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A SUSTAINABLE FUTURE FOR THE HUMBER ESTUARY



ENVIRONMENT  
AGENCY

**ENVIRONMENT AGENCY**  
**HUMBER ESTUARY SEMINAR**

**VALUING THE HUMBER'S  
ENVIRONMENTAL ASSETS**

**PROCEEDINGS OF A SEMINAR  
15 NOVEMBER 2000**

**Environment Agency  
1 Viking Close  
Great Gutter Lane East  
Willerby  
Hull  
HU10 6DD**

**Tony Edwards  
Humber Strategies Manager**

**November 2000**

ENVIRONMENT AGENCY



124356

## ATTENDANCE

Jonathan Atkins	University of Hull
Steve Axford	EA Dales
Steve Bailey	EA North East
John Bowers	University of Leeds
Steve Chambers	EA Midlands
Tony Edwards	EA Humber Strategies
Richard Freestone	EA Ridings
Marion Justice	EA Humber
Simon Keys	EA Ridings
Graham Leeks	Centre for Ecology & Hydrology, Wallingford
John Mann	Teeside Industry & Nature Conservation Trust
Ronan Palmer	EA Head Office
Ruth Parker	CEFAS
Mike Ryan	University of Hull
Alex Smith	Humber Estuary Management Strategy
Adarsh Varma	University of Hull
Brian Waters	EA Midlands Region
Philip Winn	EA National Capital Programme Management Service
Richard Young	Consultant

### Apologies

It should be noted that a number of Agency staff were unable to attend because of flood duties and there were also transport difficulties on the day. Apologies were received from the following:-

Environment Agency: Peter Barham, Ron Linfield, Karen Miller, Bob Pailor, John Pygott, David Rooke, David Wilkes and Andrew Wither (NW Region).

Other organisations: Mike Elliott, Jack Hardisty, Andy Horrocks (University of Hull), Roger Falconer (University of Cardiff), Malcolm Joslin (BP), Stephen Malcolm (CEFAS), Geoff Millward (University of Plymouth), Alan Tappin (CCMS; Plymouth), Ian Townend and Sarah Banham (ABP Research and Consultancy).

## **OBJECTIVES OF THE SEMINAR**

- To raise awareness of the pros and cons of techniques for valuing intangible benefits.
- To discuss the use of economic valuation in relation to the Agency's Humber work.

## **BACKGROUND**

### **Tony Edwards**

The Humber is one of the country's largest estuaries. It is 'world class' for maritime trade, birds and wildlife. It is of national importance for the economy and the historic environment. There are also fishery and recreation interests. Over a third of a million people live on its tidal flood plain, and much industry and high grade agricultural land is also located in that area. Sea levels relative to the land are rising. Maintaining appropriate standards of defence for people and property and the potential loss of protected inter-tidal habitat by coastal squeeze are key issues.

The sustainable management of the Humber poses considerable challenges for the Agency. The Humber Estuary Shoreline Management Plan is being developed to provide a long-term strategy for investment in flood defences, in a manner that is affordable, effective, and socially and environmentally acceptable. In recent years, industry and water companies have spent hundreds of millions of pounds on improving quality water. There may be a need to justify higher standards to raise dissolved oxygen levels in the tidal Ouse and to reduce the input of nutrients into the North Sea.

Economic techniques are valuable for aiding decision making and in the evaluation of options to achieve a particular goal.

The Environment Agency has had the Humber Estuary Scientific Advisory Group (HESAC) bringing together external researchers with Agency staff. With the November 2000 meeting the format of these twice-yearly committee meetings has been changed to that of a seminar concentrating on a specific topic.

# **ECONOMIC APPRAISAL IN THE ENVIRONMENT AGENCY**

**Ronan Parker**

John Gummer claimed that one advantage of environmental economics is that the environmentalist can speak the same language as the banker. The Agency has a duty to contribute towards the achievement of the goal of sustainable development and to take into account costs and benefits in its decision making.

The Agency has been undertaking consultation on a new environmental vision. This will have more emphasis on:-

- Health and the environment
- Social aspects
- Engagement with the public
- A more strategic and integrated approach.

