

Challenges for Applying Cost-Benefit Analysis and Valuation of Environmental Benefits to aid environmental decision-making in practice: Dr Jonathan Fisher¹

Introduction	2
Outline	2
1. Key Principles and contributions of Economics to aid Environmental decision-making	3
Stages of an Options Appraisal	3
Importance of Proportionality	4
2. Analysis of Costs	5
Importance of Costs	5
Focus on key trade offs and sectors and pressures affected	5
Focus on key Decision-makers	6
Highlight high and rising marginal costs	8
Need for technological advances and role of economic instruments	8
Need for careful scrutiny of cost estimates	8
Give Insights – not “answers”	10
Relatively Less Analysis of Costs in the Literature	11
3 Valuation of environmental benefits of the Environmental Programme in recent periodic reviews of the water industry	11
Water Industry Periodic Review in 1999 (PR99)	11
Water Industry Periodic Review in 2004 (PR04)	11
Water Framework Directive (WFD)	15
Collaborative Research Programme (CRP)	15
NERA survey of valuation of environmental benefits of the WFD	15
4 Outstanding Challenges for valuation of environmental benefits	18
Political	18
Conceptual	18
Technical and Practical	18
Summary and Conclusion on the Challenges	24
Summary on the challenges	24
Conclusion on Way forward for Tackling the Challenges	25
5. Summary and Conclusions	26
Annex 1: Show Cards used in Survey of Valuation of Environmental Benefits of the Water Framework Directive	28
References	29

¹ Economics Policy Manager, Environment Agency for England and Wales. This paper represents the author’s personal professional views and do not necessarily represent those of his current or any of his previous organisations.

Challenges for Applying Cost-Benefit Analysis and Valuation of Environmental Benefits to aid environmental decision-making in practice²

Introduction

The Environment Agency has long been a strong supporter of environmental economics. Along with the Swedish Environmental Protection Agency, we are the only public bodies that are institutional subscribers to the European Association for Environmental and Resource Economists (EAERE). We sponsored a session at EAERE's conference in Southampton in 2001³ and have sponsored Envecon in 2007 and 2008. We have for four years given an annual prize for Masters dissertations that apply economic analysis to a practical environmental policy issue⁴.

In this vein, this paper highlights lessons and challenges for the environmental economics community for the practical application of Cost-Benefit analyses and benefit valuations so that they can best aid environmental decision-making in practice. It draws on 30 years experience of applying economic analysis to various environmental issues ranging from global matters such as climate change to local matters such as water management. This draws on experience of working internationally at the OECD and concerning the EC (regarding the development and implementation of the EC's Water Framework Directive), nationally in institutions responsible for developing environmental policies and applying the Treasury's Green Book guidance for appraisal and also ten years of working at the Environment Agency implementing environmental policies to achieve better environmental outcomes as efficiently as possible.

Outline

Section 1 draws on an earlier paper that set out key economic principles and the value added contribution that economics provides to aid decision-making.

Section 2 demonstrates the importance of careful analysis of the costs of proposed measures.

Section 3 reviews recent experience with the application of valuations of environmental benefits in the specific case of the periodic reviews of the environment programme for the water industry. This included carrying out about 440 CBAs for the appraisal of the environmental improvements in the review of the water industry in 2004.

Section 4 then draws on this experience to set out major challenges that the environmental economics community needs to overcome so that valuations of environmental benefits can best aid environmental decision-making in future.

²Dr Jonthan Fisher. This paper represents the author's personal professional views and do not necessarily represent those of his current or any of his previous organisations.

³ See Fisher (2001)

⁴ For further information see http://www.environment-agency.gov.uk/aboutus/512398/516810/516841/1297233/?version=1&lang=_e

1. Key Principles and contributions of Economics to aid Environmental decision-making

Economics can make the following fundamental contributions to aid environmental decision-making⁵:

- I. Environmental economics focuses on market failures, which are the primary rationale for considering government intervention.
- II. Economics addresses the important opportunity costs of environmental protection options in that the resources used for implementing the options could be used to yield other benefits.
- III. Economics is fundamentally concerned with analysing the trade-offs that decision-makers face in practice.
- IV. Economics focuses on analysis at the margin of the actual choices that decision-makers actually face in selecting between the options. Economics' law of diminishing returns reflects the fact that there are increasing constraints to achieving the greater levels of environmental improvements. This means that it will become increasingly more important to analyse the opportunity costs and trade-offs, as the public demands greater environmental improvements.
- V. Economic appraisal reflects the intensity of the preferences of all – or a representative sample of - individuals affected by the options.
- VI. Economic appraisal aims to specify comprehensively and systematically impacts of options without omissions or double counting.
- VII. Economics focuses on creating incentives for better environmental management. Moreover, it examines what incentives are created by options for the affected parties and how they might then respond to them. This can then help ensure that the measures will achieve the desired objectives and avoid unintended consequences.

Stages of an Options Appraisal

An appraisal of environmental policy options usually comprises the following stages:

- A. Identify and assess the problem (or opportunity). This involves an assessment of the risks of environmental impacts arising and the scale, nature and significance of these impacts.
- B. Specify objectives (in terms of improvements in A) and criteria for the appraisal.
- C. Identify and appraise options for tackling the problem. This involves:

⁵ For further details see Fisher, J.C.D, McMahon, P(2003) **Economics and Environmental Decision-Making**
<http://www.environment-agency.gov.uk/aboutus/512398/516810/516841/>

- (i) Assessing the costs of the options
 - (ii) Identifying key trade offs
 - (iii) Assessing and valuing the benefits of the options
- D. Compare the costs and benefits to inform which is the best option
- E. Evaluate the implementation of the selected option wrt its actual costs and its benefits and effectiveness in tackling the problem (or opportunity) and, if there remain significant residual problems, then reiteration of the appraisal to assess additional options to tackle them.

Importance of Proportionality

Carrying out economic appraisals can be expensive and time consuming. So it is necessary to examine the costs and benefits of the options to determine the appropriate form and level of economic appraisal. The benefits depend on the significance of the options and the trade offs facing decision-makers – hence focusing on principle III above will help here. The benefits are essentially the extent that findings of the appraisal will actually aid and improve to the decisions.

It is first necessary to specify clearly the question and issues – principle I about focusing on market failures can fundamentally help here. It is then necessary to focus the economic analysis on delivering value added information to improve decisions on the question and issues. The other principles above can then help shape the analysis accordingly.

Carrying out studies and surveys of environmental benefits can be particularly expensive and time consuming. Therefore this question of proportionality is particularly important here in addressing principle V above.

Assessing environmental benefits can involve qualitative, quantitative and monetary assessment, with each being an essential building block for the next one. This should start with a qualitative scoping of the impacts and uncertainties for the options and trade offs in question and then a systematic qualitative description of the nature and significance of these impacts using a simple Appraisal Summary Table.⁶ There should then be quantification of the scale of these impacts. Where the impacts and outstanding trade offs are significant, then it may be worthwhile valuing them in monetary terms using either benefits transfer or original valuation studies.

