COSTS & BENEFITS

The seas are described as the world's biggest dump but also the world's biggest bank providing services that often are taken for granted and resources often overused.

You are here:

GUIDELINES

1 2 3 4 5 6 7

WHAT

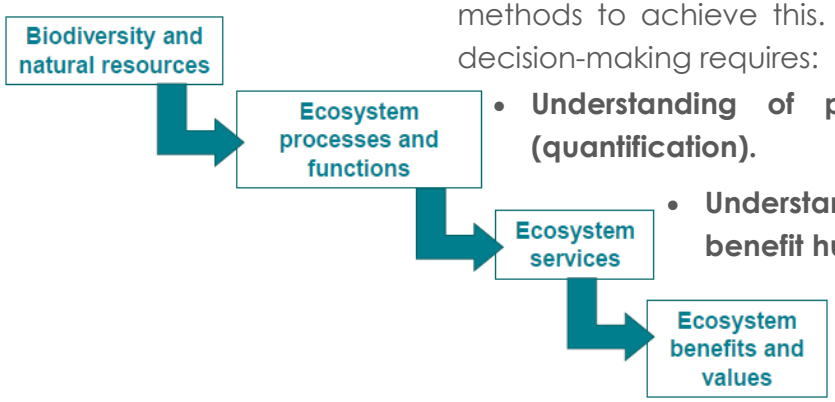
Why ecosystem services?

The MSFD requires integration of the value of marine ecosystem services into decision-making, so that policies are designed to achieve sustainable management of these ecosystems.

Management task

Assessment of the current benefits from marine and coastal goods and services; and the costs of human induced changes.

Marine and coastal ecosystems generate critical ecosystem services, e.g. food production, mitigation of eutrophication, storm protection, recreation and carbon sequestering. Traditionally, these services have been valued according to the price they can attract in the market place (e.g. the cost per kilo of fish). However, this price may not represent the true value of the service if aspects such as the cost of environmental degradation associated with bringing the service to market are not included (e.g. the cost of the consequences of damages caused by fishing methods). This guideline presents the rationale for assessing the 'true' value of environmental services and then some background to the methods to achieve this. To mainstream ecosystem services into decision-making requires:



- **Understanding of provision of ecosystem services (quantification).**
- **Understanding how ecosystem services benefit human well-being (valuation).**
- **Creation of incentives for sustainable ecosystem services (policy/governance).**

Ecosystems and biodiversity services need to be recognised as a precondition for a strong, competitive and sustainable economy, as well as for food production, security, and climate mitigation and adaptation objectives.

For many resources, including those of importance to industries such as fishing and tourism, efficient management and sustainable exploitation have been the exception rather than the rule leading to resource depletion and collapse.

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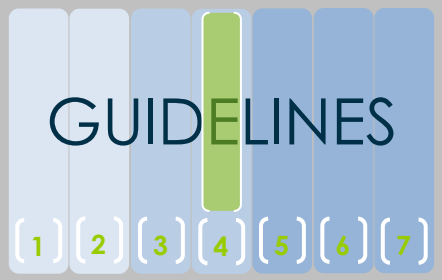
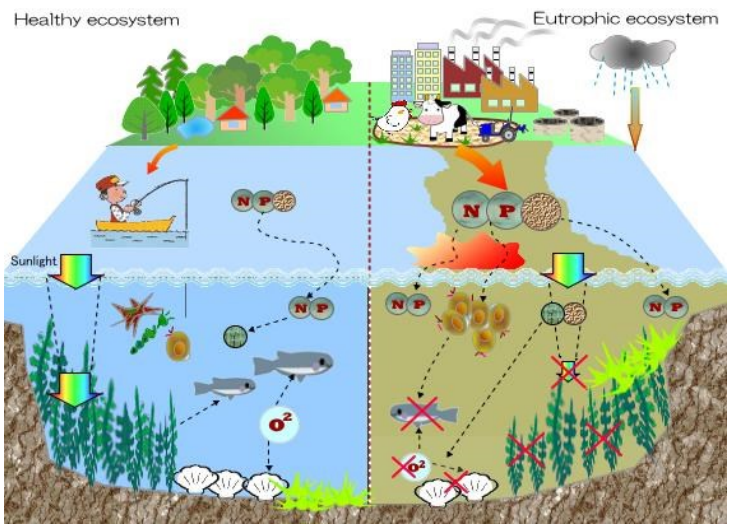


Challenges for valuing ecosystem services

It is questionable whether we understand the social-ecological dynamics that link and connect systems well enough to establish payments for ecosystem services. Issues of variability, thresholds, regime shifts and uncertainty add to the complexity.

Coastal and marine ecosystems provide ecological functions that directly or indirectly translate to economic services and values to humans through resources that can be renewable and sustainable if properly managed. In contrast, over-exploitation and poor management can suddenly shift coastal and marine systems between alternate states that provide quite different bundles of goods and services to human beings.



For example the Baltic Sea seems to have shifted to a state where algae blooms occur very regularly with negative impacts on tourism and fisheries. Once the sudden change has occurred, going back is costly and sometimes impossible. Further, there are strong indications that the magnitude and the frequency of change between alternate states are likely to increase in the near future due to human activities' global consequences for major processes that affect ecosystems.

When designing policy instruments the distribution of benefits must be considered, the relationship to poverty alleviation and a general discussion on equity and justice is needed.

COSTS & BENEFITS

Linking marine and coastal ecosystems to concepts of value, flow of goods and services and natural capital is important for a socio-economic contribution to EBM through cost-benefit analysis to evaluate losses and benefits resulting from policy decisions.

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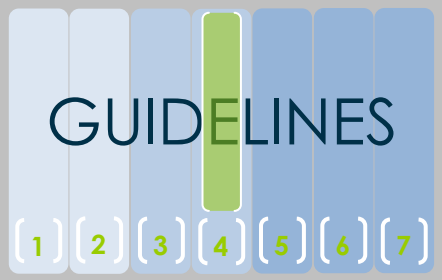
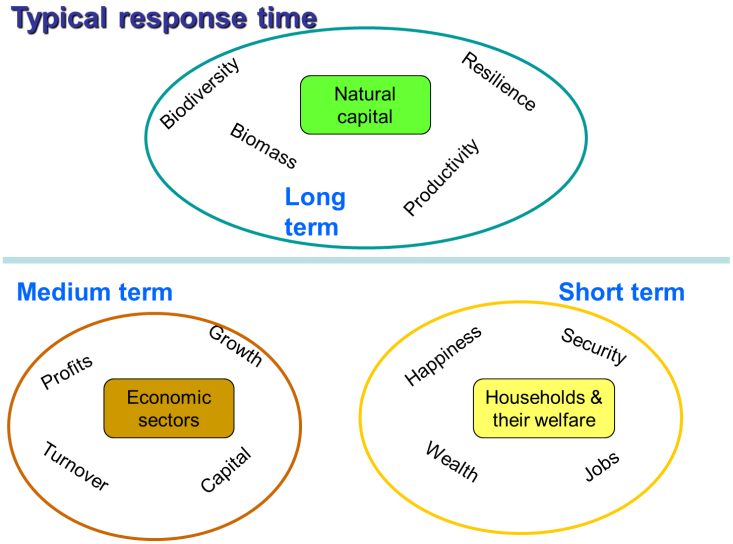


C & B

The need for valuing ecosystem services

Human welfare depends upon healthy ecosystems, including coastal and marine environments, but human activities are altering these environments often disadvantageously.

One reason management of coastal and marine environments is problematic is that it is difficult to organise information to represent interactions between different forms of capital (assets that generate value) – Natural (provided by ecosystems), Financial (held by economic sectors) and Social (households and their welfare) capital. Each has its own currency and responds to, and recovers from, changes over different timescales.



This makes linking valuation between ecosystem state changes, impacts on human welfare and monetary measures of welfare gains/losses difficult. A key way to achieve economic growth is to make more efficient use of factors of production, but this can also be achieved unsustainably by drawing on more ecosystem services or using up reserves of natural capital. Subsidies applied to fisheries is an example of such a distortion – click **here** to see an example of this that illustrates how current governance and management systems can lead to such a distortion of markets.

It is important to build a comprehensive picture of the full cycle of interaction: the human causes of ecosystem change, the nature of that change, and its consequences to underpin social-ecological accounting.

COSTS & BENEFITS

To communicate the 'big picture', simple models are needed that describe interpretations of how a system works, is exploited by humans, whether or not this can be managed sustainably, as well as the difficulties to establish a common currency between types of value.