A number of tools and methodologies have been developed. An example is the manual for appraising water quality benefits. Many of the benefits from cleaning up rivers or estuaries are intangible and there are considerable uncertainties in allocating monetary values. For the third Asset Management Plan (AMP 3) of the water companies, a multi-criteria approach was adopted, which used a point scoring system rather than cash values.

The Agency is now moving away from developing methodologies towards a more integrated approach particularly for high level policy.

It is important to judge objectively which option should be adopted, eg. for River Basin Management Plans. A workshop had recently been held bringing together a number of different views. A framework was needed that brought together economic techniques and the views/perceptions of people and institutions which make decisions. This would be a framework for informed dialogue.

The identification of opportunity costs is important for determining the worth of a project. Economic analysis aids challenging conventional wisdom and what is perceived to be the 'right solution'. The main barrier, however, is the intangible nature of many environmental benefits and the controversy over the derivation of monetary values by using techniques such as contingent valuation.

The following tasks are being undertaken:-

- Development of integrated approaches, first for Water Quality (with a view to AMP 4 and the Water Framework Directive) and then for Water Resources and Flood Defence;
- Development of strategic assessment models;
- Further studies on the links between ecology and economics, how to value things not valued by the public (eg. whole ecosystems, not just photogenic, cuddly animals);
- Better use and training in economic appraisal, contingent valuation and questionnaire techniques, and the incorporation of social issues.

## **Discussion**

**Q – (Tony Edwards) Are expert systems being considered?**

**A – Yes, but as yet, they are not widely used for environmental economics. Why not have a Humber web site and allow people to use a variety of models to explore different scenarios?**

**Q – (Philip Winn) How will the Agency's new approaches fit MAFF's requirements for project appraisal?**

**A – The Agency commented in detail on the new Project Appraisal Guidance Notes (PAGN) and got some improvements. They will be kept under review with the possibility of further refinements. The Humber could be a good test case to look at appraisal techniques at the strategic level.**

**Comment (John Bowers) – In working with consultation groups over 30 years challenging the cost benefit analysis for flood defence schemes, he took a 'conflictionist' approach and was not in favour of the proposed 'integrated approach'.**

## COMMENTS ON MAFF PROJECT APPRAISAL GUIDANCE

John Bowers

The new PAGN is an improvement, but still has weaknesses. These can be summarised as:-

- Use of contingent valuation techniques
- Replacement and relocation costs
- Recreation benefits.

Contingent valuation is still a matter of controversy and academic debate. It is based on people's 'willingness to pay' in order to establish monetary values for intangible benefits. The use of questionnaires can cause bias. Misuse can lead to very large, meaningless numbers to insert into the cost/benefit equation. The MAFF Guidance advised the need for care with CV and its use only in circumstances where really needed.

A difficulty with the results of questionnaire surveys is how to deal with the many 'zero bids' and unrealistically high outliers which are found. Likewise, what population should be sampled (local, regional, national or even international for a SPA or SAC) and how should the results be scaled up to the whole population?

The MAFF Guidance suggestions on deriving benefits from the cost of creating a similar site elsewhere of equivalent value, or the cost of relocating to another site are conceptually wrong.

Care is required in incorporating recreational benefits or the loss of them in benefit analysis. Recreational benefits are largely transfer payments. If people are denied an opportunity to visit a particular site because of flooding or a flood defence scheme, they will take their recreation elsewhere.

The following papers were provided by John Bowers:-

- If you want to know the price just ask. A sceptical look at environment valuation.
- Taken on the flood: the new project appraisal guidelines for flood defence. ECOS 20 (314) 99/2000.

## CASE STUDIES ON ENVIRONMENTAL APPRAISAL

RICHARD YOUNG

Environmental Benefits are the things that make life worth living, and we need to value them to make sure that we can get as many of them as possible. The point is, of course, that very often we cannot have everything we would like, so we have to choose between things and to make the best choice we need to know the relative values of the things. The most commonly accepted way of doing this is by cost-benefit analysis, which involves identifying all the costs (or negative impacts) and benefits (or positive impacts) of each possible course of action, adding them up and comparing them. Once you have done this, the argument goes, the best course of action will stand out because it is the one with the highest ratio of benefits to costs.

