4 Services provided by nature

4.1 This section provides evidence about the different services provided by nature. Specific services may be of interest to different policy makers and practitioners, so you may choose to focus just on those. Alternatively, you may be interested in overarching themes such as economic competitiveness, so **Chapter 2** and **Chapter 3** may be useful in identifying how the environment contributes to those themes.

4.2 It is important to note that not all services provided by nature are included here. The ones chosen are the ones which on the basis of current evidence are most important in the context of environmental projects. The ones selected are also those for which we have available scientific and economic evidence.

4b Coastal flood risk management

Traditional flood defences are expensive to build and maintain. Coastal environments such as saltmarshes offer a cost-effective alternative and provide additional benefits to biodiversity and recreation.

Introduction

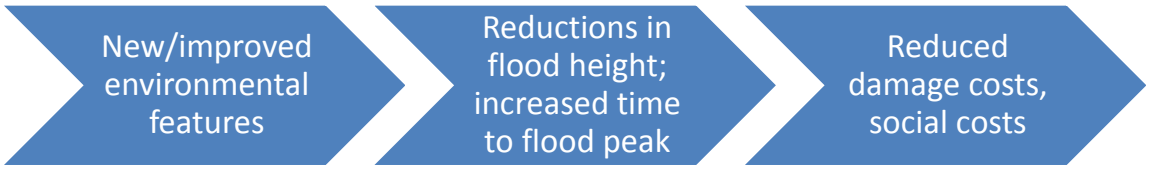
4.7 This section reviews the evidence for flood risk management at the coast. Flood risk management from freshwater is discussed in Section **4d**. Coastal flood risk management is a particular issue for England – 46 per cent of the English coastline is protected from coastal erosion and flooding by engineered sea defences (UKMMAS 2010). Futures research from the Government Office for Science and Technology found that continuing with existing flood risk management policies was not an option, because under virtually every scenario considered risks rose unacceptably (Foresight 2004).

4.8 Improved flood risk management leads to reduced costs of flooding and can by extension lead to reduced insurance premiums and increased property values[48]. Additionally, being flooded significantly increases the risk of both physical illnesses such as gastroenteritis and mental ill health (Tunstall, Tapsell et al. 2006). Reacher (2004) found that adults who had suffered from flooding had four times the background level of psychological distress.

4.9 The managed realignment approach, in which new habitat is created in the inter-tidal zone between the high and low water lines, can have benefits for flood risk management, whilst at the same time providing habitat for fish nurseries and encouraging recreation. Visitors are attracted by the wide variety of plants and animals.

4.10 Salt marshes are a form of coastal wetland that act an important natural form of sea defence, by dissipating wave energy before it reaches the sea wall or other infrastructure/high ground behind it. However, many salt marshes have been lost due to 'coastal squeeze' where they are trapped between rising sea levels and hard man-made sea defences. Inter-tidal habitat re-creation therefore has a major contribution to make to cost effective flood defence at the coast; as does the conservation of, and allowing 'natural roll back' of, existing salt marshes (Collins, Empson et al. 1997)[49].

Theory of change



Can the benefit be quantified?

4.11 The economic figures which are normally offered relate to costs of engineering for coastal defence, and these can be quantified within reasonable error margins. The avoided costs of

[48] See the section on house prices to put this in economic context.

[49] This evidence is taken from a joint Environment Agency, English Nature and Cambridge Coastal Research Unit paper and contains academic references which have not been reviewed for this evidence package.

flooding can also be quantified, but these are likely to be less certain, particularly when they include wellbeing loss (economic VALUE) as well as direct economic loss (IMPACT).

How strong is the evidence?