Since the costs of the appraisals rise substantially as you move along this spectrum of further analyses, we should start with the qualitative step and proceed along these sequential building blocks where the initial assessment shows this to be necessary due to, for example, significant trade offs and where additional analyses would yield value added information to aid decisions.

⁶ This is the approach in the New Appraisal for Transport (NATA). See Environment Agency (2002) which proposed this approach for the WFD. See Eftec (2007) for how the Environment Agency is applying this sequential building block approach to assess environmental benefits of flood risk Management schemes.

The following sections review experience of applying economic analysis to aid environmental decision-making over the last 30 years. Section 2 examines practical application of cost analyses which relates to principles II - IV and VII above. This mainly concerns stage Ci in an options appraisal. Section 3 examines practical experience of valuing environmental benefits which relates to principles V and VI. This mainly concerns stage Ciii in an options appraisal, but can be relevant to stage A in demonstrating the significance of the environmental impacts to justify considering options to tackle them.

2. Analysis of Costs

Analysis of the costs of proposed measures is a most important element of a **Cost-Benefit Analysis** for the assessment of the options (stage Ci in Section 1 above). It should be carried out **before** valuation of environmental benefits is conceived for this options appraisal stage C. It can help frame and target any such subsequent study to value the benefits of options (stage Ciii).

Importance of Costs

This **sequence** can focus attention on the costs of the measures and then highlight the correct key question of whether these costs are worthwhile. This can help avoid debates about whether it is possible to value some environmental impacts which involve individuals' subjective views. Such debates tend to generate more heat and emotive debate than helpful light to aid decisions. Fact of the matter is that some decision has to be made on the available options. Doing nothing implies a zero value to the environment. Eliminating the impacts implies an infinite valuation. Neither of these extremes is likely to be valid or helpful. Public decision-makers require a balanced assessment of the views and preferences of (a representative sample of) the affected people on the costs, impacts and outcomes for the available options (see Section 3).

Thus the EC's Water Framework Directive (WFD)⁷ helpfully first focuses on a cost-effectiveness analysis to estimate and scrutinise the costs of achieving an environmental objective and target (eg good status) and variations of this target⁸. It then asks whether these costs are disproportionate.

Focus on key trade offs and sectors and pressures affected

This cost analysis can identify the key trade offs and options on which difficult decisions need to be made and hence where CBAs could usefully aid such decisions. It can highlight the key pressures and sectors on which we need

⁷ See European Commission (2002) Economics and the Environment: The implementation of the Water Framework Directive: A Guidance Document (The Wateco Guidance).

⁸ This presents a significant challenge of how to derive consistent and comparable cost estimates for different sectors ranging from monopoly water companies to sectors subject to strong international competition (eg agriculture).

to focus the policy and economic analysis. For example, analysis of the costs of WFD measures shows that the costs of achieving WFD targets would be high and disproportionately expensive. It highlights that the following are the most important pressures:

- water resources,
- water quality pressures regarding phosphates and Ammonia
- Chemicals (Priority Substances and Priority Hazardous substances).

It shows that the annual costs of achieving good status under the WFD could most significantly affect the following sectors with highest cost first:

- water industry,
- agriculture
- ports.

Moreover, the cost analysis shows that existing separately binding EC statutory requirements (eg Urban Waste Water Treatment Directive, Nitrates Directives, Habitats Directive etc) make up a significant portion of these costs for the water industry and agriculture. These statutory requirements require cost-effectiveness analysis to determine how to achieve them at least cost – and **not** CBAs⁹ since CBAs would not be a valid argument or consideration in any infraction proceedings regarding these statutory requirements unless the Directive in question specifically allows for flexibility in implementation in consideration of costs and benefits. Consequently it is a waste of time and resources doing CBAs for such binding statutory requirements. Instead efforts should focus on CBAs for the further measures to achieve the WFD good status objectives, which will entail overcoming some major fundamental challenges (see Section 4).

Focus on key Decision-makers

For an economic appraisal to be most useful requires clarification of what decision it is helping to inform and who makes the key decisions on the trade offs in question. Thus Figure 1 also shows that almost all of the decisions on WFD measures are made at **national** rather than local or regional level. In the case of agriculture, flood risk management and EC cohesion Funds, it is the national tax payer that might be paying for the measures; so HMT will play a major role in determining these matters. Hence these would involve national decisions as to the overall sums involved. But they would involve regional and local decisions as to the allocation of these sums. For the water industry and PR09, the bills are company specific and paid by water customers at water company (close to regional) level. But any decision on bills in PR09 will still be made nationally within in an essentially overall national process (the periodic reviews). In contrast, Figure 1 also shows that more of the costs of WFD measures are borne by local customers rather than coming nationally from the exchequer. This means that we need an efficient means of explicitly incorporating the views of such local customers as part of the appraisal, consultation and national decision-making.

⁹ See Environment Agency (2003) **Economic Appraisal for the Environment Programme in PR04**
http://www.environment-agency.gov.uk/commondata/103599/eappenvprog_852140.doc

Thus there is a fundamental imbalance between local funding and national decision making in England and Wales. This causes significant institutional challenges and difficulties. It requires much greater and more explicit level of economic appraisals to justify such decisions at national level than is the case in other countries such as France, where decisions in each RBD are made at that RBD level since they are paid for locally at RBD level (see Figure 2). Consequently locally based appraisals and decision-making are likely to be less applicable in England and Wales.

Figure 1 Who funds and who decides on WFD measures

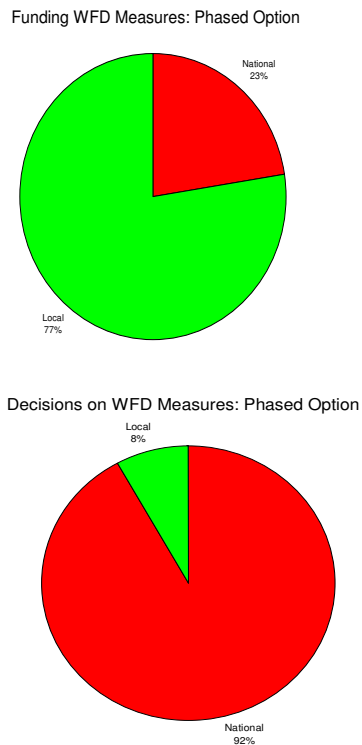
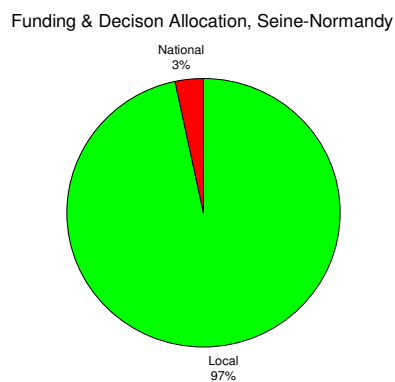


Figure 2 Decision and Funding in Seine-Normandy



Highlight high and rising marginal costs

Cost analysis can highlight high and rising marginal costs of achieving greater environmental protection (see for example ERM Economics (1996)). This can identify distinctive points at which costs rise sharply and where problems for decisions are most likely to arise and hence where CBAs should focus on estimating the outcomes of options to compare with these costs.