Cost benefit analysis is not the only way of making decisions. It is, however, a very powerful tool, particularly when resources are limited and you have to choose the best way of using them. Nevertheless there are a number of difficulties, the first being to work out what all the impacts of a particular course of action will be and the second to express these impacts in terms of a common unit, generally money. Often this is difficult enough to do for tangible items, in a way that most people are prepared to accept, and it is even more difficult to do for intangible items that, by their very nature, appeal to different people in different ways. This means that simple cost-benefit analysis should never be used on its own to make a choice. There always needs to be at least an element of judgement to take into account such things as what is acceptable, what has been missed out of the analysis, and so on before reaching a decision.

Environmental benefits include such things as health, security (confidence), amenity, recreation, heritage, nature and landscape, all of which are intangible and, therefore, difficult to value. The concept of use and non-use or existence values is important. All of these items rely on things being experienced or used by people if they are to have a value. A football ground, for example, will only have a recreational value if it is used for football or some similar activity. If it is not it may have other values, due perhaps to the fact that it could be used for building houses on, but it will not have a value for recreation. This argument does not apply, however, to the last three items, heritage, nature and landscape. They do have a use value, which comes about because people like watching birds or looking at mountains, but they also have a value purely because they exist, irrespective of whether they are used or not.

One method of evaluation that can be used when the impact involves the destruction of an environmental asset is simply to work out the cost of recreating it elsewhere. This, the replacement cost approach, is fine if the asset can be replaced with all its attributes unchanged, but of course, it is not always possible to do this. How, for example, do you replace a 1000 year old oak tree if it is cut down? Another approach is the hedonic pricing method, in which the price of an impact is measured by its effect on other prices that are more easily measured. An example would be to estimate the cost of providing flood defences by determining the increase in property values.

The third approach involves estimating how much people are willing to pay to avoid or achieve something and use this estimate as a measure of its value. There are basically two ways of doing this, by observing what people do and by asking them. An example of the first

way would be to determine the value of a recreational site by measuring the average amount that each visitor spends to use it (including travelling, entrance fees and so on) and then multiplying this by the number of visits. This way, of course, can only be used to measure the use value of an asset; it cannot measure the non-use value. The other way is Contingent Valuation, asking people what they would be prepared to pay rather than simply observing them, can be used to measure both. Some of the difficulties of CV are outlined in Ronan Palmer and John Bowers contributions.--

Contingent valuation and other benefit assessment studies can be expensive. Consequently there has been quite a lot of work on trying to obtain answers by transferring the results of studies carried out for one project to a different but similar project.

### **Case study – Ouse Washes**

The Ouse Washes form part of the flood defence system for the Fens in Cambridgeshire, protecting them from high flows in the Bedford Ouse, which discharges to the Wash at Kings Lynn. The Dutch engineer, Vermuyden, built the system in the 1650s; the Washes are about 30km long and a couple of hundred metres wide. When flows in the Bedford Ouse are low all the water passes down the New Bedford, or Hundred Foot, River. If the water level at Earith rises above a pre-set value, a sluice is opened and the surplus water is discharged into the Washes, where it flows down to the lower end and, once the flood is passed, is released back into the Bedford Ouse and drains off to the sea.

Most of the Washes are grazed, which maintains them as grassland and makes them very good for birds, particularly over-wintering wildfowl and breeding waterfowl. As a result they are designated as an SPA and as a RAMSAR site.

Flooding in the winter is expected and causes no problems. In the 1980s and early '90s, however, there was some flooding in spring and early summer that disrupted the breeding birds on the site and, it was feared, could affect the number of birds such as the Black-Tailed Godwit that were using it. A scheme was developed that would reduce this summer flooding but sufficient benefits could not be identified to justify anything that would be effective by considering the standard agricultural and property losses on their own. Environmental losses, thus, needed to be considered as well.

We identified three impacts of continued summer flooding (and consequent reduction in bird numbers) that we felt might be worth looking at. The first was the reduction in the value of the shooting, which we based on how much people were spending for a day on the Washes, including travel and ticket costs. The second was the recreational value of the reserves), which we based on the number of visitors, again estimating how much they would spend for each visit. Finally, we obtained an indication of the existence value of the environment within the reserves, which we measured by determining what the owners were willing to pay to maintain them in their present condition (excluding the costs of provided visitor facilities). Together, these figures came to £950,000/year, which was enough to justify the scheme.