4.12 There is reasonably strong evidence for the contribution of the coastal environment to reducing flood risk.

Evidence

- In 1997 it was estimated that an 80 metre wide zone of inter-tidal habitat fronting sea walls can save £4,600 per metre in sea defence costs (Collins, Empson et al. 1997).
- Alkborough Flats is a managed re-alignment scheme on the south side of the Humber estuary. The sea wall was deliberately breached to allow both permanent and irregular flooding of former farmland. In particular, the site is designed to trap tidal surge floodwaters and has delayed the need to raise flood defences elsewhere in the inner estuary. The Environment Agency's project appraisal report assessed the flood defence benefit as worth £12.26 million based on a time period of 100 years leading to a cost benefit ratio of 1:2.72. Further work which sought to quantify the other benefits of the scheme, particularly provision of habitat raise the cost benefit ratio to 1:3.22 (Everard 2009)[50].
- Modeling of the potential benefits of the adoption of a managed realignment approach to the Blackwater Estuary in Essex was undertaken. It found that the approach would reduce the maintenance costs of flood defences, significantly reduce nutrient discharge into the North Sea (reducing the eutrophication risk) and create important wetland habitat. Under very conservative assumptions the scheme was cost-beneficial over a 100 year time frame (Shepherd, Burgess et al. 2007)[51].
- A second entirely separate modeling of the potential benefits of the Blackwater Estuary in Essex was also undertaken, but this one undertook a bespoke willingness-to-pay study for the habitat creation. The study identified reduced cost of developing hard defences, the value of the new habitats as fish nurseries, carbon sequestration, and the composite value of the new habitat (covering amenity, recreation and biodiversity). The study found benefits of £100 million after 25 years following increased use of managed realignment, where the level of realignment was designed to combine economic growth and environmental protection (Luisetti, Turner et al. 2008)[52].

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[50] I have not reviewed the Environment Agency project report from which the flood defence figure is taken. The flood defence figure cited is a net present value figure with future year's benefits discounted according to Green Book standards. The wider ecosystem service valuation is experimental in that it pushes the edges in finding values for things that would normally be considered too difficult and contains a number of very strong (i.e. questionable assumptions). However assumptions are all clearly spelled out, and none of the strong assumptions make a material difference to the cost benefit ratio. Additionally the approach taken is appropriately conservative and so I have no hesitation in recommending the use of the ratio.

[51] The cost benefit analysis is constructed extremely conservatively, it is therefore likely that a realignment approach would be cost-beneficial on a much shorter time frame. For example, the costs of new secondary defences are included as part of the realignment scenario, but might not be needed. Furthermore, by today's standards, the study uses a very conservative price for carbon (£7 per tonne). The nutrient capture function and the habitat creation function of the project are not counted independently to avoid risk of double-counting. The study also doesn't take account of the global warning effect of the N_2O. The study includes a value for the habitat creation which is transferred from other literature and not reviewed (however it is important to note that a separate study which conducted a bespoke willingness to pay study for the value of habitat creation on the Blackwater estuary also finds managed re-alignment strongly beneficial - see the Luisetti study in the next paragraph).

[52] The figure quoted is the difference between the Net Present Value of 'Hold the line' level which assumes no re-alignment and the 'Policy Targets' level in which economic growth is combined with environmental protection at the official HM Treasury discount rate over a 25 year timeframe. This figure increases to £221 million over 50 years and £444 million over 100 years, which is a reasonable time-frame for this sort of infrastructure. The analysis also shows that greater benefits would derive from higher levels of managed re-alignment. Note that this benefit does

- Modelling on the Humber Estuary found that a whole estuary managed realignment approach led to a benefit to society of £3.8 million over a 50 year time frame and £8.7 million over a 100 year time frame. These calculations are based on values for the habitat created, the value of the agricultural land, avoided carbon emissions, and wall maintenance and replacement costs (Turner, Burgess et al. 2007)[53].

Link with climate change

- Sea levels have risen by 1mm a year during the 20th century, and sea level is projected to rise by 18cm in London by 2040 and 36cm by 2080 (Department for Environment Food and Rural Affairs 2009).

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not include the cost saving from not maintaining the traditional infrastructure which would add another £1.2 million. The big advantage of this study is that values for habitat gains are based on a new bespoke choice experiment study which was well designed, including concerns about size and quality of the habitat and distance from the respondent's home.

[53] The figure quoted is the difference between the Net Present Value of 'Hold the line' level which assumes no re-alignment and the 'Policy Targets' level in which economic growth is combined with environmental protection at the official HM Treasury discount rate. The analysis also shows that greater benefits would derive from higher levels of managed re-alignment. The value for habitats driving this analysis is based on transfer from a meta-analysis of studies which value wetlands, which is the most robust way to derive a value without a new willingness-to-pay study. A figure of £22 per tonne of carbon was used, which is conservative compared with the figures currently recommended by the Department of Energy and Climate Change.