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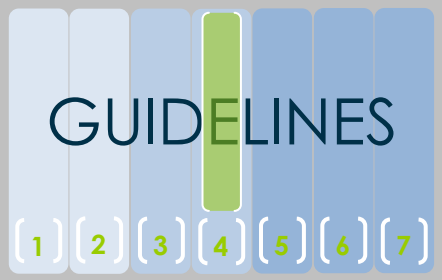
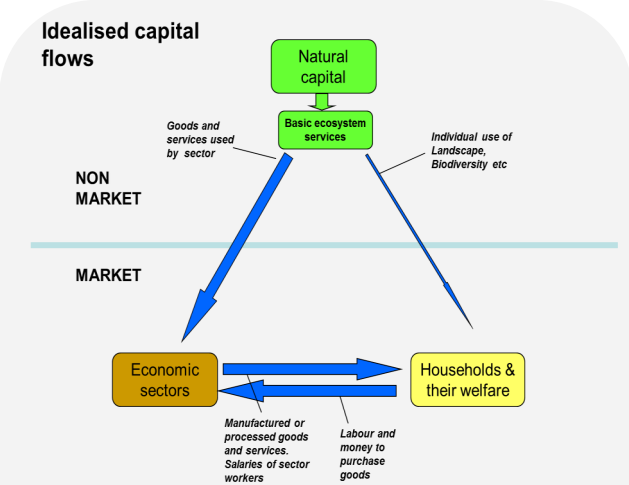


C & B

Society and environment interactions

Communication of the complex interactions between society and its natural environment is challenging because key messages often become lost in the tangled web of causal links and different currencies used to measure capital.

A simple systems model can explain how natural capital is converted to services used by economic sectors and people. People convert natural capital into social capital, largely but not exclusively through the medium of economic production. In the process, the goods and services derived from natural capital acquire monetary value and contribute to human welfare. But does this simple closed system reflect reality? Are all goods and services used for production, how do governance systems alter the dynamics of flows of goods and services and how is the stock maintained?



Click on this image to see an overview of the systems model

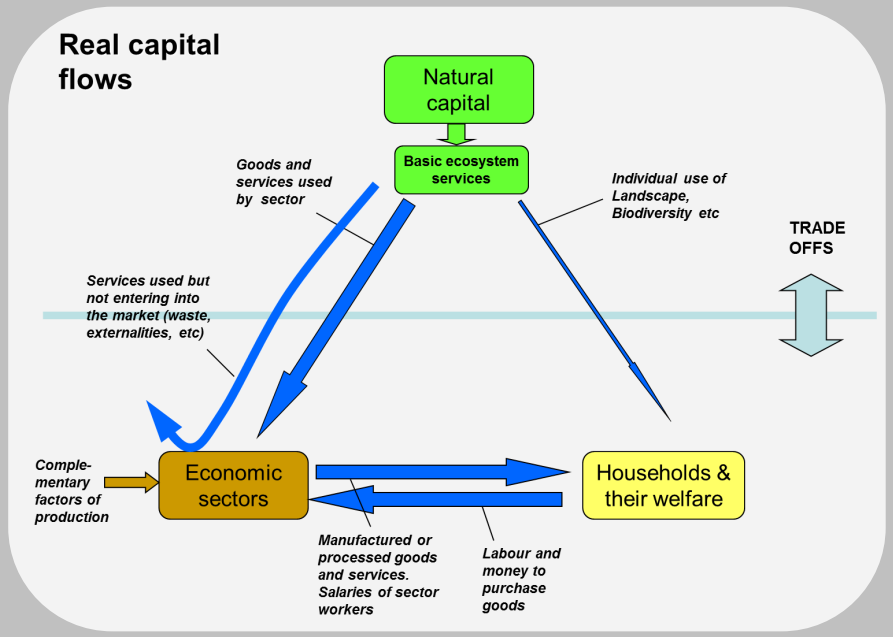
The next three pages will illustrate the development of the systems model — or click here to jump to a more detailed explanation of Ecosystem services.

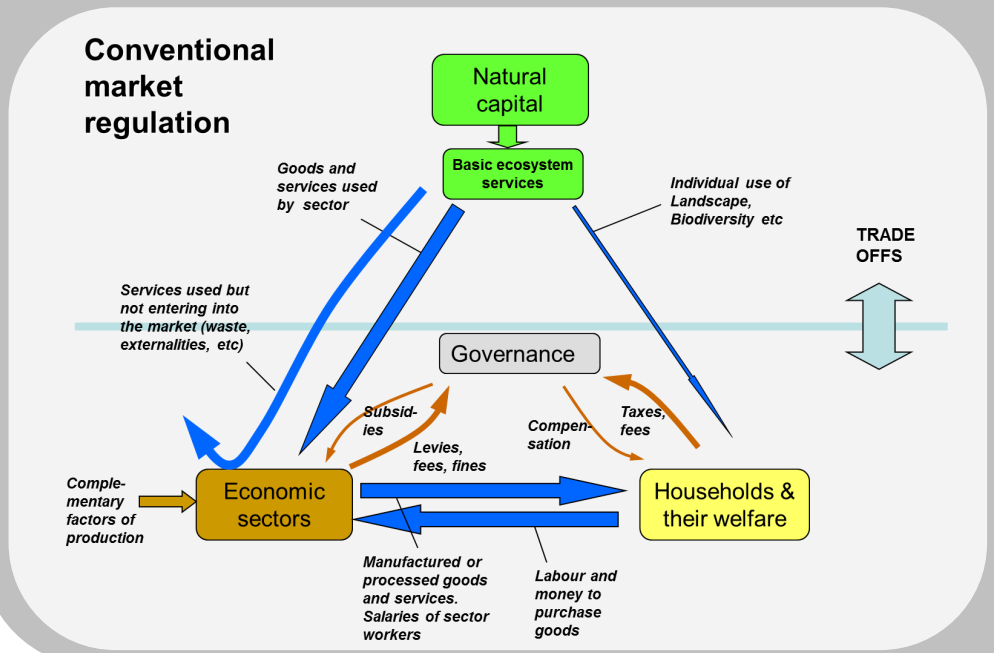
Stakeholder and political actors have different ways of measuring the capital most associated with their roles and interests: Conservation vs. entrepreneurs vs. elected representatives. The ecosystem approach seeks to balance different concerns and expectations.

Puffins, profit and people or Conservation vs. entrepreneurs vs. elected representa-

The soft system model described here helps to visualise the challenge of resource management and illustrate the need to capture all the different 'types' of cost associated with gaining a benefit from ecosystem services.

The 'ideal' reality has natural capital converted primarily into economic production but also to services used directly by people (such as recreation). However, the 'real' reality is that some of the goods and services are not used directly for production (Figure right). This includes the use of the system to receive waste, incidental loss of natural capital (habitat destruction, by-catch, etc.) and the externalities caused by "free riding" the environment during transport etc. Also, some factors of production usually come from outside the system; oil or other energy sources are a typical example and this imposes pressures somewhere else on the planet. In an increasingly globalised economy it is becoming difficult to describe system boundaries.