## HOUSE WASHES: ENVIRONMENTAL VALUES

	Value £k/yr
• Recreation (shooting)	190
Travel costs	
Membership, day ticket costs	
• Recreation (visitors)	343
WWT Reserve visitors & membership	
RSPB visitors	
• Environment (reserve costs)	420
Salaries, buildings, administration	
Operating and capital	

### Case Study – Broadland (Norfolk Broads)

Broadland is the low-lying area of land, marsh and open water, totalling about 30,000 ha that surrounds the tidal reaches of the Bure, the Yare and the Waveney.

It is famous for its open areas of water, with opportunities for sailing. Other important activities are agriculture, particularly the traditional marsh grazing, and nature conservation, not so much for the individual animal or plant species but rather for the range and variety of the habitats that are found there.

The trouble is that much of the land is below mean sea level and would be permanently flooded if the defences beside each river fail. When we started the project these were in a pretty poor condition and the risk of failure was really quite high. Unfortunately, the cost of improving them was also high, to the extent that the work could not be justified on the basis of agriculture alone. We therefore looked at the environmental impacts of losing the defences and decided these were quite high. The whole character of the area would change and this would have major impacts on amenity, recreation and nature conservation.

To try and value these impacts we commissioned the University of East Anglia to carry out a contingent valuation studies - Visitor Survey to capture use values and a Postal Survey for the non-use values. The Visitor Survey was a large exercise, involving developing a storyboard (including photographs) to describe the impacts, and a range of questionnaires which asked people how much they would pay to keep Broadland unchanged in several slightly different ways. The system was pilot tested and about 30 interviewers were trained. The survey itself took about four weeks and involved 3,200 interviews at 17 different sites around the Broads.

The Postal Survey was rather smaller in scale, involving posting 1,000 information and questionnaire booklets of which just over 300 were returned. The Visitor Survey gave upper and lower bands of £6m and £25m/year, depending on how you aggregated the figures and whose data about the number of visitors each year you believed. The Postal Survey gave much higher results since, although the individual "willingness to pay" was much lower the affected population was assumed to be very much higher.

## BROADLAND: CONTINGENT VALUATION RESULTS

	£m/yr
• Visitor Survey (use values)	
Lower band	6
Upper band	25
• Postal survey (non-use values)	
Near Broadland	32
Elsewhere in UK	77
Total	109

The first lesson from this exercise was that it was very important to have well-trained interviewers (students in this case). The second was that, in the Visitor Survey at least, we were really valuing amenity and recreation, not nature. Thirdly, on the whole, the lower band Visitor Survey seemed to be a fairly robust estimate while the Postal Survey did not inspire the same confidence. In practice the Visitor Survey results gave us the benefit we needed so we did not feel the need to justify the other items. The final point is that the study cost £60,000 at 1991 prices.

The costs of environmental valuation studies can be reduced by transferral - using the results of a study for one scheme to estimate the costs or benefits of a similar scheme elsewhere. This is only valid if the two schemes are similar, in terms of the type and scale of the impacts, access.

### Summary of Lessons Learnt

- Avoid unnecessary effort – there is no point in doing something unless you actually need the results.
- Consider very carefully what it is you want to value, what you are actually valuing, and whether the two are the same.
- Consider, and be sceptical about, the validity of the results you get, because if you do not, somebody else will.
- Be very careful if you are trying to transfer benefits because if you are not you can come up with some really silly answers.

### Implications for the Humber

The designation of the estuary under the Habitats Directive means that there is a legal obligation to avoid adverse impact and therefore there is no need to value the benefits of doing this, as there is no choice. All there is to be done is to work out what is needed to avoid such impacts and then find out the most efficient way of doing this. Critical to this, of course, are the conservation objectives for the estuary, due to be set by English Nature

This leaves us the other environmental impacts: Health, Security, Amenity, Recreation, Heritage Landscape, etc. The following questions can be asked:

- Do we need to think about all these in the Humber, or are there some we need not worry about?
- Are there any others that we should think about?
- How might we value them, and how confident would we, and others, be about the results?
- Do we need to put monetary values on these impacts or are there other, simpler or more robust ways of comparing their importance?