Need for technological advances and role of economic instruments

However, faced by such a high and rising marginal cost curve, we need then to examine how to induce technological changes to shift the cost curve downwards and to the left. OECD (1984)¹⁰ examined this subject and highlighted the potentially beneficial role of economic instruments in providing a dynamic incentive for polluters to reduce these costs and achieve more effective and efficient environmental improvements over time.

Consequently, we may then need to estimate the environmental damage costs of current pollution levels to aid setting such an economic instrument to support the case for providing such an ongoing dynamic incentive. This would be consistent with the WFD. Thus we have estimated the costs of current water pollution and abstractions in England and Wales¹¹. Defra has recently updated the valuations of the environmental costs of failing to achieve good status in NERA's benefits survey¹².

Need for careful scrutiny of cost estimates

There can be significant differences in cost estimates given by different bodies at different times. For example, Table 1 shows that water company's initial estimates of the present value (PV) of their estimates in their Draft Business Plans (DBP) are significantly (ie about 40%) higher than their costs in the Final Business Plans (FBP) once Ofwat and the Environment Agency have scrutinised the estimates and significantly refined the scheme requirements. In two of the schemes, the difference in the cost estimates meant that the findings of the appraisal changed from the schemes having costs greater than benefits to benefits exceeding the scrutinised costs.

A key role of economic analysis should be to give insights into the reasons for differences in the cost estimates to aid public decision-making. Thus, in response to the cost differences in Table 1, the Environment Agency (2005a) emphasised the importance of careful scrutiny of water company's initial estimates since they have an evident strategic incentive to over-estimate the costs at early stages in a periodic review.

¹⁰ OECD (1984) Environmental Policy and Technical Change.

¹¹ See the assessment for the Article 5 report for the WFD in Environment Agency (2005c)

¹² See NERA (2007) http://www.coastms.co.uk/cgi-bin/ftpex/FTPex_conferences.cgi?browse&Outputs%20and%20Reports/A%20%20WFD%20Benefits%20Report%20Nov%202007

Table 1: Changes in Company costs from Draft Business Plans (DBP) to Final Business Plans (FBP) in PR04

Scheme name	PV costs (DBP) (£k)	PV costs (FBP) (£k)	Difference in costs (£k) [% change FBP vs DDP]	Reason for cost difference
Thornaby	1,208	1,300	92 [+8%]	No significant change
Etton	1,615	1,090	-525 [-33%]	Options clarified and implementation scheme agreed
Windemere	17,800	8,220	-9,580 [-54%]	The costs of phosphorus removal and impact investigations were originally included but these will not affect outcome of scheme and were therefore excluded
Coniston	8,448	2,740	-5,708 [-68%]	The costs of phosphorus removal and impact investigations were originally included but these will not affect outcome of scheme and were therefore excluded
Dambridge	14,100	10,180	-3,920 [-28%]	Scheme clarified following options appraisal
Tetbury	2,296	2,490	194 [8%]	No significant change
Dour	298	1,430	1,132 [380%]	Scheme clarified following options appraisal
Blewbury – The Cleve	4,185	1,720	-2,465 [-59%]	Scheme clarified following options appraisal
Total	49,960	29,170	-20,790 [-42%]	

Key:

	Costs increased by >20%		Cost lower by >20%
--	-------------------------	--	--------------------

Source: Environment Agency (2005b)

The media tends to pick up on differences in cost estimates and unfortunately often makes unhelpful remarks about economists never agreeing etc. This is most prevalent regarding disputes over the costs of climate change control measures.

A key role of the economic analyst is to set out the various cost elements associated with proposed measures and then give appropriate methodologies to estimate each element and, more importantly, give key insights to aid policy making. For example, with respect to climate change measures, we need to distinguish between the following 3 elements¹³.

¹³ Fisher, JCD (1991), Transition and Continuing Costs. Paper for a workshop in Washington USA on “The Uses and Limits of Economic Models as a Tool for Assessing Climate Change Policies. 1991

- A. No regrets measures that could yield benefits
- B. Transitional dislocation costs from changes in established consumption and production patterns and premature scrapping of capital and macro-economic disruption in response to controls (eg increased energy prices).
- C. Long run equilibrium costs from reallocating resources to reduce greenhouse gas emissions from other uses.

Fisher and Grubb (1997) explain which economic model addresses which of these cost elements A-C above¹⁴. Given the different nature of the elements above, it is not surprising that different models generate different cost estimates.

Moreover, different countries will be most concerned about different aspects of these cost elements which will be most important in different circumstances. Thus developing countries will be most concerned about C – the opportunity costs to their development of having to pay higher energy resource costs and reallocate resources from development to reducing greenhouse gas emissions and hence not being able to benefit from development in the way that developed countries did earlier. The developed countries will be particularly concerned about dislocation costs in B as well as the ongoing opportunity costs in C.

Give Insights – not “answers”

Any economic analysis and model should give policy analysts and decision-makers **insights** to aid decision-making – **not “answers”**.

Careful analysis of each of these cost elements is needed to give a full assessment of the costs and to identify options to reduce them. Thus sudden implementation of stringent measures later on could subsequently cause significant dislocation costs. This underpins the Stern report’s calls for early (rather than late) action on climate change to prevent having to implement much stricter and much more costly measures later on – see Stern (2007). Moreover, it supports Professor Helm’s calls¹⁵ for integrating climate change concerns into current decisions (eg on energy infrastructure) to prevent us being locked into carbon intensive systems and to avoid significant dislocations costs if tighter climate change controls have subsequently to be introduced. We therefore need to integrate climate change concerns into development plans and processes and seek to promote economic and technological changes that will reduce both the ongoing opportunity costs and also potential dislocation costs.

¹⁴ For a fuller description and analysis of the various models and studies, see Department of the Environment (1991) *The Macroeconomic Consequences of Controlling Greenhouse Gas Emissions: A Survey*. Report by Professor Alan Winters, Rosemary Clarke, Gianna Boero. HMSO. IASBN 0 11 752540 8.

¹⁵ See for example, Helm, D (2007), *European Energy Policy: Meeting Security of Supply and Climate Change Challenges*. European Investment Bank Papers, Volume 12, 2007

Relatively Less Analysis of Costs in the Literature

Given this importance of analysis of costs for the reasons set out above, it is surprising that the subject gets relatively little treatment in the environmental economics literature, which tends to be dominated by papers on economic instruments and the valuation of environmental costs and benefits see Table 2 which indicatively illustrates the numbers of papers given at recent EAERE and Envecon conferences.

Table 2: Papers at Key Environmental Economics Conferences¹⁶

Subject	EAERE 2007	Envecon 2008	Envecon 2007	Envecon 2006
Valuation of Environmental benefits	78	9	16	11
Economic instruments	50	4	3	2
Environmental Policy	36	1	2	1
Technology	21	1	1	1
Costs	14	2	2	3
Cost Benefit analysis	5	2	2	1
Other (including resource management)	96	1	1	6

3 Valuation of environmental benefits of the Environmental Programme in recent periodic reviews of the water industry

Water Industry Periodic Review in 1999 (PR99)

The Agency carried out about 700 Multi-Criteria Assessments (MCA) using the Multi-Attribute Technique (MAT) to prioritise and rank a large number of schemes, which successfully led to a major environmental improvement programme in PR99.