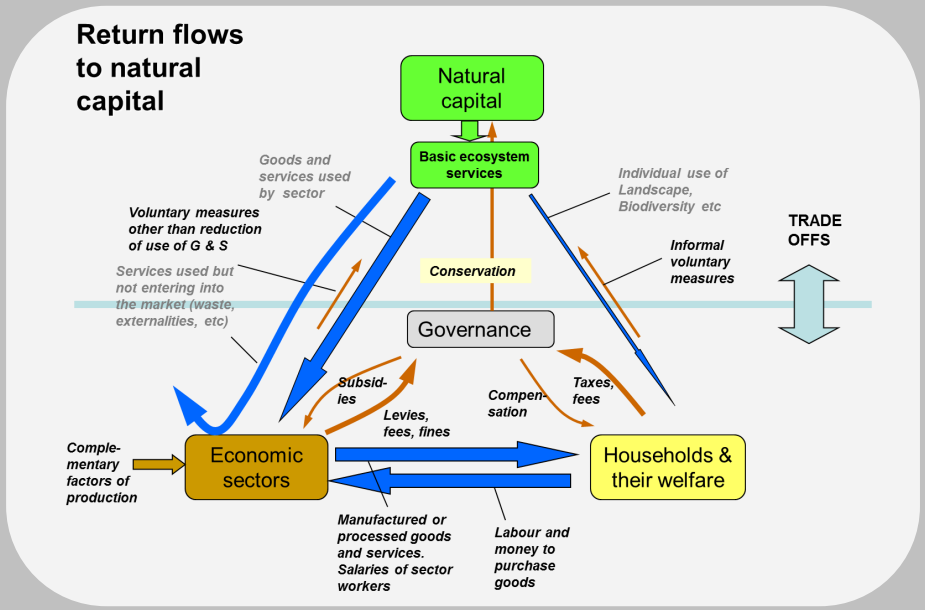


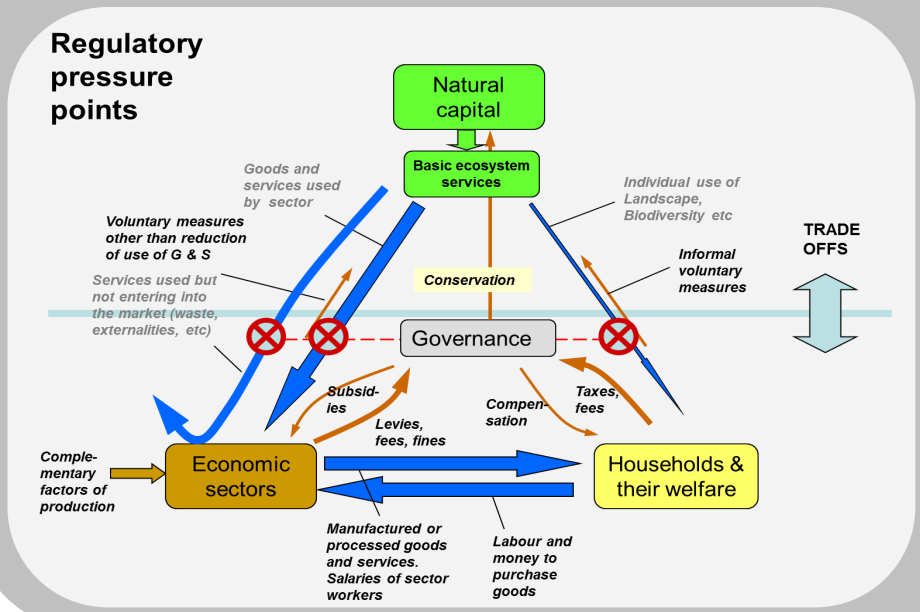


Governance introduces a mechanism to avoid social injustice, smooth out 'bumps and scrapes' in the system and support economic sectors to develop new ideas and processes (Figure left). Governance systems can attempt to modify the patterns of use of natural capital by regulating markets and maintain social norms. Revenue is raised by taxes and levies and redistributed through subsidies (to private and publicly owned companies and social services) and direct compensation to socially disadvantaged people.

Puffins, profit and people or Conservation cf. entrepreneurs cf. elected representatives

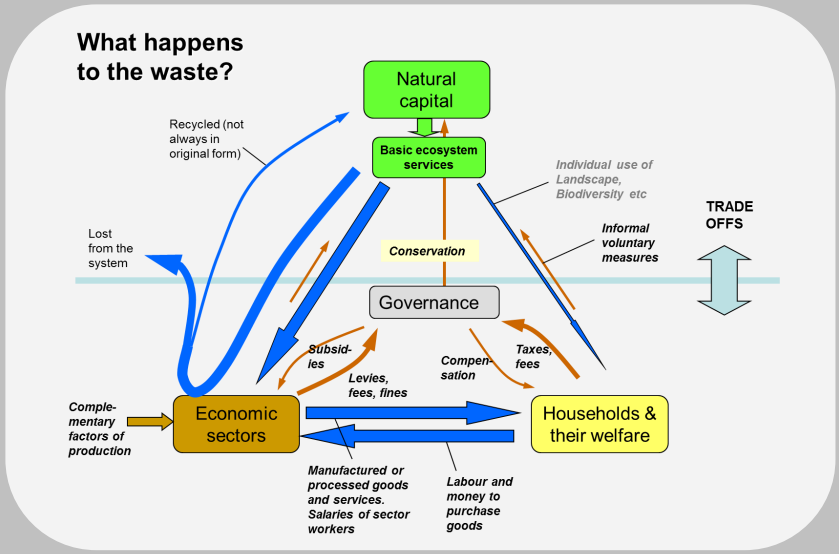
The norm is for ecosystems to be mined as if they are a bottomless resource and there are few societal mechanisms or financial tools existing to maintain or replenish natural capital. Governance can direct some money to conservation to avoid degradation of the natural capital base. This involves a conscious decision to avoid loss of species and habitats or restore damaged environments. From an economics perspective, the ultimate objective is live off the 'interest' from natural capital and avoid spending the capital itself The first priority of regulation is usually to reduce loss of natural capital as waste and to improve the efficiency of production. If natural capital is still drawn down faster than natural replenishment, the only remaining option is to scale down the economic sector or discourage demand.



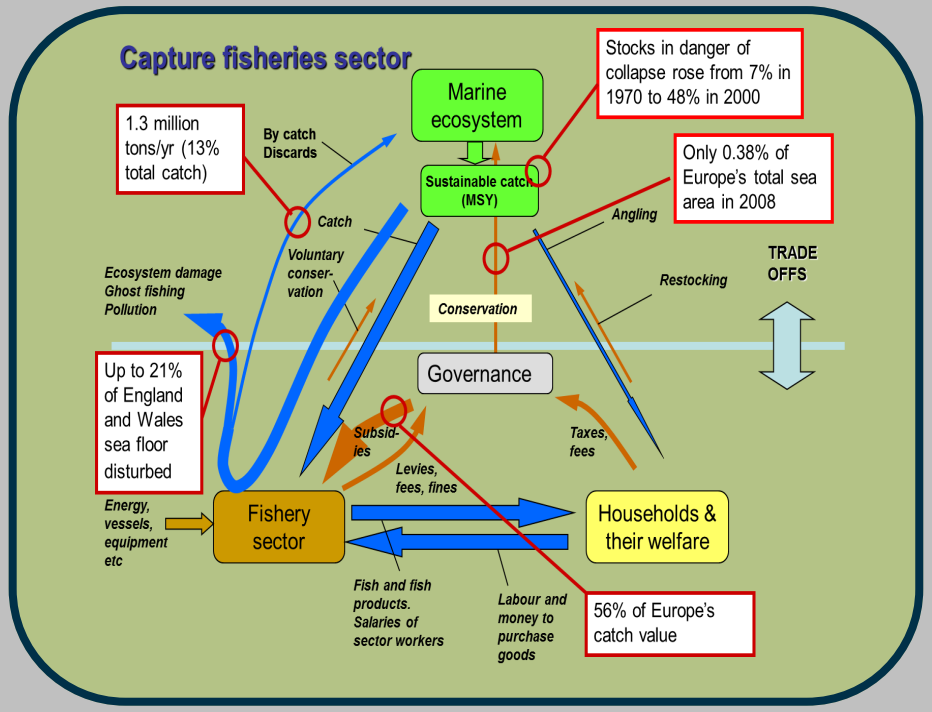


So far, it has not been possible to achieve sustainable use of ecosystem services by economic tools alone. Normative regulation is necessary through legislation in order to control harmful and anti-social actions and ensure effective planning. The regulatory burden is also a financial one and draws upon the funds raised from taxes and levies.

Puffins, profit and people or Conservation cf. entrepreneurs cf. elected representatives

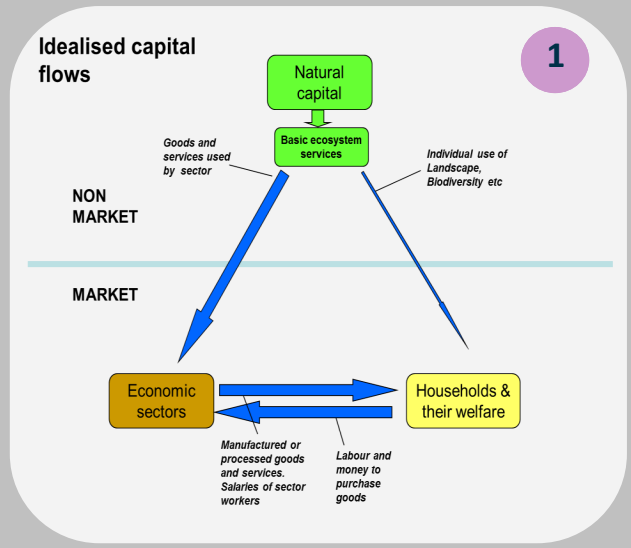


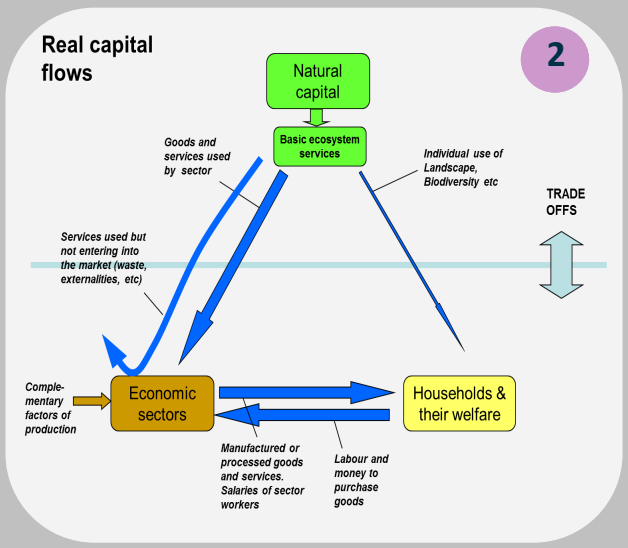
The fate of waste of ecosystem services drawn down is important. Although some of it will be lost from the system, some will return and may alter ecosystem dynamics. Nutrients returning to the system can enhance production for example or may cause eutrophication and further ecosystem damage. The regulation of waste is a key way to optimise the use of services. Economic sectors can also be scaled down to match service supply but this rarely happens in practice. A degree of self-regulation should emerge when demands for factors of production cannot be satiated.

