Chapter 55. Overall Value of the Oceans to Humans

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1. Introduction

The ocean provides countless ecosystem services. The Millennium Ecosystem Assessment describes ecosystem services as "the benefits people obtain from ecosystems" (MEA, 2005). Some of the ecosystem services from the ocean are delivered without human intervention – though they can be affected or disrupted by such intervention. Examples of these are the regulating and supporting ecosystem services (as described in Chapter 3), such as distribution of heat around the planet, the functioning of the hydrological cycle and the absorption of carbon dioxide as part of the carbon cycle. Other ecosystem services are obtained as a result of human activity to acquire the benefits. Most of these are provisioning ecosystem services (as also described in Chapter 3). The obvious example of such acquired ecosystem services is the food provided by capture fisheries, where humans take from the ocean significant amounts of the protein required for human diets. As demonstrated in Part IV and Part V and in Chapter 54, if the human activities are not carefully managed to maintain ecosystem structure and function, the acquisition of such ecosystem services can result in damage to the marine environment and reduction or loss of ecosystem services. Important issues arise for the institutions of ocean governance at global, regional, national and local levels in balancing the benefits of acquiring these services against the disbenefits (referred to by some as detriments) caused by over-exploitation and in preventing or mitigating those disbenefits.

Very different aspects of the concept of value are brought into play by these different kinds of ecosystem services. For most of the ecosystem services obtained from the ocean by human effort, there are global or local markets for the products obtained. Market valuations are therefore possible, although in some cases questions arise whether such a market value captures all the facets of the value to humans. For example, the value of fish in the sea in maintaining biodiversity and ecosystem functions may be more than the market value of the fish if they were caught and sold for consumption. Or, on a lesser scale, the value of their activities to recreational sea anglers may well be more than the market value of the fish (if any) that they catch. For ecosystem services that do not involve human effort to benefit from them, there is no market, and it is a question of producing a valuation in other ways. It is also important to remember that any discussion of value has to take into account the question of who is benefiting (or suffering the disbenefits) – even where they are unaware of what they are benefiting (or suffering).

A further category of ecosystem services of importance to humans are the aesthetic, cultural, religious and spiritual ecosystem services ("cultural ecosystem services" for short). Some of these (such as cultural objects and marine plants and animals that

have cultural significance) are on much the same footing as the other material that humans take from the sea, and may well have market value (see Chapter 8). However, even marketed objects of cultural significance have an added dimension that may well not be captured by the market. This is particularly the case where the cultural value lies in communal self-identification through sharing in the activity that wins the cultural objects (such as communal whale-hunting in the North-East Pacific or the Faeroe Islands). Other cultural ecosystem services stand outside any market: for example, the cultural/religious values that are obtained by having access to the sea during rituals, through the existence of special, sacred places, the cultural values that lie in the enjoyment of the seascape or watching the beauty of seabirds, marine mammals or corals and the knowledge that comes from underwater cultural heritage.

2. Quantification

To mention value is almost inevitably to raise the issue of quantification: comparing values and assessing trade-offs require some idea of the relative sizes of what is being compared. There are many ways of measuring the benefit that humans derive from ecosystem services from the marine environment. "Consuming an ecosystem service" can cover all facets of deriving benefit from some aspect or aspects of the marine environment. It can, for example, include the way that, in some countries, houses enjoying a view of the sea can command higher prices than identical houses without such a view. It is not therefore easy to delimit the scope of what are the values that need to be taken into account. This is particularly the case with cultural values.

Looking only at economic valuations of the marine environment, one library among many contains nearly a thousand such valuations, with nearly twice as many valuation estimates (MESP 2014). And economic valuations are not the only forms of valuation that can be made: social and ecological metrics can be equally significant, without necessarily being reduced to a single economic balance-sheet. Among the metrics that can be important for many different groups of stakeholders are:

(a) The net economic value (for example, the net economic benefits that those who enjoy an ecosystem service derive from it (consumer surplus), or the economic value that those who use some component of the marine environment derive from it (producer surplus). This kind of metric can be valuable when the economic services enter directly into commerce;

(b) The gross and net revenues in monetary terms that are gained by those who enjoy an ecosystem service, or use some component of the marine environment. Such metrics focus on the cash flows related to the ecosystem service, and can sometimes be more readily derived as a measure of changes in the enjoyment of an ecosystem service. This kind of metric can be valuable in many contexts of ecosystem services,

including those where non-monetary valuation approaches are necessary;