However, this was heavily criticised afterwards by Ofwat and the water industry largely on the grounds that the MCAs did not demonstrate that the measures were worthwhile and did not reject or defer any schemes that were not worthwhile¹⁷. This led to DETR requiring the Agency to reappraise 62 schemes. The Environment Audit Committee (EAC) recommended (para 90) that “The Environment Agency must develop and strengthen its capacity to assess and demonstrate the benefits of the schemes which it proposes for inclusion in future National Environment Programmes”.

Water Industry Periodic Review in 2004 (PR04)

Accordingly, the Agency carried out extensive work to develop the Benefits Assessment Guidance (BAG) to apply CBAs for PR04 so as to prepare the

¹⁶ Table 2 is purely indicative and is based on quick review of the agendas for these conferences. Welcome fuller and more accurate figures.

¹⁷ Select Committee on Environmental Audit (2000) [Seventh Report: Water Prices and the Environment](#) <http://www.publications.parliament.uk/pa/cm199900/cmselect/cmenvaud/597/59703.htm>

Environment Agency's advice to Defra and Welsh Assembly Government (WAG) Ministers who decide on the requirements in the environmental programme for the water industry in the periodic review. We involved stakeholders (Defra, Ofwat, water industry, Watervoice, RSPB) and leading economic researchers in developing and reviewing the BAG and examining in-depth the available studies. This included a seminar and a workshop in 2003, which refined the methodology and the valuations used in it.

We devoted about 19 person years of work and £165k in consultancy support to assess the benefits and costs of 437 schemes and assess the overall benefits of the whole environment programme for PR04. These are more cost benefit assessments than any other organisation in Europe carried out in 2002/3 and the largest such appraisal of its kind in the UK to date. We demonstrated the benefits of the overall (statutory and non-statutory) Environment Programme for PR04 by quantifying its environmental outcomes (e.g. 4267 kms of rivers improved). We valued these benefits in England and Wales at about £200m- 400m pa or a capital sum of £3.1bn to 5.6bn (Environment Agency (2004)). The water industry, Ofwat and academics made a number of criticisms of the BAG, which we examine in the challenges for environmental valuation in Section 4¹⁸. Most notable they criticised valuations from a study of an individual scheme being applied to all schemes in a programme, which could lead to over-estimation of benefits.

We assigned the non-statutory schemes to one of the following six categories on the basis of their Benefit:Cost (B:C) ratio and additional benefits not (adequately) covered in the monetary benefits assessments and factors of particular importance to local stakeholders:

1. Regionally important schemes identified by the Agency and/or local stakeholders as being of high local importance and regional priority but which have monetary benefits less than 1.2 times costs;
2. Monetary benefits at least twice as great as costs;
3. Monetary benefits less than double but more than 1.2 times costs;
4. Monetary benefits less than 1.2 times but greater than 0.8 times costs;
5. Monetary benefits less than 0.8 times costs;
6. Schemes which have benefits exceeding 1.2 times their costs but which we recommended for deferral.

Categories 1-3 comprised the non-statutory schemes that the Agency recommended for implementation in PR04. Categories 4-6 comprised the non-statutory schemes that we recommended for deferral. This was not a mechanical exercise. We made specific allowance for qualitative consideration of unquantified impacts, local circumstances and plausibility checks (in placing schemes in category 6).

Figure 3 shows the total number of non-statutory schemes in England and Wales in each of these six categories. Table 3 shows the overall number of these schemes and their total costs and benefits for categories 1-3

¹⁸Environment Agency (2005b)), http://www.environment-agency.gov.uk/aboutus/512398/516810/516841/554371/?version=1&lang=_e

(recommended for implementation) and categories 4-6 (recommended for deferral).

As a result of our assessments, in our advice to Defra and WAG Ministers in November 2003, we proposed schemes that would achieve environmental benefits in excess of £1bn and that would achieve 80% of the total environmental benefits at 37% of the costs of the total possible programme. We advised that schemes costing more than £1bn be deferred. Hence we considerably enhanced the value for money of our proposed environment programme.