# NUTRIENT FLUXES THROUGH THE HUMBER ESTUARY – PAST, PRESENT AND FUTURE

Ruth Palmer

CEFAS, BGS and the Universities of East Anglia and Essex have undertaken research on the Humber's nutrient budget as part of the LOIS and JONUS programmes. The work is to be published in *Ambio* (Jickells et al).

The geomorphology of the present day and Holocene (3000 years ago) Humber Estuary was examined. More than 90% of the inter-tidal area and sediment accumulation capacity of the estuary has been lost to reclamation over this time period. A similar situation prevails in many other urbanised estuaries. Nutrient budgets for the modern estuary demonstrate extensive modification nutrient levels within the estuary, but little net trapping of nutrients due to the loss of inter-tidal areas and sediment accumulation capacity. A speculative budget for the Humber during the Holocene is constructed which suggests that the estuary was then an efficient sink for nitrogen and phosphorus. A budget is then constructed describing how nutrient cycling might operate in the Humber with contemporary nutrient loadings but the pre-reclamation geography. The results suggest that in this form, the estuary would significantly attenuate nutrient fluxes through the Humber to the North Sea.

In order to manage the input of nutrients to coastal waters, controls are being implemented in catchments or through sewage and industrial effluent treatment, all which have a significant cost. With implementation of Water Framework Directive in future, whole system approaches will be advocated. Management of inter-tidal sediments may offer a complementary strategy to end-of-pipe nutrient reduction. Managed realignment schemes which bring benefits for flood and coastal defence and ecological habitat are also conducive to maximising estuarine retention of P and N; this aspect should be included in any cost-benefit analysis.

For the Humber, maximum denitrification of the riverine nitrate should be in the tidal rivers and around Trent Fall and may, thus, tie in with some of the Humber Estuary Shoreline Management Plan proposals. This work should be developed by a more integrated modelling approach.

**Table 1** Summary budget for dissolved inorganic nitrogen (DIN = nitrate + nitrite + ammonium) and dissolved inorganic phosphorus (DIP) for the Humber Estuary and associated tidal rivers, tonnes yr<sup>-1</sup>.

	DIN	DIP
Input	57.4 x 10 <sup>3</sup>	5.7 x 10 <sup>3</sup>
Output	55.2 x 10 <sup>3</sup>	0.85 x 10 <sup>3</sup>

**Table 2** Phosphorus sedimentation in the Humber

	Sedimentation Rate Tonnes yr <sup>-1</sup>	Sediment P content gP kg <sup>-1</sup>	P deposition tonnes yr <sup>-1</sup>
Holocene	2947000	0.7	2059
Modern	222000	3.3	733

**Table 3** Sedimentation and N storage in the Modern and Holocene Humber Estuary

**Holocene Estuary**

Environment	Area (km <sup>2</sup> )	Average %N content	Sedimentation Rate Tonnes yr <sup>-1</sup>	Total N deposited tonnes yr <sup>-1</sup>
Peat	51	1	2187	22
Alder Carr	955	0.9	1837080	16534
High Salt Marsh	124	0.55	233280	1283
Low Salt Marsh	146	0.23	262440	604
Intertidal Sand and Mud	365	0.06	612360	367
<b>Total</b>	<b>1640</b>		<b>2947347</b>	<b>18810</b>

**Modern Estuary**

Environment	Area (km <sup>2</sup> )	Average %N content	Sedimentation Rate Tonnes yr <sup>-1</sup>	Total N deposited tonnes yr <sup>-1</sup>
Peat	neg	1	0	0
Alder Carr	neg	0.8	0	0
High Salt Marsh	neg	0.45	0	0
Low Salt Marsh	5	0.25	10000	25
Intertidal Sand and Mud	106	0.09	212000	191
<b>Total</b>	<b>111</b>		<b>222000</b>	<b>216</b>

neg = negligibe

**Table 4** A budget of DIP and DIN in the Humber in Holocene times 3000 years BP (tonnes yr<sup>-1</sup>). PP is particulate phosphorus. Minus output denotes a net import.