(c) Measures of the numbers of those employed in a human activity and the rewards (in kind or in cash) that they gain. This kind of metric can be valuable when considering livelihoods outside the monetary economy, as well as when labour is engaged for wages;

(d) Numbers of people benefiting from specific forms of ecosystem service, such as coast protection, recreational use of beaches, eating food from the sea or enjoyment of watching wildlife. This kind of metric can be useful in considering the extent to which different groups benefit from the ecosystem service, since it will avoid building differences in economic circumstances between the groups into the valuation;

(e) Direct measurements of the environmental situation (for example, area covered by mangroves, proportion of coral reefs that are in good condition, lengths of beaches with low levels of marine debris, proportion of dead seabirds contaminated with oil). This kind of metric can be useful when considering values where some of the areas are not (or only sparsely) inhabited, and the value lies in the areas' contributions to some other metric of overall global or regional value.

Considering only economic valuations, there are a wide range of techniques that can be used. Table 1 sets out some of the main approaches that can be used.

Table 1. Some economic valuation methods, typical applications, examples, and limitations

VALUATION METHOD	**APPROACH**	**TYPICAL APPLICATIONS**	**EXAMPLES**	**LIMITATIONS** **Some of these may apply to more than one method**
Methods using issue-specific data				
Market price	Observe market prices and volumes of trade to analyze the economic activity generated by use of an ecosystem good or service. (Includes economic impact analysis, which examines the impacts of spending related to the good or service, and can also include indirect impacts in related economic sectors, as well as financial analysis, where operating costs	Coastal goods and services that are traded on markets	Fisheries, tourism, mangrove timber	Market prices can be distorted (for example, by subsidies). Additional data is required to estimate net value added. Under conditions of unsustainable use the value in trade may be higher than the value the ecosystem can provide sustainably. Many ecosystem services are not traded in markets.

VALUATION METHOD	APPROACH	TYPICAL APPLICATIONS	EXAMPLES	LIMITATIONS Some of these may apply to more than one method
	are subtracted.)			
Replacement cost	Estimate cost of replacing ecosystem service with man-made service. Requires three conditions be met to be valid: (1) man-made equivalent provides the same level of ecosystem service; (2) man-made equivalent is the least-cost option of providing the service; (3) people would be willing to incur the cost rather than forgo the service.	Ecosystem services that have a man-made equivalent that provides similar benefits	Shoreline protection by reefs and mangroves; water filtration by forests and wetlands	Estimates might not reflect the true value of ecosystem goods and services. The method only seeks equivalence for the subset of services being costed. The co-benefits of other services provided by the ocean feature of concern are not considered. For example, a seawall might effectively protect the shore, but does not provide fish habitat in the way a healthy coral reef does.
Cost of avoided damage	Estimate damage avoided (e.g., from hurricanes or floods) due to ecosystem service	Ecosystem services that provide protection to houses, infrastructure or other assets	Shoreline protection by reefs and mangroves	Difficult to relate damage levels to ecosystem quality.
Production function	Estimate value of ecosystem service as input in production of marketed good	Ecosystem services that provide an input in the production of a marketed good	Commercial fisheries	Technically difficult to determine and model the relationship between ecosystem change and its impact on the provision of the ecosystem service. High data requirements.
Hedonic pricing	Estimate influence of environmental characteristics on	Environmental characteristics that vary across	Tourism, shoreline protection	It is possible to value individual units, but much more difficult to

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	price of marketed goods	goods (for example, houses or hotels with a sea view compared with those that do not)		generalize from this to broader coverage.
Travel cost	Travel costs people are prepared to incur to access a resource indicate a minimum value	Recreation sites (for example, some marine protected areas)	Tourism	Technically difficult. High data requirements.
Contingent valuation	Ask survey respondents directly for willingness to pay for ecosystem service	Any ecosystem service (most widely used for non-market ecosystem and services)	Tourism	Expensive to implement because of survey costs. Vulnerable to many sources of bias and requires careful survey design.
Choice modelling	Ask survey respondents to trade off ecosystem services to elicit their willingness to pay	Any ecosystem service (most widely used for non-market ecosystem and services)	Tourism	Expensive to implement because of survey costs. Vulnerable to many sources of bias and requires careful survey design.
Methods using data not specific to the particular issue				
Benefits transfer	Value transfer: Use values estimated at other locations ("study sites") Function transfer: Use a value function estimated at another location to predict values	Any ecosystem service	Any ecosystem service	Relies on judgements of what other locations are sufficiently similar. Possible transfer errors if the "study sites" and "policy site" are different.
Meta-analysis	Synthesize results from multiple existing valuation studies, using mathematical methods to estimate a value function. Meta-analysis can be used for benefits transfer.	Any ecosystem service	Any ecosystem service	Requires compilation of multiple studies and power depends on sample size of value estimates. Adequacy of studies may vary. Can lead to a loss of important valuation information during data aggregation process

Source: adapted from Waite et al, 2014.