Figure 3: Number of non-statutory schemes in each category

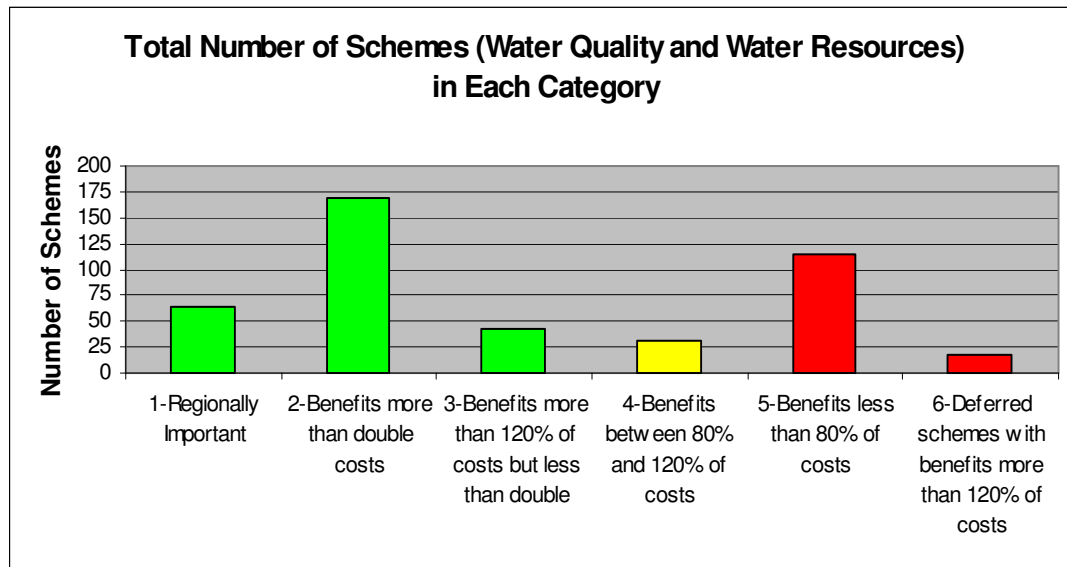


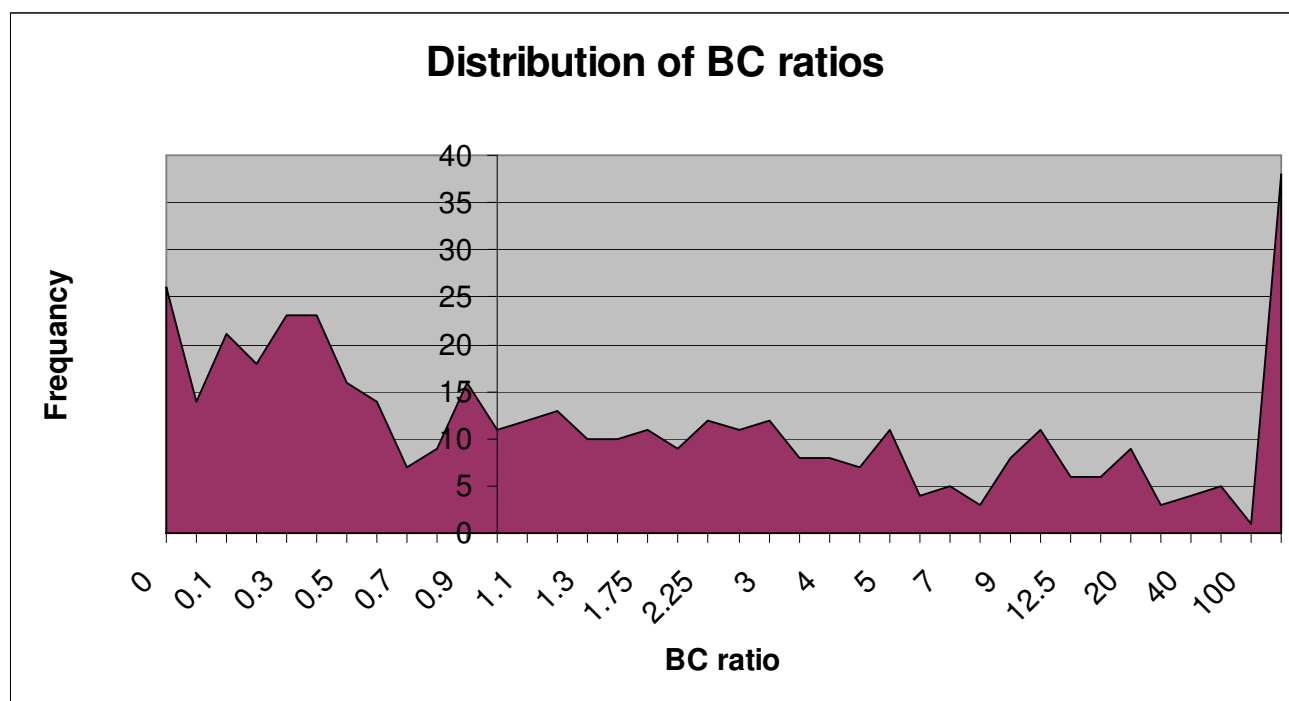
Table 3: Summary Findings of Costs and Benefits of Schemes

	Categories 1 to 3 Proposed schemes (% of total)	Categories 4 to 6 Deferred schemes (% of total)	All categories
Total number of schemes	274 (63%)	163 (37%)	437
Total costs	£649m (37%)	£1,035m (63%)	£1,684m
Total benefits	£1,160m (80%)	£286m (20%)	£1,446m

Source: Environment Agency (2003b)

Figure 4 shows the distribution of the non-statutory schemes by their benefit:cost ratio. There are spikes at either end with many schemes with low B:C ratios because they had either low benefits or high costs and there are many schemes with high B:C ratios because they could achieve significant benefits and/or can be delivered at zero or low cost since they were being integrated on top of a scheme to achieve an existing statutory driver. This points to the need for a rapid means of quickly eliminating the former category and approving the well worthwhile schemes in the latter category.

Figure 4: Distribution of Benefit:Cost ratios in schemes



Source: Environment Agency (2005b)

Unfortunately many of our worthwhile proposed non-statutory schemes were not funded and implemented due to affordability constraints, which meant that the PR04 programme was largely limited to meeting the existing statutory requirements. One might therefore question whether it was worth devoting so much time and resources to doing CBAs on all these non-statutory schemes. Consequently, it is important to do a sound preliminary analysis to determine the possible scope of the programme. This must include deriving soundly reviewed estimates of the costs of the statutory programme before determining what efforts to devote to CBAs for the non-statutory programme.

Nevertheless, we needed to make these major efforts to demonstrate that we could seriously engage and develop appropriate cost-benefit analyses for PR04 to address the concerns and criticisms of the MCA techniques used in PR99. We needed this to support our line of cost-effectiveness analysis for the statutory programme and CBAs for supplementary measures¹⁹. Moreover, there were no reviewed cost estimates available at an early stage in PR04 since Ofwat would not review the costs until late in that review. In preparing for the WFD, Ofwat have addressed this point by analysing and scrutinising costs in the preliminary cost-effectiveness analysis for the WFD which helped inform the specification of environmental requirement for companies and others in the first round of River Basin Management Plans for the WFD.

¹⁹ See Environment Agency (2003a) **Economic Appraisal for the Environment Programme in PR04**
http://www.environment-agency.gov.uk/commondata/103599/eappenvprog_852140.doc

Water Framework Directive (WFD)

The WFD allows for exemptions if the costs are disproportionately expensive. Hence this entails careful scrutiny of the costs and some form of CBA in determining the case for such exemptions.

Collaborative Research Programme (CRP)

Consequently, we instigated the establishment of the CRP to develop methodologies and tools for the economic analysis for implementing the WFD. Defra subsequently led this major research programme, which has a budget of about £1.8m over 4 years and involves the major bodies and stakeholders concerned with the WFD²⁰.

The CRP first focused on developing methodologies for cost-effectiveness analysis – in line with the sequence advocated in section 2.

The CRP then devoted considerable effort and resources to improving the valuation of the environmental benefits for implementing the WFD.

NERA survey of valuation of environmental benefits of the WFD

The principle aim of this study was to estimate the overall level of the environmental benefits of the WFD on a national basis to aid decisions about what is disproportionately costly and hence inform the broad scale of the programme of measures for the first round of River Basin Management Plans (RBMP) for the WFD. Defra used the results of this survey to inform the draft Ministerial Guidance for implementing the WFD.

The study was carried out in line with best practice and was extensively peer reviewed by leading academics in environmental valuation. The steering group included representatives from Defra, Environment Agency and UK Water Industry Research (UKWIR).

Extensive deliberation is an essential precursor to a benefits valuation survey to clarify people's understanding of the issues and to frame the questions accordingly. Accent carried out this for this study, which is one of the best examples of such deliberative studies so far undertaken as a core component of a stated preference valuation survey.

Table 4 summarises the results from the different elicitation methods. This shows mean Willingness to Pay (WTP) for improving 95% of water bodies to good/high status by 2015. This shows the big range of valuations given by the different elicitation methods. Defra derived a tighter value range from a conservative interpretation of NERA's results based on:

²⁰ These collaborators included: Environment Agency, Defra, Welsh Assembly Government, Scottish Executive, Department for Trade and Industry (as was), Natural England, Sniffer, UK Water Industry Research (UKWIR), Joint Environment Programme of the Association of Electricity Producers (JEP), the Department For The Environment in Northern Ireland (DoENI), the Country Land And Business Association (CLA), the National Farmers Association (NFU), Royal Society for the Protection of the Birds (RSPB) and the British Ports Association and the UK Major Ports Group

- a revised analysis which took out respondents from the ladder payment card (PCCV) and the dichotomous choice (DCCV) questions who gave inconsistent replies in the Contingent Valuation (CV) survey.
- a range based on the recommendation from Nera/Accent that the true value would lie at the lower end of the range between PCCV and DCCV. The upper end of this range is based on half the DCCV value.