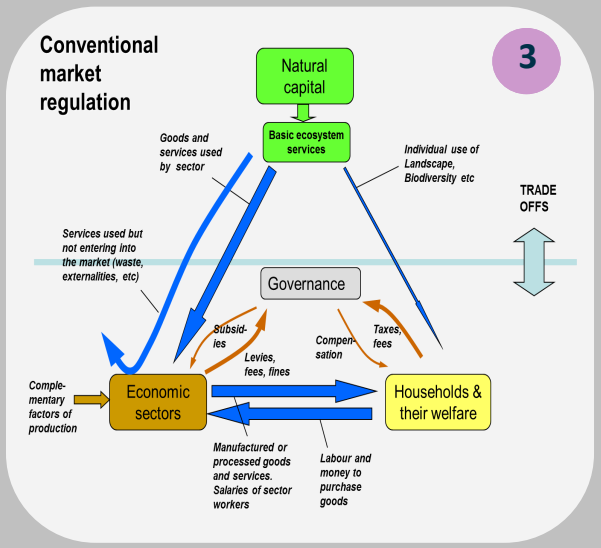


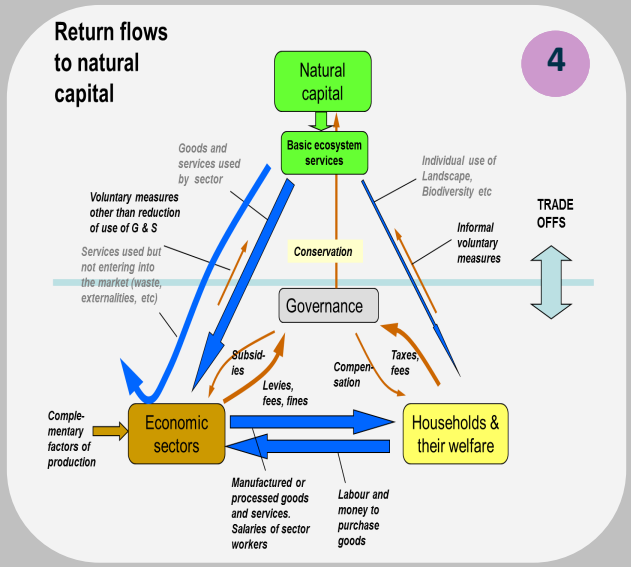
The example (right) shows how the descriptive system model can be applied to fisheries. Current international agreements define the sustainable supply of fish as the MSY (Maximum Sustainable Yield). This is derived from the dynamics of the fish stock and the state of the ecosystem that supports it. This ecosystem is also under pressure from other sectors and the sector-specific model shown here should not be regarded in isolation. However, MSY provides a reasonable starting point for analysis. In Europe, the sector uses colossal subsidies and, by any measure, does not operate sustainably. There is a huge 'fish deficit' in the EU that is satisfied by imports, and to a lesser extent by aquaculture. The aquaculture production is about equal to the amount of fish thrown into the sea as discards. It is difficult to estimate ecosystem damage on a European scale so a proxy figure has been given using data for England and Wales. It is evident that the return flow for conservation measures is very small indeed.

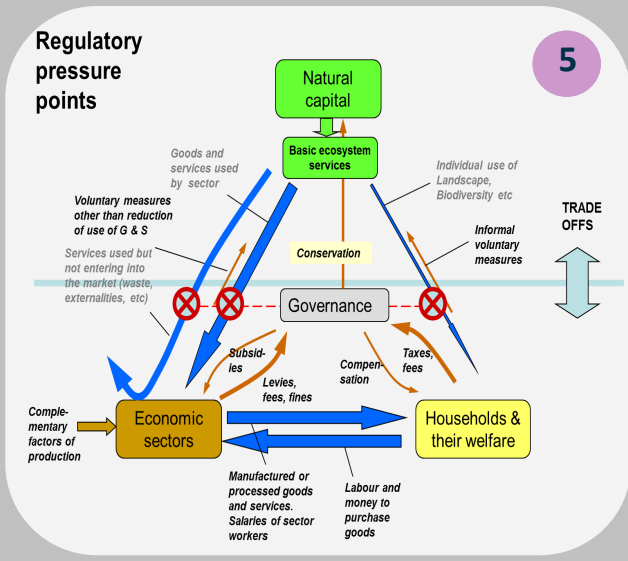
The development of the systems model

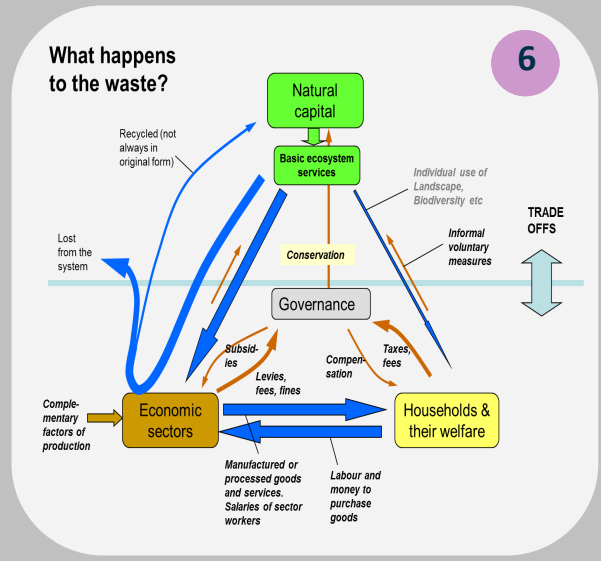










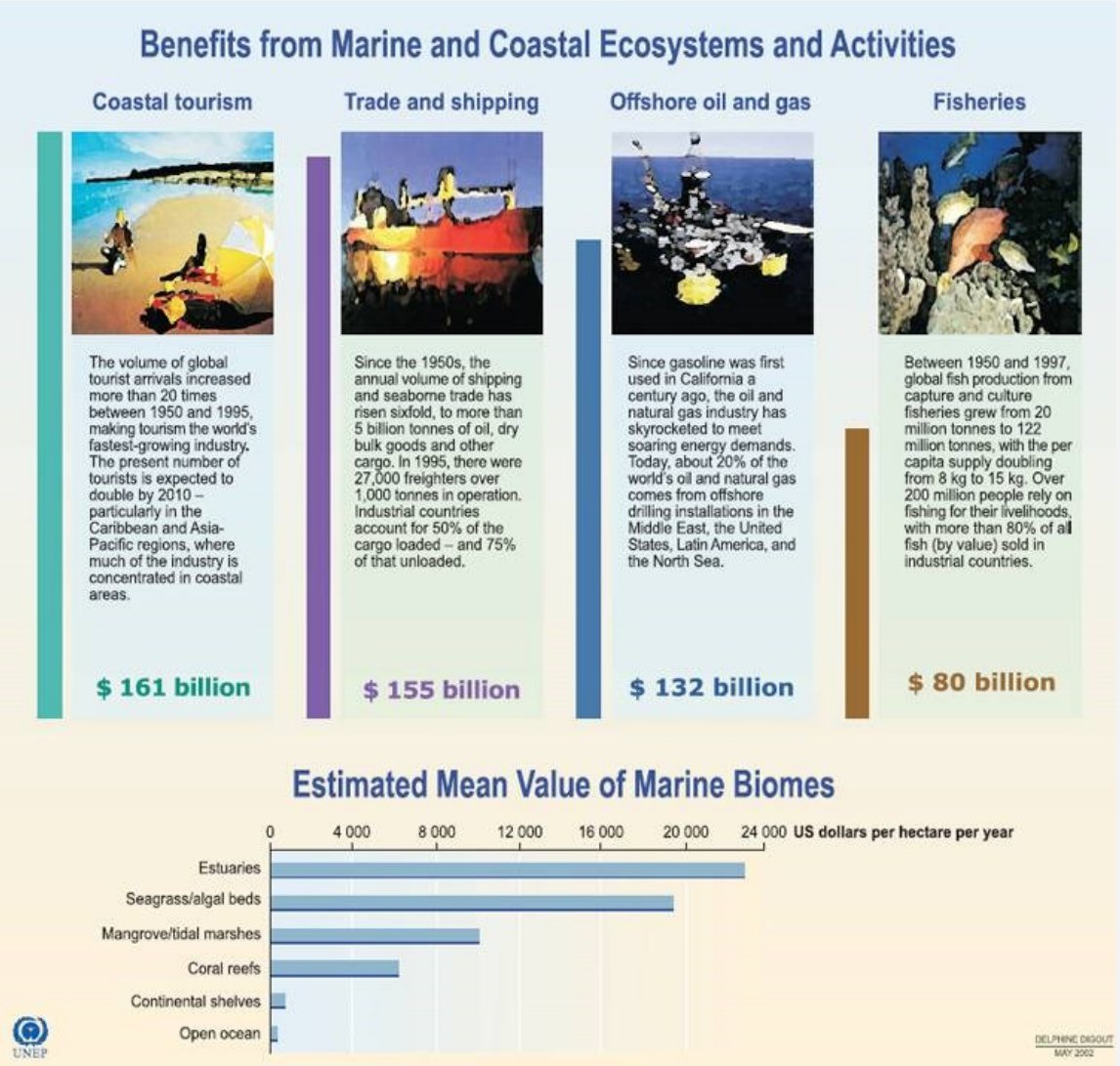


ECOSYSTEM SERVICES

There is a strong link between ecosystems services, welfare benefits and policy/ management which is why the MSFD requires 'an economic and social analysis of the use of those waters and of the cost of degradation of the marine environment'.