Although such economic valuation methods have been used to varying degrees, and several of them widely and with considerable success, in many cases the results do not achieve general acceptance as a significant factor to be taken into account. The reasons for lack of acceptance can include that:

(a) Decision-makers do not consider that the decision should turn on purely economic factors. They may wish to apply some overriding principle, such as national security or some other long-term goal, which they regard as incommensurable with economic factors;

(b) The techniques may not manage to give an economic value to some policy or other concerns of the decision-makers or of the society involved that is sufficient to carry conviction that a valid value has been calculated;

(c) The margins of error in the techniques are such that the meaning of the results is unclear to users;

(d) The potential users distrust the reliability of the method of valuation. This can sometimes be because the method has not been adequately explained;

(e) The decision-makers may not have an adequate understanding of the techniques or access to the necessary skills.

Furthermore, most of these techniques require detailed data, which in many cases does not exist for them to be applied. However, where they have been applied at local, national and sometimes regional level, the results are interesting, and can be used for a number of purposes.

3. Value of non-marketed ecosystem services

Looking at the ecosystem services that are delivered without human intervention, there are major problems in trying to place a value on them, especially in monetary terms. Some of these ecosystem services (such as the transfer of heat from the equatorial regions towards the poles) are such fundamental and inherent features of the way in which the whole planet operates that it is not possible to imagine the planet without this type of ecosystem service. It is not possible to conceive of the earth with its present populations of plants and animals (including humans) without the ocean. Without the ocean and therefore without the ecosystem services that it provides, the planet would be totally different. We cannot therefore consider scenarios with and without one of these non-marketed ecosystem services, and use the difference between the two scenarios to isolate an absolute value (whether in monetary terms or in some other form) of the benefits conferred by that ecosystem service.

Nevertheless, changes in the way in which the planetary ecosystem services operate can be measured, since it is possible to compare two different situations. The

consequences of those changes can be seen to be massive. A good example of this is the El Niño Southern Oscillation (ENSO). This name refers to the way in which the ocean system of the tropical and subtropical Pacific can, in some years, produce a significant warming of the sea off the western coast of North and South America, often greatest off Peru, in the middle of the southern hemisphere summer. The coastal water temperature difference between one year and another, measured on the same day at the same hour, can be as much as 10º Celsius (Glantz, 2001). This produces major changes in weather across not only South and North America (with major increases in rainfall or other changes in Brazil, Peru, and the United States of America, for example), but also in Australia, India, Indonesia, the Philippines, and parts of Africa (see Chapter 5). There are only limited economic studies of the global effects of the variations brought about by the ENSO. Nevertheless, one study concluded that, over the period 1963-1997, the ENSO cycle can explain about 10-20 per cent of the variation in the growth in gross domestic product of the world's seven largest economies and about 20 per cent of real commodity-price movements (Brunner, 2002). A more recent modelling exercise, looking at the period 1979-2013, concluded that Australia, Chile, Indonesia, India, Japan, New Zealand and South Africa faced short-lived falls in economic activity following an El Niño shock, but that the United States may have benefitted from such events (Cashin et al., 2014). The conclusion on the situation in the United States is illuminated by an analysis of the severe El Niño event of 1998/1999. This analysis estimated that, compared with an average year, the 1998/1999 El Niño event led to costs of 4,000 million United States dollars for the United States; however, there were offsetting savings of 19,000 million dollars (in lower expenditure on natural gas and heating oil, increased economic activity, lack of spring flood damages and savings in highway-based and airline transportation) (Changon, 1999). Elsewhere, of course, the costs outweighed the savings. Such estimates of the economic implications of changes in the behaviour of the ocean are, of course, capable of generating endless discussion, but they serve to give an idea of the orders of magnitude of the costs and benefits that such changes can cause. In Part III of this assessment, likely and potential changes in the delivery of non-marketed ecosystem services from the ocean are noted. Such changes would be accompanied by massive economic consequences, but the data to develop sound economic valuations have not yet been assembled.