The resultant mean per household per year WTP estimates are:

- £49 to £87 for the revised analysis, and
- £45 to £85 for the lower part of the payment card and Dichotomous choice range

This conservative approach is in line with the advice of the eminent economists on the NOAA panel on CV (Arrow et al (1993). But Hanley and Shogren (2005, p. 16) rightly point out that “it is not obvious that always choosing the lower value for an environmental impact makes sense .. in terms of allocative efficiency”. Hanley’s comments become particularly pertinent when we face significant trade offs where the balance of costs and benefits is not clear cut and requires careful assessment. In such circumstances, we cannot just take conservatively the lower values. The values chosen need to be based on a sound and objective consideration of reasons why the possible values might be over or under-estimates (see Section 4).

Table 4 WTP (Willingness to Pay) Valuations of benefits for Water Environment Improvement by Elicitation Method

Elicitation Method / Model	England Mean WTP £/hh/yr	Wales Mean WTP £/hh/yr	England and Wales Mean WTP £/hh/yr
PCCV Sample Statistics	49.2	62.6	50.4
PCCV OLS Model	44.8	40.1	44.5
DCCV Turnbull Statistics	101.6	129.9	103.0
DCCV Logit Model	167.0	181.4	167.9
Choice experiment Logit Model	293.7	508.0	299.9

Source: NERA(2007)

This valuation survey by NERA is the best survey done so far on the environmental benefits of the WFD (and probably other environmental subjects). It achieved its designated purpose of giving an approximate valuation for the overall benefits of the WFD which has effectively shaped and focused the first RBMP for the WFD.

Limitations

However the survey still has the following limitations, which particularly affect how the results can be used.

The uncertainties associated with the impacts of improvements and stated preference techniques mean the results can only be seen as approximate.

The water industry and Ofwat criticised the survey's focus on just the environmental benefits and does not adequately make respondents address the opportunity costs of their stated preferences in terms of alternative services (eg water service improvements) that could be foregone by devoting resources to securing such environmental benefits. Consequently they prefer their choice experiment surveys asking customers to express choices between the environmental improvements and other service improvements, although it is not clear that these can provide sufficient information on the environmental benefits in question (see Section 4). The NERA questionnaire reminded respondents to consider "your household budget and all of the things that you and your household need or would prefer to spend your money on before you decide" and (qu 24d) "where you would find the money from for the extra payment". However, it could be worthwhile emphasising this more and perhaps checking whether respondents would really be willing to pay their stated sums in the CV questions in terms of asking whether they would be willing to forego some equivalent service benefits that they could otherwise purchase with this sum. It is not clear if it is possible to devise such a supplementary question to check that respondents are really willing to pay the high values given by the CE (see Table 4) since these are derived by econometric analysis after the survey is completed.

Table 4 reports mean values - in line with the economic efficiency principles of CBA in assessing the intensity of preferences of beneficiaries. However, the water industry stress that median values are approximately 40% lower and highlight distributional issues since all customers pay for the measures.

The Nera survey does not provide values for addressing individual pressures. In particular, while the survey included consideration of low flows caused by abstractions in the descriptions of the water bodies, it did not include a separate diagram of low flow problems. So it is not clear how fully the survey respondents covered low flow issues.

The analysis was essentially a national survey and so has more limited application at water body or scheme level where individual characteristics and values will vary from site to site and for which valuations need to be treated carefully as being indicative. The sample size was 1487, which gave reasonable benefits estimates at the national level. But smaller sample sizes in each RBD may limit the applicability of benefit estimates for each RBD.

Most significantly, Table 4 highlights that the valuations given by the CE method is 2-6 times greater than that those for the CV methods. These high valuations given by the CE method were rightly not used to estimate the benefits since they were not considered valid and plausible. The ranges of valuations given can still help determine the first River Basin Management Plan (RBMP). But as the choices and conflicts become more pronounced in further rounds of RBMPs, then such a wide range of benefits valuations would be of more limited use. This poses serious credibility problems for the environmental economics community, especially since valuation critics are likely to emphasise these differences in support of their arguments that Stated Preference techniques are at best useless and at worst misleading.

4 Outstanding Challenges for valuation of environmental benefits

Consequently the environmental economics profession needs to address and overcome the following major challenges²¹ to enable valuations of environmental benefits to aid environmental decision-making in future.

Political

1. It is difficult to include non-anthropocentric valuations of environmental benefits (eg intrinsic value of nature in its own right independent of human welfare) in monetary valuations in a CBA. This is a matter for policy makers (Defra/Welsh Assembly Government, Scottish Executive) to determine and give guidance on. Such policy guidance needs to highlight that economic appraisal is one **input** to decision-making. The intrinsic value of nature could be addressed through the existing policy framework. For example, the WFD could be said to assign these natural rights to the environment in terms of specifying Good ecological status (GES). It then puts the onus on the polluters to prove that the costs of measures to achieve GES are disproportionately expensive, which a CBA (based on anthropocentric valuations) could then help to determine.

Conceptual

2. Some (eg Sagoff (1988) argue that collective values (derived through a collective discussions such as focus groups or citizens juries) differ significantly from the aggregation of individual values (through economic valuations such as stated preference surveys). However, others (Turner (2007) consider that they push this distinction too far and that since resources and especially public budgets are constrained, there are always opportunity costs of actions which must be fully taken into account. Moreover, the advocates need first to demonstrate just what are the significant additional aspects of collective values that are not adequately reflected in the aggregation of the individual valuations and show how these can be taken into account in practice.
3. CBA is concerned with enhancing efficiency. Strictly applied it does not allow for distributional or equity concerns. However, Sugden (2004) proposes disaggregating the costs and benefits to specific groups as a way of overcoming this limitation. The Green Book (HM Treasury (2003) advocates application of equity weights to assign greater weight to impacts on lower income groups.

Technical and Practical

²¹ For a fuller discussion, see Jacobs (2006) Report on non-use benefits valuation. Report for the Environment Agency.