Natural capital — Coastal and marine ecosystems support livelihoods and are vital to the World economy in numerous ways, including food as fish; income to coastal communities from tourism shipping and trade; and through petroleum reserves to mention a few. Ecosystems, such as salt marshes, wetlands and rocky shores maintain the functioning of coastal and marine areas. Ecosystems form the natural capital stock that yields a flow of valuable goods or services now and into the future, such as nutrient / sediment storage and protection from storms and erosion. Conserving the stock helps to maintain the flow of services; by analogy we could be seen as trying to live off the interest from natural capital rather than mining it. When ecosystems are degraded or destroyed there is a consequent decay in the natural capital and reduction in services they provided that impact on human welfare.

Human benefits — Welfare benefits derived from ecosystems can change over time through large scale factors, such as climate change, or more local factors, such as change in a wetland flooding regime. Humans can affect welfare benefits through management interventions, such as coastal defence and protected area designation, which are in turn directed by law, policies and planning.



ECOSYSTEM SERVICES

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Natural capital extends the economic notion of capital (manufactured means of production) to goods and services relating to the natural environment and refers to the stock of natural ecosystems that yields a flow of ecosystem goods or services into the future. Ecosystem services can be any of the following:

⇒ Intermediate services are ecosystem features that influence human welfare indirectly (e.g. primary production or nutrient cycling),

⇒ Final services (e.g. biodiversity maintenance and creation of beaches and dune systems), contribute directly to human welfare, which directly yield

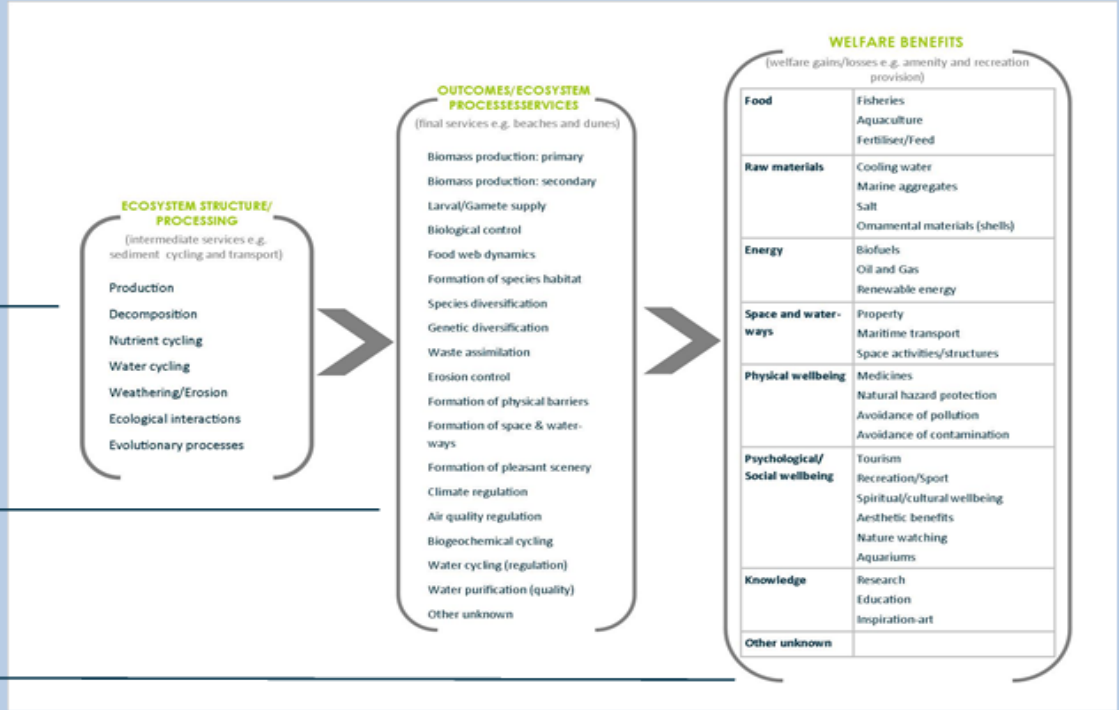
⇒ Welfare benefits, which are directly related to the benefits for humans (e.g. fish production or flood / storm buffering, as well as non -material benefits (e.g. cultural, recreational).

The linkages between these categories can be seen in the figure below.

INTERMEDIATE SERVICES e.g. sediment cycling and transport: Ecosystem structure/processing

FINAL SERVICES e.g. beaches and dunes Outcomes/ecosystems processes services

WELFARE BENEFITS e.g. amenity and recreation provision: welfare gains/losses



ECOSYSTEM SERVICES

It is important to recognise that a Pressure on the environment is only removed by policy responses addressing the Driver. Responses to State or Welfare changes only mitigate the impact of the Pressure.

The DPSWR framework clarifies the role that socio-economic drivers play in generating pressures on the environment (over varying timescales and spatial scales) and the impact on Natural Capital. Pressures on the environment result in state changes (often eco-systems degradation or loss) and consequent impacts on the welfare of people and communities locally, regionally and sometime globally. Efforts to modify the impacts (policy responses) produce feedback to address the drivers/pressures systems.

The DPSWR analysis standardises and organises categories of information to make environmental decision-making more auditable in Such an analysis is important for the inclusion of socio-economic aspects to EBM to articulate the flows of goods, services and capital of the sort required by cost-benefit analysis.

Policy responses can have results ranging from solving a problem to taking away the pain depending upon whether they are directed at Driver, Pressure, State or Welfare levels:

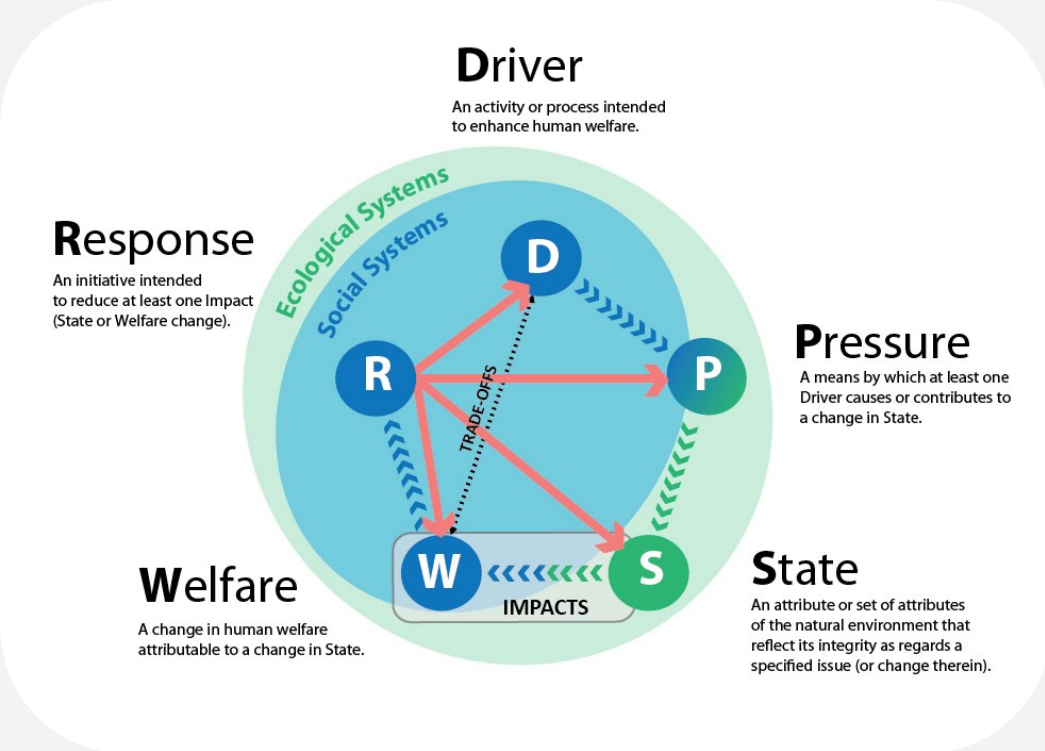
Drivers Responses can alter patterns of use or subsidise activity to mitigate a Pressure;

Pressures Manage or identify responses to change economic activity impinging on the environment.

