Managed realignment of sea walls can enhance coastal protection provided by natural habitats and save costs

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mainly based on Turner et al. 2007 and DEFRA and EA 2002.

Short title: Managed realignment for coastal protection, UK

Key Message: When investigating coastal protection strategies with a time horizon beyond 25 years, managed realignment of sea walls can be an economically efficient policy for coastal and flood risk management, instead of maintaining sea walls at the current line of defence (hold-the-line strategy).

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What was the problem?

As a result of climate change the coasts of England and Wales are coming under increasing threat from erosion and flooding. To protect human settlements, coastal defences such as sea walls were built. It is now increasingly recognised that these defences cause the degradation or loss of coastal and intertidal habitats and the ecosystem services they provide, in particular flood protection (Turner et al. 2007). The security provided by 'hard' engineered defences encourages infrastructure and settlements to develop closer to the coast which increases the risk of damage and consequently the need for protection. Furthermore, the establishment and maintenance of the sea walls comes at a high cost, while the flood protection by the intertidal habitats is an ecosystem service that these areas provide naturally. Therefore, the costs and benefits of sea walls and intertidal habitats need to be carefully considered when developing a strategy for coastal protection.

What can be done to solve it?

According to the Department for Environment, Food & Rural Affairs of the United Kingdom government (DEFRA), "maintaining the current line of defence (hold the line)", "limited intervention", "doing nothing" and "managed realignment" are among the policy options to be considered in coastal and flood risk management. Managed realignment (see Figure 1) is an actively controlled process including defence retreat to higher ground, moving defences inland, widening flood plains or other types of shortening or lowering defences (DEFRA and EA 2002). In order to decide for a certain site whether managed realignment is economically efficient or not, the different realignment scenarios need to be compared.

Based on case studies in England, Luisetti et al. (2011) identified criteria that are central for the economic valuation of coastal realignment strategies. Using the ecosystem services approach is important for environmental valuation and policy assessment. The basic analytical steps include: a spatially explicit assessment of ecosystem services, capturing marginal changes, identifying possible double counting, considering non-linearities, and

threshold effects. Using sequential decision support systems that are targeted at integrated coastal zone management is of great help (Luisetti et al. 2011).

Existing site:

An impression of what the site will look like after the bank is breached:

Figure 1: Example for coastal realignment at the Humber in Alkborough (Source: Humber Tides News 2005).

Which ecosystem services were examined? And what methods were applied?

Managed realignment creates space for new intertidal habitats, including tidal mud flats and salt marshes that provide a number of ecosystem services including coastal protection and flood defence. These areas provide productive habitats for plants, invertebrates and molluscs, and they are very important fish nursery areas and feeding, breeding and roosting areas for birds (Colclough et al. 2010, Rupp and Nicholls 2002).

Salt marshes dissipate wave energy and provide the first line of defence against tides and waves, particularly during storms. Hence, they reduce the capital and maintenance costs of fixed flood defences. Intertidal habitats also act as sinks for pollutants and carbon and provide recreational opportunities (Rupp and Nicholls 2002). Furthermore, valuable habitats are created which are declining worldwide. Thus, managed realignment has both, conservation and coastal defence benefits.

Figure 2: Humber Estuary www.humberems.co.uk/

A cost-benefit analysis comparing several scenarios of a managed realignment of sea walls to a business as usual strategy was done for the Humber estuary in north-east England, currently protected by 235km of coastal defences (Turner et al. 2007, Fig. 2, Humber Management Scheme, URL: http://www.humberems.co.uk/)

The scenarios that were compared are the following:

- The hold-the-line (HTL) scenario maintains the existing defences to a satisfactory standard, but intertidal habitat is lost due to continued development and coastal squeeze.

- The business-as-usual scenario (BAU) takes into account the existing realignment schemes. However, the compliance with the Habitats Directive is considered as insufficient and continued economic development possibly leads to a loss of habitats due to coastal squeeze. This scenario has a negative NPV for every period of appraisal.

- The extended deep green scenario (EDG) places a greater emphasis on habitat creation and uses less restrictive criteria to identify suitable areas for realignment. All types of areas are considered, from those smaller than 5 ha to those not previously reclaimed from the estuary. Moreover, while the other scenarios consider that the optimum length of realigned defences could not exceed the length of those already existing; the EDG scenario doesn't have such limitations (Pilcher et al., 2002). The EDG scenario appears to be the more efficient in the long term.

- The policy target scenario (PT) combines economic growth with environmental protection: realignment for reducing flood defence expenditure and compensation for past and future intertidal habitat loss in compliance with the Habitats Directive. This appears to be a compromise solution, being neither negative as the business-as-usual scenario nor as positive as the EDG scenario.