4. **Sound scientific information.** We need sufficient scientific information to describe and quantify the impacts in question, especially for **marginal/incremental improvements** from measures and for **changes in the risks** (or likelihood) of such impacts arising since questions of risks underlie most environmental policy debates (Hanley and Shogren (2005)). The Ecosystem Services approach could enable and facilitate such greater and better specification and assessment of the impacts²². Multi-disciplinary work is needed to link the outputs from Environmental Impact Assessments and scientific and risk assessment to input into an options appraisal, including risk management²³. There was considerable input from Environment Agency technical specialists in helping NERA carry out the WFD benefits valuation survey described in Section 3. A key challenge here is that it can take more than 1 year to complete a sound original benefits valuation survey. Scientific analyses will continue in parallel to input into the policy making process. Consequently, we have to input into a survey the best possible scientific assessment for the impacts of the options in question at that time based on certain assumptions, which need to be clearly spelt out. Subsequently, as the options and their impacts change as the policy analysis develops, then the economic analysis will need to be refined so that the findings are appropriate to the outstanding options in question.
5. **Specify clearly the impacts.** A survey needs to cover all aspects, looking broadly and including social aspects (eg impacts of angling in reducing crime and help to disadvantaged groups). But we need to work hard to specify clearly just what are the additional benefits that a specific additional aspect brings to the debate to avoid problems of a long list with overlaps and double counting. This could be best pursued concretely (rather than in abstract) in the working up of the qualitative descriptions of the benefits of the measures – as in the Appraisal Summary Tables referred to in Section 2. In this, we need to address the issue of how to treat option value (which should really be part of the use value for which they are an option value rather a non-use benefit per se). We also still need to find a new term for the non-use components of the impacts, which are more comprehensible to a non-specialist audience.
6. **Adequate information and perception of such impacts** is essential for respondents to be able to derive good valuations of them. Best practice guidance for stated preference surveys (eg Bateman et al (2002)) requires that sound means are used to provide this information (eg use of visual aids etc). This aspect is particularly important for the intangible environmental benefits about which respondents are not well aware and do not have readily defined views and preferences. The significance of

²² See Defra (2007a) The Ecosystems Approach Project – Action Plan - <http://www.defra.gov.uk/wildlife-countryside/natres/eco-actionp.htm>

DEfra (2007b) Introductory Guide to Valuing Ecosystem Services - <http://www.defra.gov.uk/wildlife-countryside/natres/eco-value.htm>. This includes a case study that the Environment Agency provided on the application of the ecosystem services approach to a flood risk management scheme.

²³ Accordingly, the Environment Agency is developing a handbook for valuation of environmental benefits of habitat improvements for flood risk management schemes – See Eftec (2007)

the lack of information can be particularly important if respondents are being asked to compare these intangible environmental benefits with more tangible benefits that they can more readily perceive and understand (eg availability of water in taps, sewer flooding etc). We also need multi-disciplinary research to understand peoples' concerns about such impacts and their motivations behind their perceptions and valuations of such impacts. Moreover, it is essential to do such research on specific issues through in-depth discussions. But such discussions can only involve a limited number of people, who may not be representative of the affected people. So this is essentially a prelude to a stated preference survey of a wider representative sample of the affected people.

7. Moreover, the survey needs to cover their perceptions and valuations of **perceived changes in risks** – or likelihood of impacts arising, for which we may need to distinguish between risks of loss of an environmental asset as opposed to benefits of achieving greater environmental improvements since the valuations for these changes can differ. In the past, some studies have valued changes in outcomes as if they were certain and treated scientific outputs as definitive. But most environmental policy matters today concern changes in risks – or likelihood of outcomes. For example, studies of the benefits of low flow alleviation have to value the benefits of a river running dry one year in 10 instead of every four years (in the absence of any policy change) – see Jacobs Gibb (2002).
8. **Sound estimation of the number of beneficiaries**, which can also be affected by the following practical issues regarding the valuations. It is much more important than the individual valuations (see the Axford case), but most of the debate in the literature and in the public discourses is about the individual values with the exception of good discussions on distance decay relationships. We need to allow appropriately for distance decay effects (ie those living close to the environmental asset generally have higher valuations than those living further away from it).
9. We need to **allow for availability of substitute sites** that beneficiaries could visit or enjoy.
10. **Scoping, embedding and part-whole effects.** It is important to value an individual scheme as part of an overall programme (as was done in the Mimram and Darent studies of benefits of low flow alleviation from water resource improvement programmes – see Jacobs Gibb (2002), Willis and Garrod (1994))
11. **Allowing for income constraints.** We need to allow for opportunity costs of a person's stated preference and willingness to pay for an environmental benefit in terms of the other goods or services that they would be willing to forego to allocate some of their finite income to this environmental benefit.
12. **Size and representativeness of the sample of beneficiaries in the study.** We need a sufficiently large sample size to derive valid

valuations. This can present significant challenges when examining sub-samples for specific locations.

13. **Starting point bias.** Valuations given can be affected by any initial sum mentioned to survey respondents in a Dichotomous choice Contingent Valuation (CV) question as to whether they are willing to pay this sum. But using a payment ladder in a PCCV starting from zero could likewise bias the valuations downwards.
14. **Warm glow effects.** We need to ensure that individuals' responses reflect their real preferences and not just a good feeling (warm glow). However, it is difficult to separate out a warm glow response from a real preference and WTP view. We suggest this is best handled by addressing properly the income constraints (10), clarifying peoples' concerns (4) and ensuring that their values represent individuals' real preferences.
15. **Need clear presentation of findings, methodology and assumptions.** Our review of the available benefits valuation studies for the development of the Benefits Assessment Guidance (BAG) in PR04 (see Section 3) found that, in many cases, the reports did not clearly present their findings and how they were derived (Environment Agency (2003c)). This made it difficult to apply and use them. Consequently, we had to interrogate the studies carefully and convene a 2 day workshop to determine how best to use these studies. Therefore it is essential that study authors pay particular attention to presenting clearly their findings and how they were derived, including the methodology and key assumptions and clear descriptions of the environmental changes being valued and what information they provided respondents on them. They need to go the extra mile to ensure that the final report is clear on these matters.

We face a fundamental outstanding problem that even the best practice SP techniques may not be able to answer all of these challenges, especially 3 – 12 above. Hence there are always going to be limitations, criticism and challenges to any study.

However, the problem for decision-making is that the alternatives equally cannot measure up to all these challenges and in fact fare worse. For example, Turner (2007, p. 266) concludes that "the appropriate scope for CBA may have to be limited to use and option values in the environmental context, with existing values left to other forms of analysis". But such use and option values do not cover all the benefits and hence such a CBA would miss out key elements. It is not clear what he means by 'other forms of analysis'. But he

Deliberative research techniques such as focus group are often proposed as an alternative that better reflects people's more informed views on an environmental issue in question. However, such discussions can only involve a limited number of people, who may not be representative of the affected people. In particular, they usually do not include representatives of one body that might be asked to pay for the measures (HM Treasury), which means that

they may fail to address challenge 10 above and therefore this seriously limits their validity and use. So this technique should be essentially a companion and prelude to a stated preference survey of a wider representative sample of the affected people rather than a substitute for a valuation survey.

Valuation surveys are expensive, especially since they need to be undertaken with great care to address all of these challenges. Some argue that if a policy could cost £bns, then we must spend commensurate sums on valuation studies (costing £100k - 200k+) to determine that the measures are worthwhile. But any such survey must actually yield better value added information that reduces uncertainties and aids decision-making. It should not just give an uncertain wide range of benefits, which we could know from a scoping assessment rather than an original survey – in which case it might be better to use the research funds to scrutinise the costs and seek ways of reducing them.

Moreover, we need to make best use of the available constrained budgets to do more new studies to overcome the challenges and improve the benefits valuations. This should be part of a coherent long term programme. We need the information gathered to address challenges 3-6 (eg in the first phase of this programme) to form a sound basis for new surveys that address effectively the remaining challenges (7-12). This is in line with the qualitative, quantitative and monetary building blocks in our framework for assessment and monetary valuation of environmental benefits (see Section 2).