State Responses lead to remediation to restore a system (e.g. a MPA).

Welfare Responses compensate losers and/or taxes winners to change their behaviour.

For examples of these categories click **here**.

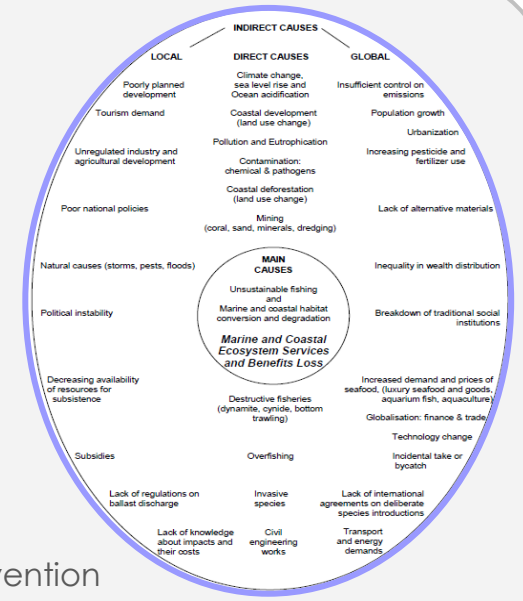


Click **here** for more information on services & benefits

CASESTUDY: European fisheries - I

METHODS FOR ECOSYSTEM SERVICES

The core of economic assessment is to determine how changes in ecosystem goods and services provision are translated into changes in welfare benefits.



Click icon above for full size image and more explanation.

Economic valuation makes links between ecosystem state changes, impacts on human welfare and monetary measures of welfare gains/losses connected with marine ecosystem management. The trade-off associated with obtaining or maintaining a good or service can be determined by:

- Cost–benefit analysis (CBA) that attempts to quantify and compare economic advantages (benefits) and disadvantages (costs) associated with a project or policy for society as a whole, or
- Cost–effectiveness analysis (CEA) that seeks to find the best activity, process, or intervention that minimises the costs of achieving predetermined targets or objectives of a policy goal, e.g. biodiversity conservation and maintaining landings at Maximum Economic Yield (MEY).

Economic valuation and assessment evaluates a range of types of policy intervention:

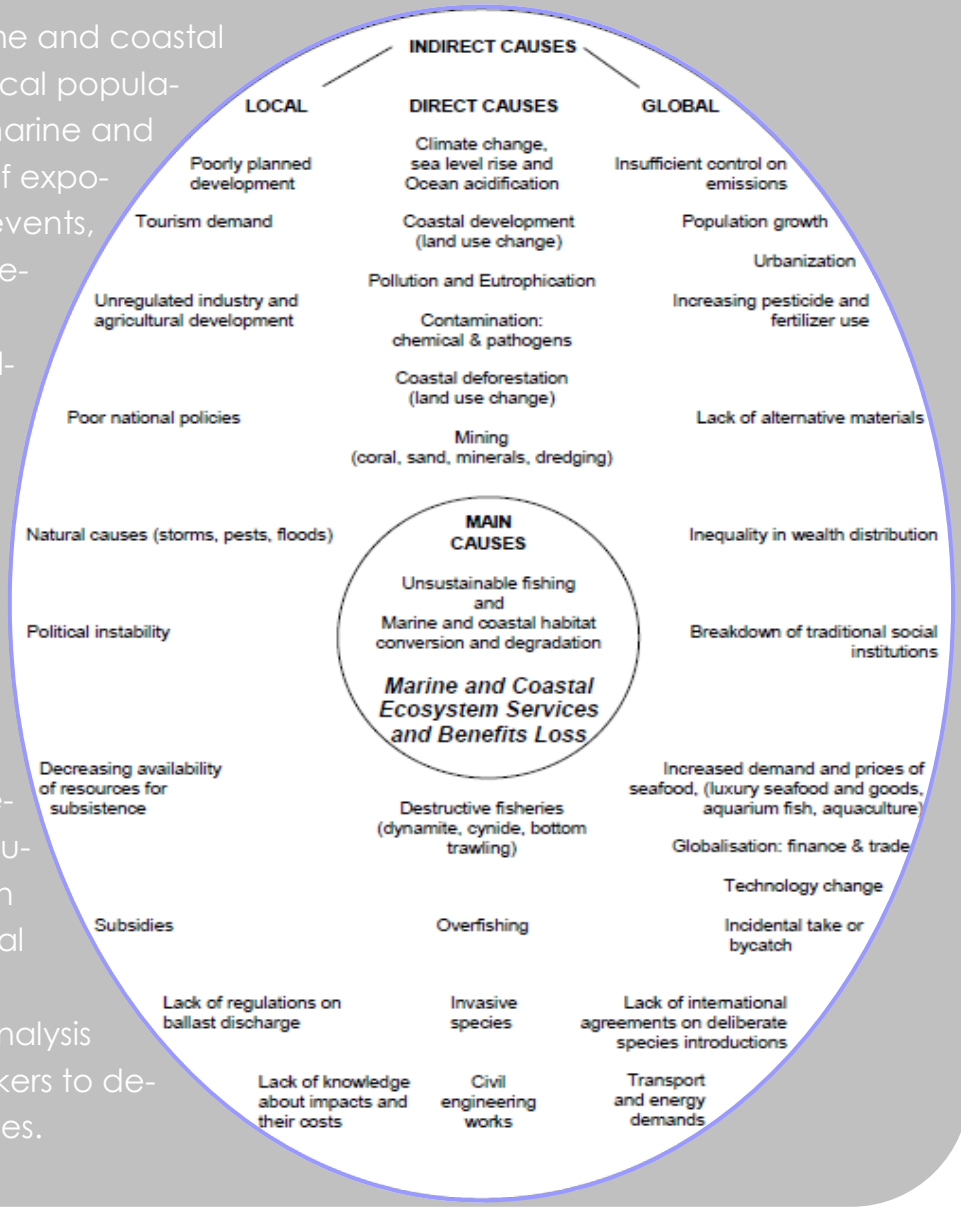
- ***Mitigation of pollution and resource overexploitation problems*** –benefits are related to remediation/restoration measures, e.g. reduced flooding, restoring wetlands, changing practices, i.e. fishing quotas or gear restrictions;
- **Enhancement of marine/coastal zone ecosystem goods and services** – actions that increases the output of a product or service, e.g. reduction of conflicts between users of coastal ecosystems via pricing schemes or zoning;
- **Preservation of unique marine/coastal ecosystems** – benefits stem from setting aside and managing particular areas to preserve natural ecosystems for amenity and/or conservation benefits.

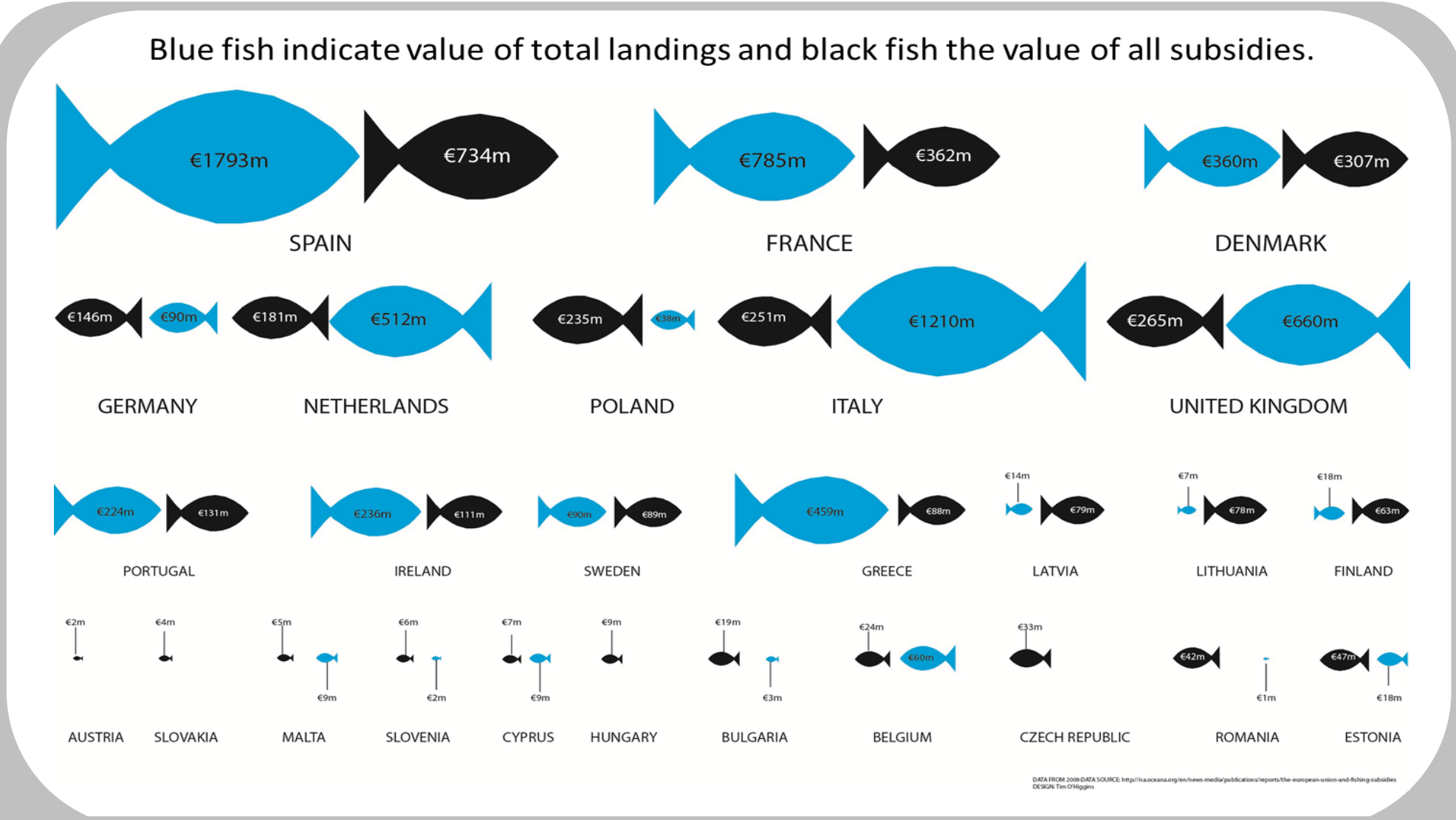
Economic valuation can make links between ecosystem state changes, impacts on human welfare and monetary measures of welfare gains/losses connected with EBM. In all cases gains need to be assessed against the losses of a 'do nothing' approach. A persistent challenge for making a 'true' economic assessment of ecosystem services is to determine an accurate valuation of the services provided, which may not be reflected in the prices that are currently paid.