To estimate the net present value (NPV) of providing defence for each of the scenarios, the present value of all the costs was subtracted from the present value of all the benefits (Table 1). The present value for the HTL scenario was then subtracted from the present values for the BAU, PT and the EDG scenarios, respectively, to calculate the NPV of realignment for each scenario. The results of the analysis show that the NPV of the business-as-usual scenario is negative for any of the analysed time horizons of 25, 50 or 100 years (Table 2). In contrast the scenarios of managed realignment become economically efficient when considering a time horizon of more than 25 years with clear positive NPVs after 50 and 100 years (Table 2).

***Table 1**: Values for estimating costs and benefits of realignment. Source: Turner et al. 2007*

Costs and benefits appraised	**Value (£)**	**Value (€)** (using 2005 conversion rates)
Capital costs of realignment	878 £/km	1274 €/km
Opportunity costs :		
Grade 1 and 2 agricultural land	4790 £/ha	6950 €/km
Grade 3 agricultural land	5458 £/ha	7920 €/ha
Maintenance costs of defences	3560 £/(km*year)	5165 €/(km*year)
Costs of replacing defences to hold status quo	668 £/km	969 €/km
General habitat creation benefits	621 £/(ha*year)	901 €/(ha*year)
Carbon sequestration benefits	45 £/tC	65 €/tC

***Table 2**: Net present value (NPV) at 25, 50 and 100 years for the two positive management scenarios. A declining discount rate is used; 3.5% for years 1-30, 3% for years 31-75 and 2.5% for years 76-100. Source: Turner et al. 2007.*

Scenarios	25 years	50 years	100 years
Business as usual NPV(BAU)–NPV(HTL)	£ -3.75 mio. (€ -5.44 mio.)	£ -3.32 mio. (€ -4.81 mio.)	£ -3 mio. (€ -4.35 mio.)
Extended deep green NPV(EDG)–NPV(HTL)	£ -23.90 mio. (€ -30.45 mio.)	£ 11.53 mio. (€ 16.73 mio.)	£ 37.1 million (€ 57.83 mio.)
Policy targets NPV(PT)–NPV(HTL)	£ -2.83 mio. (€ -3.75 mio)	£ 3.79 mio. (€ 5.5 mio.)	£ 8.66 million (€ 12.57 mio.)

What policy uptake resulted from examining the ecosystem services?

Whether managed realignment is the policy of choice or not depends on the location. A shorter defence line, lower height of embankments and the beneficial effect of intertidal habitats for reducing wave energy can reduce maintenance costs. In addition the ecosystem services provided by newly created intertidal habitats beyond coastal protection have to be considered (e.g. carbon sequestration or as habitat for endangered species). However, the value of land that needs to be protected (e.g. infrastructure, housing or farmland) is an important factor which varies locally. Managed realignment is thus reasonable at sites where it favours the creation of intertidal habitats with its subsequent benefits and where land use changes do not involve high opportunity costs (e.g. low quality agricultural land). In contrast managed realignment seems not suitable for developed urban areas or in very extensive agricultural areas with high productive farmland. There, economical and social gains associated with the assets protected generally justify the resources required to defend them from the sea for the foreseeable future (Tinch and Ledoux 2006).

An analysis carried out in 2002 by the DEFRA listed 151 coastal sites in England and Wales where defence line retreat has been adopted as a strategy for coastal protection. From these sites 41% were classified as actual managed realignment sites and 59% as limited intervention sites since the retreatment process of the defence line was not actively managed (DEFRA and EA 2002).

For further information please visit:
Humber Management Scheme, URL: http://www.humberems.co.uk/

References:

Colclough, S., L. Fonseca, W. Watts and M. Dixon 2010. High Tidal Flats, Saltmarshes and Managed Realignments as Habitats for Fish. Wadden Sea Ecosystem 26, 115-120.

DEFRA and EA. 2002. Managed Realignment Review - Project Report. Department for Environment, Food & Rural Affairs (DEFRA) and Environment Agency (EA).

Humber Tides News (2005) Delivering the Humber Strategy. Humber Tides News 6, March 2005.

Luisetti, T., R. K. Turner, I. J. Bateman, S. Morse-Jones, C. Adams, L. Fonseca (2011) Coastal and marine ecosystem services valuation for policy and management: Managed realignment case studies in England. Ocean & Coastal Management 54 212-224.

Rupp, S., and R. J. Nicholls. 2002. Managed Realignment of Coastal Flood Defences: A Comparison between England and Germany. Prepared for Proceedings of “Dealing with Flood Risk”. An interdisciplinary seminar of the regional implications of modern flood management.

Tinch, R., and L. Ledoux. 2006. Economics of Managed Realignment in the UK. Environmental Futures Limited.

Turner, R. K., D. Burgess, D. Hadley, E. Coombes, and N. Jackson. 2007. A cost-benefit appraisal of coastal managed realignment policy. Global Environmental Change 17: 3-4: 397-407.

Pilcher, R., P. Burston and R. Davis. 2002. Seas of Change. Royal Society for the Protection of Birds.