The distribution of those economic consequences around the globe is likely to follow the distribution of the changes, but it is clear that some of that distribution will have very different effects in different situations. Some States are at risk of finding much, if not all, of their territory lost to the sea as a result of sea-level rise. Elsewhere, some island and coastal communities risk suffering a similar fate, but impacts would be more local – although with consequences (such as population movements) possible far beyond the coastal sites potentially inundated. Where it is possible to safeguard against such losses by improved sea defences, the cost implications can be regarded as the cost of such improvements. Where the whole territory is lost, different considerations of value come into play. Where sites of cultural significance are lost, another dimension is added to the problem. In addition, of course, the capacities to address the costs are not distributed equally around the world.

It has not proved possible to come to conclusions on one important aspect of assessing the marine environment: a quantitative picture of the levels of many of the non-marketed ecosystem services provided by the ocean. There is simply insufficient quantitative information to allow an assessment of the way in which different regions of the globe benefit from these. Nor do current data-collection programmes appear to make robust regional assessments of ocean ecosystem services likely in the near future, especially for the less developed parts of the planet. Calculations can be made on the basis of sweeping assumptions, which allow estimates to be produced, but the assessment would then be an assessment of the assumptions, and not of the situation that is actually present. This is not to say that some valuations cannot be made at a local level where adequate data is available. Such local valuations can be valuable in assessing the marginal trade-offs between options for action in relation to the management of human activities.

4. Value of cultural ecosystem services

If it is difficult to approach the physical value of non-marketed ecosystem services, it is even more difficult to do so in respect of the cultural aspects of ecosystem services. We may be able to rank some cultural ecosystem services in terms of their importance for the cultures that they support. For isolated aspects such as a particular view of a seascape, it may even be possible to produce a monetary valuation, using one of the methods described in Table 5.1. But the more an aspect of an ecosystem services is embedded in a culture, and the more fundamental that aspect is to the culture, the less that kind of approach can work. Putting an explicit value of any kind on a whole cultural system is impossible, since it would involve value judgements for which there is no recognized system. However, the world may sometimes make implicit valuations of such cultural ecosystem services when it allows a cultural ecosystem service to be downgraded or lost as a result of pursuing some other objective.

5. Value of market-related ecosystem services

The discussions in Parts III, IV and V of the various ecosystem services from the marine environment that are linked to markets contain estimates of the values that can be linked to them. It is not, however, sensible to try to compile such estimates to give an overall picture. There are several reasons for this conclusion.

First, there are the problems of the quality of the estimates. If one takes the example of capture fisheries, it appears from Part IV that there is probably under-reporting, including of the scale of activities of small-scale fisheries. Such under-reporting is bound to distort any attempt to bring together estimates of the value of the different fisheries. Moreover, the “value” of fisheries must be viewed through multiple lenses. Estimates suggest that small-scale fisheries contribute about half of global fish catches, and large-scale fisheries the other half. When considering

market-price, production-function or even hedonic-pricing valuations, the revenues generated through commerce would indicate large scale fisheries have much higher "value". However, when considering the provision of livelihoods, nutrition and food security to low income, food-deficit parts of the world, then the value of catches contributed by small-scale fishers increases greatly, on account of the importance of affordable fish and employment to populations in developing countries. Any single method of valuation would fail to communicate crucial information about each type of fishery. Even if a view is taken through a single lens – using a single one of these valuation methods – the uncertainty about the statistics in this field mean that overall estimates of the economic value of fisheries, and of the number of people working in them, are not sufficiently well-founded to compare with the figures for, say, seafarers, where much more comprehensive reporting is available.

Second, there are problems of definition. A good example of this is the tourism industries. Estimates exist of the number of people employed in tourism and of the contributions of tourism to Gross Domestic Product, both directly and indirectly (see Chapter 27). At present, however, there is considerable doubt about how consistently definitions are applied to the tourist industries in deriving the data on which those estimates are based (for example, how far back up supply chains the effects are estimated). There is further difficulty in deciding what parts of the values that can be attributed to "tourism" are related to the ocean and coasts directly. Most reports of tourism revenues do not differentiate revenues from tourism directly related to maritime areas from inland tourism. Even where tourism in the coastal zone can be separated from that inland, it may be generated by the direct attractions of the sea and coast (with tourists engaging in ocean-based activities), it may be indirectly linked, (with tourists visiting coastal cities or sites for cultural or historical features that are present because of the links between the places to the sea), or it may not be linked to the sea at all (for example, if a casino simply happens to be at the seaside). Consequently, the value of ocean-related tourism is a matter of inference. Therefore, there are major issues on how far it is appropriate to analyse or aggregate information within this field, or indeed other fields, and how to bring that information together with information from other fields.