	DIN	DIP
Input	1.1-2.2 x 10 <sup>3</sup>	24-98 (PP 666)
Sedimentation	18.8 x 10 <sup>3</sup>	2.1 x 10 <sup>3</sup>
Denitrification	2.0 x 10 <sup>3</sup>	0
Output (by difference)	- 18.6 - 19.7 x 10 <sup>3</sup>	~-1.4 x 10 <sup>3</sup>

**Table 5** A budget for a modern Humber without reclamation (tonnes yr<sup>-1</sup>)

	DIN	DIP
Input	57.4 x 10 <sup>3</sup>	5.7 x 10 <sup>3</sup> (PP 2 x 10 <sup>3</sup> )
Sedimentation	18.8 x 10 <sup>3</sup>	2.1 x 10 <sup>3</sup>
Denitrification	14.7 x 10 <sup>3</sup>	0
Output (by difference)	23.9 x 10 <sup>3</sup>	5.6 x 10 <sup>3</sup>

## **DISCUSSION GROUP A**

### **Key Issues for Economic Appraisal**

The group thought that the main areas that the Agency could improve and enhance are:

Health  
Security  
Amenity  
Recreation  
Heritage  
Landscape  
Nature Conservation  
Quality of Life

There is a need for a clear vision of what the Agency is seeking to do.

In the Humber there were specific issues where Economic Appraisal would help:

- **Managed Realignment:** This would have to be carried out but Economic Appraisal would help decide where.
- **Migratory Salmon:** It is uncertain whether or not the fishery was sustainable (self supporting) at the moment. If it were not, Economic Appraisal would be useful in evaluating the costs and benefits of achieving a fully sustainable fishery.
- **Amenity/Recreation:** There is an opportunity to enhance amenity and recreation as a marginal additional cost on major flood defence schemes.
- **Fish mortalities on power station inlet screens:** For new stations the onus should be on the developer to carry out an economic appraisal of measures to prevent fish mortalities. For retrofitting existing power stations, the onus is on the Agency.

**Copper non-compliance** This is thought to be a clear case where an economic appraisal could readily show that the cost of achieving the standards is far greater than the benefits that would accrue. Such a finding may also apply to some other trace contaminants.

It was thought that it is very difficult to put a price on protecting and enhancing the environment as the benefits are somewhat intangible.

### **How well informed should Agency staff be in relation to Economic Appraisal Techniques?**

It was felt that officers at area level should understand the principles and be aware of the methodology framework as our customers are starting to use these techniques. Expert advice should be available at region.

## **DISCUSSION GROUP B**

A great deal of discussion mainly focuses around the roles of the economist, Agency and community.

### **General**

Is it a case that when the scientists/engineers are flummoxed they call in an economist? If this is true, it must carry a health warning. It would be better to use an economist as a referee.

As the Agency has a 40-50 year strategy for the Humber, we have an opportunity to look for novel solutions and it might be the best place for economic evaluation.

The Agency should be trying to use more carrots than sticks.

The Agency should have a vision and a commitment. There is a worry that too much evaluation would mean that nothing would get built.

The Tees barrage was used as an example of vision and commitment and getting the job done. There are obvious pros and cons to this. It was felt that the Agency should be setting the agenda and policy and deciding things, but the Agency has to respond/bend to so many other factors – eg. politics and pressure groups.

How do you pay for collective goods, eg. flood defences? Should more individuals or companies pay for flood defences, but this might mean losing the strategic view and therefore being able to drive the policy and process forward. Is it cheaper to pay people to move?

### **Skills Required**

The Environment Agency needs the skills. There is a chasm between estuarine scientists/engineers and social scientists. However, we cannot be experts in environmental economics.

We need dialogue and a framework which staff can use, a framework which is relevant to the questions we might be asked. Agency staff needs to facilitate the process, but they also need to own the economic advice given. They need to be able to question it intelligently.

We have two sides of the triangle – the technical and research sides, we do not have the socio political. We must accept that people outside the organisation think differently. We need to bridge the gaps and engage in debate. We need transparency in the process.

### **How do we communicate environmental economics?**

Do we actually know who the community is? There are many communities. Some of these communities might be happy to be told, this is what you are getting, some may want full participation. We need to look at what levels we pitch the environmental economics. We must not be seen to be hiding behind 'experts'.

It might be possible to give a plan to a community and provide resources to allow them to explore alternatives. This would engage debate and reach a democratic consensus.

This all goes back to having a framework to work to in different scenarios.