The key direct drivers for coastal zones seem to be land use change and habitat loss and climate change; and indirect drivers such as shifting consumer preferences and diets (particularly in richer countries), population growth and globalisation in terms of finance and trade arrangements.

The socio-economic drivers of environmental change in marine and coastal zones are increasingly regional and global in scale and the local population may have little leverage over them. The vulnerability of marine and coastal ecosystems is increasing because of a combination of exposure to natural (often weather and climate change related) events, storms etc. and the workings of the global economy and its deregulated components (industrial production/location, trade, advertising etc.). A further element in the increased vulnerability equation is the growth in world population and the fact that the more hospitable coastal zones are already densely populated with little future margin for out-migration.

Ecosystem services include ecosystem organisation or structure (the ecosystem classes) as well as ecosystem processes and functions (the way in which the ecosystem operates). The processes and functions become services only if there are humans that (directly or indirectly) benefit from them. In other words, ecosystem services are the ecological phenomena, and the benefit is the realisation of the direct impact on human welfare. The key feature of this definition is the separation of ecosystem processes and functions in intermediate and final services, with the latter yielding welfare benefits the elements (indicators) and framework (DSPWR) of applying economic analysis on fisheries. The framework and analysis aim to aid policy-makers to decide which policies are the best for managing marine resources.





Growing demand for fish combined with local resource depletion has promoted a major expansion of European fleets in size and fishing range. The EU fishing industry receives a significant amount of government subsidies, which have promoted an overcapacity of European fishing fleets.

The European fishing fleet is estimated to be two to three times greater than what sustainable limits would allow. In 2009 subsidies were greater than the value of the fish catch in 13 countries. So that the fisheries in many European countries are unprofitable and a poor investment for taxpayers.

Economic activity and population growth
e.g. National accounts, energy flow accounts, agricultural accounts, land use / cover accounts

Use as sink, extraction, harvest, or catch of natural resources,
e.g. Air emission accounts, flows of carbon

The physical quantity of resources, the quality of the environment and the size and extent of ecosystems and areas
e.g. Asset acc's including land use and land cover accounts

Pressure

Driving force

State

Response

Welfare

Money spent to protect the environment
e.g. Env. protection expenditure accounts (incl. mitigation/adaptation exp), env. goods and services sector, env. taxes, env. subsidies, emission permits

Consequences of depletion and degradation of the environment on human welfare, e.g. Water accounts, forest accounts, fisheries accounts, land and ecosystem accounts

CASESTUDY: European fisheries - I

One area in which various environmental economic assessments have been made is in European fisheries. As stated before it is necessary to be clear about the services and benefits which the fisheries provide. A categorisation of services and benefits, refined by KnowSeas is presented in the Table below, the final column includes the welfare benefits grouped in terms of "active" use (such as capture of fish) and "passive" use such as existence and bequest value.

Intermediate Services	Final Services	Welfare Benefits
Primary production	Fish production	Active use:
Nursery and breeding	Maintenance of beneficial species	Commercial harvesting of species and the consumption
Habitat provision		Commercial growth out of fish and crustaceans (aquaculture/ mariculture)
Predator-prey relationships		Recreational fishery
Sea water quality	Maintenance of Biodiversity	Non-consumptive use (e.g. visual benefits/ tourism activities)
Nutrient cycling	Resistance and resilience	Passive use
Climate stability		Existence value of species
		Option value
		Bequest value

Source: Modification from Fisher et al. 2009 and Hanley & Barbier 2009

One way that economic economics can be used is for comparing the costs and benefits of the present situation or any future situation under management intervention; this approach is termed Cost Benefit Analysis (CBA). We might be interested in the effect of fisheries pressure on ecosystem services and subsequent welfare benefit impacts. For example, it could be that an area is experiencing overfishing and thus reduced catches and associated degradation in intermediate and final services. CBA can help compare the costs and benefits of possible management options – for example, (i) keep overfishing and active exploitative welfare benefits but accept environmental degradation shown in loss of intermediate and final services and in passive welfare benefits,

(ii) ban fishing and lose active exploitation benefits but accrue benefits in passive welfare benefits, intermediate services and final services.

More complex management scenarios can be compared using CBA, for example, reduce fishing to sustainable levels and invest in aquaculture production. This might well cost more in development of an aquaculture industry but outweighed by the benefits that are gained through maintaining environmental services and improved welfare benefits.

CASESTUDY: European fisheries - II

There are many examples of CBA and other econometric methods that have been applied to fisheries in Europe, for example in the selectivity of beam trawls, "ghost fishing" of gear and wider policy improvements: a review can be found here.

Whilst CBA type approaches can be a tool to help determine management and policy, there are also a number of limitations.

Maximising welfare benefits – a CBA aims to identify when welfare benefits are maximised at least cost. However, in some or more cases it is questionable if welfare benefits should be the dominant factor on which decisions are made. Better decisions may be able to be made using multiple factors or weighting certain factors; other factors could include social aspects (e.g. community vulnerability / viability) and policy aspects (e.g. conforming to the EU Habitats Directive)

Determining value – determining value can be difficult in goods and services which are not normally traded. Additionally, with real possibilities for environmental degradation and destruction it is extremely difficult to value the irreplaceable, not just in terms of the extinction of a rare species, but the loss of an ecosystem in a particular area.

Trade-offs – it is implicit in CBA that one can trade off gains and losses among people and underlying that is the issue that the marginal gains / losses will be bigger for a "poor" person than a "rich" person. The trade-offs and wealth equality issue confound such approaches and this results need to be considered with due appreciation of the limitations.

Evidence of differences in marginal loss / gain in economic analysis — local scale fishing versus factory fishing?

PRICE VERSUS VALUE

When we are in a shop we decide whether or not to buy an item based on price. In a competitive market system it is likely that the price will closely reflect the value of the item.

However, in environmental valuation prices can diverge from values, for instance when they are public goods or when the full costs of production and consumption are not included in the price. For example, environmental impact costs are an example of costs not included in the price of consumer goods. Thus, rather than assessing the price of a good or service, an attempt is made to value it.

The benefits received from an environmental good or service lead to an increase in human well-being or welfare. In contrast, costs can result if the loss of a good service would result in a decrease in society's welfare or well-being. The balance of benefits and costs is represented using the concept of utility which is a measure of overall level of satisfaction or happiness.

However, utility cannot be directly measured, thus a proxy for this is used. One proxy is termed "willingness to pay" (WTP) for buyers ("willingness to accept" (WTA) for sellers), which indicates how much a person would choose to pay to gain a benefit or avoid a cost. Individuals would be expected to pay more for combinations of goods and services which provide high utility.

Whilst price and the value of a good or service can differ, for example water used for irrigation could have a high value but a very low price, WTP provides a means whereby gains and losses in utility can be valued or compared to allow management choices to be made. This concept underlies much of the work in environmental economics.

There are different valuation and pricing approaches , the methodology is described in detail on the following pages.

For more information on valuing click **here**

CASESTUDY: European fisheries - II

ECONOMIC VALUATION METHODOLOGY

The notion of total economic value (TEV) provides an all encompassing measure of the economic value of any environmental asset. TEV decomposes into use and non-use (or passive use) values but it does not encompass other kinds of values, such as intrinsic values which are usually defined as values residing "in" the asset and unrelated to human preferences or even human observation.

