

- Encourage regional as well as international collaborations to address challenges to the management of ecosystem services for poverty alleviation that cut across national boundaries. Regional collaborations are particularly important on shared watersheds and downstream impacts, and trans-frontier marine conservation and resource use.

- Support interdisciplinary research to enhance the understanding of complex social-ecological systems in a rapidly changing world. Options include developing research tools that integrate perspectives from the social and natural sciences and supporting initiatives that provide opportunities for interdisciplinary learning such as projects, networks, working groups, etc. Learning from experience of existing programmes, e.g. RELU would be especially valuable.

- Post-graduate training in ecosystem services and human well-being, including funding for training graduates from developing countries at the Masters and PhD level in ESPA-funded projects. This would make a significant contribution to developing research and technical capacity to integrate ecosystem services and poverty alleviation. There exist inter-disciplinary research groups in UK and Europe which have considerable experience and expertise in integrated analysis and modelling e.g. Tyndall Centre,

- Documenting successful and unsuccessful experiences where ecosystem services have been explicitly used for alleviating poverty in coastal zones and collating experiences through regional for a (e.g. WIOMSA)

- Link academic research and practice through training and extension on fisheries, aquaculture, habitat restoration, etc is an option that can be explored as a means to improve the impact of research on practice.

12. Conclusions

In undertaking a review of existing information and in consulting with stakeholders in the two regions, this Situational Analysis has assessed the state of knowledge and the capacity needs for research into ecosystem services and poverty alleviation. It has focused on interrogating the linkages between ecosystem services and poverty alleviation, and has been guided by a simple conceptual framework. The assessment therefore concludes by referring back to the four linkages identified and summarising the existing knowledge and capacity, and the urgent research needs in these four areas.

Poverty alleviation and the flows of ecosystem services

Although a wealth of information exists on ecosystem services of marine and coastal ecosystems, it is biased towards provisioning services and overwhelmingly to commercial fisheries. Far less information exists about supporting, regulating and cultural services. In particular there are difficulties in understanding the linkages and overlaps between different ecosystem services, and the pros and cons of 'bundling' ecosystem services rather than attempting to separate them, and the possibility of 'double' counting. Thus there still a tendency to assume that an ecosystem services approach is analogous to resource accounting or biodiversity assessment. The concepts and implied methods of assessing ecosystem services are still not broadly adopted or universally understood. Similarly, much data exist concerning poverty – its measurement, characterisation, distribution and causes, but there is no universally agreed approach to analysis. In particular, at an international level no dataset provides disaggregated data on coastal poverty.

For the purposes of the ESPA programme and this situational analysis, there is relatively scarce analysis which directly links ecosystem services and their role in poverty alleviation. There is information on the range of marine and coastal ecosystem services but these are not related directly to the poor nor to the process of poverty alleviation. Implicitly assumptions are made in the literature (for example, that poorer people are more directly dependent on ecosystem services than wealthier) but few studies provide concrete evidence and substantiation. Often studies provide very context specific findings which are not transferable.

The literature often assumes that increasing the flow of ecosystem services will help to alleviate poverty, but our discussion highlights the potential trade-offs in this approach with respect of fisheries and to marine conservation. In many cases the key issue in poverty alleviation is overcoming the obstacles to access by the poor to a range of ecosystem services.

Capacity of poor to benefit from ecosystem services

This analysis shows how access to ecosystem services is mediated by a range of societal factors, and is not merely a product of scarcity or abundance of a resource. Property rights, formal and informal institutions, markets, technology, conservation initiatives, all determine how people can physically access and materially or otherwise directly or indirectly benefit from coastal and marine ecosystem services. The analysis shows how the poor are systematically excluded and how a range of social characteristics – not just poverty, but factors such as gender, migration, health status, age, occupation, location interact to affect who, where and how they can benefit from ecosystem services. Some of these factors are related of course, and the same processes which make people poor may also undermine their ability to use and benefit from ecosystem services, but it is important to understand the multiple and interacting processes and factors which make people dependent on ecosystem services and vulnerable to change in ecosystem services. The analysis of vulnerability at different scales illustrates the patterns of vulnerability across the global and within and between regions, countries and communities. It highlights that adaptive capacity is differentiated across scales and is a key determinant of societal resilience to short-term and long term changes and shocks.

Understanding poor peoples' perspectives on ecosystem services

Poor people value provisioning services above all others; this message emerges from the existing literature but was strongly articulated in focus groups conducted as part of the situational analysis. Provisioning services provide people with a range of benefits, but most importantly, with cash income. People recognise change in the flows of ecosystem services and in the health of coastal and marine

ecosystems, but are often not able to affect the changes, because the important drivers of change are beyond their control. In each context they gave voice to anxieties about the status of ecosystems and resources, and the continued flow of ecosystem services, but also to feelings of disempowerment and that the wealthier are able to enjoy disproportionate benefits from ecosystem services. Indications are that the poor have and continue to bear the costs of ecosystem degradation and loss of ecosystem services.

Feedbacks

The analysis looked for examples of where vicious circles of ecosystem degradation and loss of ecosystem services have been turned into virtuous circles of poverty alleviation and environmental conservation. They are relatively few and far between. Despite a very positive outlook in the literature, MPAs are not without costs, often at the expense of poor and dependent communities. There is great scope for learning from experiences of MPAs across the regions we studied, as different models of collaborative, co-management have been applied in different contexts and with quite different results. Payments for ecosystem services are also being hailed as a potential means of turning the vicious circle into a virtuous one, but to date few examples of implementation for coastal and marine ecosystem are documented. However, the structural problems which marginalise from the benefits of ecosystem services need to be addressed unless PES further exacerbate these problems. In most cases there are trade-offs in each potential intervention and innovation and these must be carefully weighed up to ensure that the poor are not to bear disproportionate costs.

Closing remarks

Although much information and data already exist, they are not brought together in useful forms to address the fundamental issue at the heart of ESPA programme and at the focus of this analysis; ecosystem services and poverty alleviation and the extent to which ecosystem services can feasibly contribute to lifting people out of poverty around the world. There are mis-matches in how data are collected, the resolutions and scales of analysis, and in the knowledge domains and institutions in which they exist. There is also a need for new focus research which works across disciplines, institutions, and regions and explicitly links social and ecological analysis of ecosystem and diverse forms of poverty in dynamic ways.

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