Third, there are problems of the availability of data. Tourism is again an example here. For example, the involvement of international companies in the trade gives rise to uncertainty about the levels of value generated in particular areas (see Chapter 27). Shipping is another field where the lack of information is significant. International shipping is the foundation of most global trade. Without it, much economic activity would cease. Some information can be gathered on the earnings of those employed in the industry, and revenues earned in some parts of the world. However, information is not readily available on the overall earnings of the industry, and therefore its share in the world economy (see Chapter 17), nor on the distribution around the globe of direct revenues, profits, and increases in value of trade goods because ocean-based trade is available.

Nevertheless, some States are making efforts to put values on the benefits created from the ocean areas under their jurisdiction. For example, the United Kingdom published in 2010 a first attempt to put monetary values on a range of activities taking place in its waters. The activities covered were offshore oil and gas, maritime

transport, telecommunications cables, leisure and recreation, military defence, fisheries, aquaculture, water abstraction, mineral extraction, renewable energy, coastal defence, waste disposal, education, power transmission and storage of gases. For most of these, an estimate was made of the gross value added, but for some it was only possible to estimate the money being invested in the process. The detailed workings of this exercise show the amount of effort needed to achieve even approximate values (DEFRA, 2010).

6. Global distribution

Some observations can, nevertheless, be made about the way in which the values of some of the market-related ecosystem services provided by the ocean are distributed around the world.

6.1 Fish and seafood consumption

Annual per capita consumption of fishery products has grown steadily in developing regions (from 5.2 kg in 1961 to 17.0 kg in 2009) and in low-income food-deficit countries (from 4.9 kg in 1961 to 10.1 kg in 2009) (see Chapters 10 and 11). This total consumption is still considerably lower than in more developed regions, although the gap is narrowing. A sizeable share of fish consumed in developed countries consists of imports, and, owing to a steady demand and declining domestic fishery production (down 10 percent in the period 2000–2010) (see Chapters 10 and 11), their dependence on imports, in particular from developing countries, is projected to grow. Studies have shown that the selling or trading of even a portion of their catch represents as much as a third of the total income of subsistence fishers in some low income countries. Thus an increase in imports of fish by more developed countries from less developed countries has the potential simultaneously to increase wealth in low income communities and to increase inequities in food security and nutrition, unless these considerations are taken into account in global trade arrangements (see Part IV).

Over time, there has been a striking shift in the operation and location of capture fisheries. In the 1950s, capture fisheries were largely undertaken by developed fishing States, and their activities were largely in fishing grounds in the North Atlantic and North Pacific. Since then, developing countries have increased their share, and the distant water fleets of developed countries range further in the sea. It is illuminating to compare the Northern and Southern Hemispheres. Although the two hemispheres do not precisely reflect developed as compared with developing fishing States, the figures are, nonetheless, indicative. In the 1950s, the Southern Hemisphere accounted for no more than 8 per cent of the landed market value of fish. By the 2000s, the Southern Hemisphere's share had risen to 20 per cent (see Part IV).

6.2 Maritime transport

All sectors of maritime transport (cargo trades, passenger and vehicle ferries and cruise ships) are growing in line with the world economy. According to estimates by the United Nations Conference on Trade and Development (UNCTAD), owners from five countries (Greece, Japan, China, Germany and the Republic of Korea) together accounted for 53 per cent of the world tonnage in 2013. Among the top 35 ship-owning countries and territories, 17 are in Asia, 14 in Europe, and 4 in the Americas. It seems likely that profits and losses are broadly proportional to ownership (see Chapter 17).