For more information on each valuation approaches click on the relevant boxes below:

Total Economic Valuation

Contingent Valuation Method

TCM/ HEDONIC

Valuation approaches

One type of valuation is through stated preference methods that asks individuals about their preferences for non-market goods or services. For example, Contingent Valuation uses a questionnaire to establish value for a specified gain or loss of certain goods or services. This approach can be used reliably when estimating the environmental gains where the good or service is familiar to the respondents.

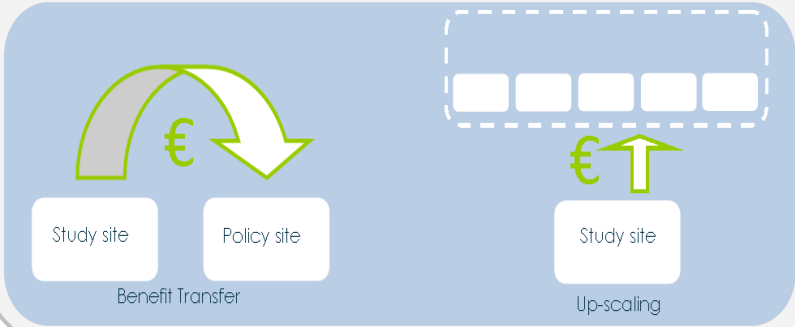
Other type of valuation methods are called revealed preference methods which infer individual preferences by observing their behaviour in markets in which an environmental good is indirectly purchased. Methods in this category include the Travel Cost Method and Hedonic pricing .

Pricing approaches

Pricing methods include:

- **Market Prices data from ecosystem goods that are traded, either in local or international markets;**
- **Opportunity Cost that estimates the benefits that are foregone when a particular action is taken (e.g. storing carbon in managed ecosystems such as salt marshes can be 'valued' in terms of the damage costs avoided from the carbon emissions) and;**
- **Replacement Cost (or substitute goods) approach entails estimating the provision of an alternative resource that provides the function of concern.**

Sometimes data is not available at the site of interest (termed the policy site), so previously estimated values and benefits are transferred from similar areas (study site) to support the analysis.



Whilst this approach fills gaps in economic valuation, it is rarely perfect and errors are inevitable for both policy and study sites. This is largely due to differences between the study and the policy site, for example in contextual aspects such land ownership and policy dimensions.

Some studies wish to look at a Policy site with a greater scale than the original study site, for example across the whole of the EEZ of the EU. Thus, as well a value transfer there is a need for spatial up-scaling (as shown here) that can lead to additional errors.

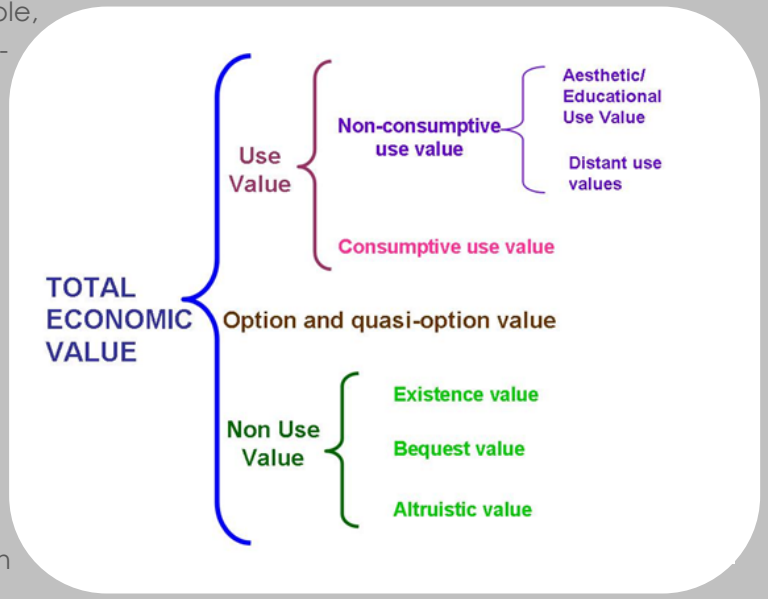
Click on this arrow to go back to all guidelines

Total Economic Valuation

Marine/Coastal ecosystems provide a wide range of final services and goods of significant value to society - fisheries, transport medium, storm and pollution buffering functions, flood alleviation, recreation and aesthetic services, and so forth. In valuing such assets, it is important to capture the values to society of these characteristic services and goods. The use of the total economic value (TEV) classification, which decomposes into use and non-use (or passive use) values, enables the values to be usefully broken down into the categories shown in Figure. The initial distinction is between use value and non-use value. Use value involves some interaction with the resource, either directly or indirectly:

Direct use value: involves direct interaction with the ecosystem itself rather than via the services it provides. It may be consumptive use, such as fisheries or timber, or it may be non-consumptive, as with some recreational and educational activities.

Indirect use value: derives from services provided by the ecosystem. This might, for example, include the removal of nutrients, thereby improving water quality, or the carbon sequestration services provided by the ocean or some coastal ecosystems.



Non-use value is associated with benefits derived simply from the knowledge that a particular ecosystem is maintained.

- Existence value: derived simply from the satisfaction of knowing that an ecosystem continues to exist, whether or not this might also benefit others.
- Bequest value: associated with the knowledge that a resource will be passed on to descendants to maintain the opportunity for them to enjoy it in the future.
- Altruistic value: associated with the satisfaction from ensuring resources are available to contemporaries of the current generation.

Finally, two categories not associated with the initial distinction between use values and non-use values include:

- Option value: an individual derives benefit from ensuring that a resource will be available for use in the future.
- Quasi-option value (QOV): associated with the potential benefits of waiting for improved information before giving up the option to preserve a resource for future use.

These various elements of total economic value are assessed using economic valuation methods. TEV is derived from the preferences of individuals. When goods and services are exchanged in actual markets, individuals express their preferences via their purchasing behaviour.

Contingent Valuation Method

CV methods employ a questionnaire format where respondents are asked what their Willingness To Pay (WTP) or Willingness To Accept (WTA) for a specified gain or loss of a given good or service is. Economic value estimates yielded by CV surveys are 'contingent' upon the hypothetical market situation that is presented to respondents and allows them to trade off gains and losses against money. Although this method is considered to be controversial in some quarters, the contingent valuation method has gained increasing acceptance in recent years amongst many academics and policy makers as being a versatile and powerful methodology for estimating the monetary value of the non-market impacts of projects and policies.

Advantages of CV:

- can estimate use and non-use values;
- a widely used and much researched environmental valuation technique;
- applicable to a wide range of ecosystem goods and services.

Disadvantages of CV:

- like many questionnaire techniques can suffer from a wide range of biases. Questionnaires need to be very carefully designed and pre-tested;
- very resource intensive. Reliable surveys need large sample sizes and hence consume manpower and finances;
- depending on the bid format used can be statistically complex to analyse.

Other issues:

- Most reliable when used to estimate the value of environmental gains and where the good or service of concern is reasonably familiar to respondents.

An alternative to CV is Choice Modelling (CM) that involves respondents making choices between goods which are described in terms of their various attributes, offered in different amounts, or levels. CM is more flexible than CV as it enables the attributes of an environmental gain scenario to be valued rather than just the overall scenario, but even more attention needs to be paid to design issues and analysis can be even more complicated.

TCM/ HEDONIC

The Travel Cost Method assesses the travel costs incurred by individuals travelling to recreation sites while the Hedonic pricing method estimates intangible aspects of environmental good, such as landscape amenity, air quality, and noise, using housing and labour market data.

Revealed preference methods are reliant upon the assumption that non-market use values are indirectly reflected in consumer expenditure.

For the Travel Cost Method:

Advantages of TCM:

- a well established technique; based on actual observed behaviour.

Disadvantages of TCM:

- can only estimate use values;
- really only applicable to specific sites (usually recreational sites);
- difficult to account for the possible benefits derived from travel, multipurpose trips and competing sites;
- very resource intensive. Reliable surveys need large sample sizes and hence consume manpower and finances; statistically complex to analyse.

For the Hedonic Pricing method:

Advantages of HP:

- a well established technique;

based on actual observed behaviour and (usually) existing data.

Disadvantages of HP:

- can only estimate use values;
- really only applicable to environmental attributes likely to be capitalised into the price of housing and/or land;
- confined to cases where property owners are aware of environmental variables and act because of them;
- market failures may mean that prices are distorted;
- data intensive and appropriate data may be difficult to obtain;
- statistically complex analyse.

Other revealed preference methods include **Averting behaviour and defensive expenditure**, which uses as a basis individual behaviour to avoid negative intangible impacts, and **Cost of illness and lost output** from impacts that can lead to an increase in medical costs incurred in treating associated health impacts, as well as a loss in wages and profit.