6.3 Offshore energy businesses

Offshore oil production is predominantly in the Gulf of Mexico (about 60 per cent of the industry is located in the Gulf of Mexico) and the North Sea. The industry accounts for about 1.5 per cent of the United States GDP, 3.5 per cent of the United Kingdom's GDP, 21 per cent of Norway's GDP and 35 per cent of Nigeria's GDP. The large majority of offshore hydrocarbon production is in the hands of international corporations or national companies (often working in partnership with the international companies). This makes the tracking of the distribution of benefits from this sector, other than direct employment in extraction and processing, very difficult (see Chapter 21). Offshore renewable energy production is very much in its infancy, and it will be some time before a clear picture of what will be the long-term future of the industry emerges (see Chapter 22).

6.4 Developments in offshore mining

There is limited information about the value of the offshore mining industry or the number of people employed, but it is unlikely to be significant in comparison to terrestrial mining. For example, in the United Kingdom, which is the world's largest producer of marine aggregates, the industry directly employs approximately 400 people. There seems little doubt that there will eventually be substantial expansion of offshore mining as terrestrial mineral deposits are worked out. In some cases (for example, diamond and tin mining), major international undertakings are involved. In the remaining cases, most offshore mining is within exclusive economic zones (and, indeed, generally close to the shore), and undertaken by relatively local enterprises. Mining in the Area (seabed, ocean floor and subsoil thereof) will be subject to a decision of the International Seabed Authority (see Chapter 23).

6.5 Tourism

Tourism has generally been increasing fairly steadily for the last 40 years (with occasional set-backs or slowing down in times of global recession). In 2012, estimates of international tourism expenditure exceeded 1 trillion dollars for the first time. Total expenditure on tourism – domestic as well as international – is several times that amount. Globally, the direct turnover of tourism was estimated to contribute 2.9 per cent of Gross Domestic Product (GDP) in 2013, rising to 8.9 per

cent when the multiplier effect on the rest of the economy is taken into account. The Middle East is the region where tourism plays the smallest part in the economy (6.4 per cent of GDP including the multiplier effect), and the Caribbean the region where it plays the largest part (13.9 per cent including the multiplier effect). In small island and coastal States, coastal tourism is inevitably predominant. Particularly noteworthy is the way in which international tourism is increasing in Asia and the Pacific, both in absolute terms and as a proportion of world tourism, with the implication that pressures from tourism are becoming of significantly more concern in those regions (see Chapter 27).

Tourism is also a significant component of employment. Globally, it is estimated that in 2013, tourism provided 3.3 per cent of employment, looking at the numbers directly employed in tourist industries, and 8.9 per cent when the multiplier effect is taken into account. In the different regions, the proportion of employment supported by tourism is approximately the same as the share of GDP contributed by tourism, although again the proportion of that which is based on the attractions of sea and coast is poorly known (see Chapter 27).

6.6 Use of marine genetic material

The commercial exploitation of marine genetic resources had very modest beginnings in the 20th century. The value of the use of marine genetic material is therefore only just beginning to develop and projections of its potential economic value differ greatly among plausible scenarios for its future development. All scenarios assume that increases in commercial exploitation will be driven primarily by more developed countries, making considerations relating to access and benefit sharing of marine genetic resources an important issue (see Chapter 29).

7. Knowledge and capacity-building gaps

As is apparent from what has been said in this chapter, there are major gaps in the knowledge available for considering the overall value of the ocean to humans. These gaps in knowledge have important implications for the governance of the ocean, because many issues turn on weighing advantages and disadvantages, and how they are distributed among the marine ecosystems and the maritime countries of the planet. Informed consideration of these issues is made the more difficult the less that is known about the values to be put upon those advantages and disadvantages.

So far there is still much debate on methods of valuing the provision of non-marketed ecosystem services. The work of the United Nations Statistics Division on valuing such ecosystem services for the purposes of national accounts may assist in informing the debate on these issues (see Chapter 9 for discussion of this programme). Other initiatives, such as the WAVES (Wealth Accounting and the Valuation of Ecosystem Services) partnership, aimed ensuring that natural resources are mainstreamed in development planning and national economic accounts, may also help in this task (WAVES, 2014).

As has been said, there are also many gaps in the basic information needed for valuation of market-related ecosystem services, in whatever manner this is eventually applied. These gaps are identified in the individual chapters dealing with the various human activities that result in the acquisition of these services, and the need for this information for comparative valuation purposes adds to the case for filling these gaps. Equally, there are gaps in our understanding of the biophysical models linking metrics of the basic features of ecosystems to the production of the goods and services to be valued. Resolving such gaps requires interdisciplinary collaboration.

There is likewise a need for capacity building in most developing countries in the use of valuation techniques and in the collection of the necessary data.

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