There are various options for tackling each challenge above. Each alternative has its respective advantages and disadvantages. So, in effect, we need to do a CBA of the options.

A proposed 'solution' for one challenge might not handle another challenge or might exacerbate it. For example, a choice experiment survey addresses well trade offs, income constraints and embedding (challenges 9 +10). But it could exacerbate the problem of respondents not being adequately informed about the impacts in question (challenge 5). It might also require greater sample sizes (11). Likewise, deliberative processes such as focus groups can address challenges 3, 4 and 5 of clarifying and specifying the impacts and providing good information to enable people to value them. But they fail challenges 10 and 11 since the small groups consulted are not representative and the process may not enable the respondents to take due account of income constraints and opportunity costs of their preferences.

Therefore there is no **simple single solution** to all the challenges.

Choice Experiment (CE) vs Contingent Valuation (CV) Surveys

We need to identify and analyse variants of the options that achieve the advantages while overcoming or diminishing the disadvantages. For example, there are five alternative ways of tackling the challenge of how to address embedding, part-whole effects and income constraints, which are key challenges 9 and 10 above:

- (i) Statement of opportunity cost in survey;
- (ii) Reminder/emphasis in survey (e.g., references to foregone goods, current bills, past payments for improvements, extra bills to pay for additional improvements in question);
- (iii) Deriving value for a total program and individual schemes within it;
- (iv) (iii) with (ii)
- (v) Choice experiment survey for total programme

Table 5 reviews potential advantages and disadvantages of each approach.

Table 5: Means of Addressing Income Constraints and Part/Whole Problems

Method	Example	Advantages	Disadvantages
(i) Statement	Willis and Garrod (1996)	Simple statement	Limited, not address embedding
(ii) Emphasis	Georgiou <i>et al.</i> (2000a) – River Tame Georgiou <i>et al.</i> (2000b) – bathing waters	Clear and with emphasis by illustration	Does not address embedding
(iii) Value benefits of a scheme in context of valuing benefits of all schemes in programme	Jacobs Gibb (2002) – Mimam Willis and Garrod (1994) – Darent	Addresses embedding, emphasises costs	Complicated for respondent to understand
(iv) (iii) + extra emphasis of opportunity costs in terms of goods foregone + check respondent is really WTP their stated sum in foregoing equivalent goods and services they could purchase with this sum	NERA survey for WFD (see section 3)	Addresses embedding, and allows for opportunity costs	Complicated
(v) ii + comparison with alternative improvements.	Yorkshire Water (2002)	Addresses opportunity costs, embedding, simultaneous valuation and comparisons between service improvements. Comparison with goods/services can overcome some people's problems with assigning monetary valuations and can reduce protest votes.	Study is costly and takes long time (Yorkshire Water survey cost £250k) Ltd categories and information that can be provided on them; esp on intangible env benefits (see challenge 5 above). Not clear how wide the scope should be. Green Book (covering wide range of public expenditures) uses monetary valuation as common measure. ? Problems where not possible to check in the original CE survey that people are really WTP the sums in terms of goods foregone since the WTP sums are calculated after the survey by analysing the CE findings. So might need follow up validation survey, which would take time and might not be feasible where there are

			tight and binding deadlines by which policy decisions have to be made on the matter in question..
--	--	--	---

Summary and Conclusion on the Challenges

Summary on the challenges

The most important outstanding challenges concern:

- how to address income constraints (challenge 9)
- and cover an overall programme of measures and schemes (8);
- while providing full information on the risks of each of the impacts arising so that respondents can properly perceive and value them (5).

This is particularly challenging where a policy comprehensively covers many wide ranging measures - as is the case for the WFD for which Table 6 illustrates its main diverse types of pressures, measures and impact categories. Respondents in a survey can only handle information on a limited number of impacts. NERA, in their survey, cleverly addressed this problem by focusing on non-use benefits and grouping these diverse impacts into a smaller number of specific broadly related categories. Annex I presents an example of the showcard that NERA used to depict the characteristics of the different quality states. It shows how they communicated meaningful outcomes. Nonetheless, it is still not clear how well the survey covered each of the impact categories. Consequently, it is difficult to use the findings from the NERA survey to value the benefits from tackling specific pressures.

It is not clear whether even best practice stated preference techniques can overcome all of these conflicting challenges (Hanley and Shogren (2005, p. 28). The currently available literature²⁴ does not seem to be addressing this fundamental matter, which the environmental economics community must overcome so that valuations of environmental benefits can effectively aid environmental decision-making in practice in the future. A notable and excellent exception is Hanley and Shogren (2005), which addresses challenges 5,6 and 7. They question whether the increasing evidence about the anomalies raised by these challenges “runs the risks of undermining the credibility of CBA or, perhaps more accurately, weakening the power of its advice... and makes the straw man version of CBA easier to knock down”. However, straw man arguments, while easy to deliver academically are not much use in aiding public decision-making, especially where the proponents of straw man arguments do not put forward any alternatives or where their alternatives are subject to even greater limitations (see earlier). They rightly conclude (p. 28) that “the CBA test of allocative efficiency is too valuable a baby to throw out with the bath water in a world increasing resource scarcity”. They therefore examine possible strategies to cope with these challenges and anomalies. These involve getting away from fixation (on the part of both the

²⁴ EAERE conference in 2007 and Envecon conferences in 2006 and 2007 did not address this matter. But Envecon 2008 has a session that addresses this fundamental matter.

protagonists of CBA and their opponents) with assumptions or paradigms in strictly defined neo-classical economics to seeing how to apply the fundamental principles of CBA (see section 2) to the specific context and trade offs for the issue and decision in question. We need such coping strategies to evolve to make CBA valuable and useable for environmental decision-making.

Table 6: Main Types of Pressures, Measures and impact categories for WFD

Environmental Pressure/Measure	Specific water body affected	Type of impact and beneficiary
<i>Intermittent/peaked problems</i>		Informal recreation, Formal recreation (eg water based recreation (eg canoeing)) Angling Commercial fisheries Shell fisheries Local amenity (through impacts on local property prices) Non-use benefits Abstraction For the following water body types: Rivers Lakes Coasts Estuaries Wetlands Etc
Abstraction/Low flow	Rivers, wetlands	
Eutrophication (N, P)	Rivers, lakes	
Intermittent discharges of sewage Combined Sewer overflows (CSOs)	Rivers	
Bathing waters	Coasts/estuaries	
Minewaters	Rivers	
<i>Continuous problems</i>		
Water pollution (BOD, DO, NH4, etc)	All	
Groundwater problems caused by: <ul style="list-style-type: none"> • nitrates; • other contaminants; • and shortages of groundwater resources 	Rivers, wetlands	
Priority substances and Priority Hazardous substances	All	
Endocrine disruptors	All	
Modifications of fluvial water bodies (eg meandering rivers vs culverts)	Rivers/lakes	
Modifications of coastal waters (eg saltmarsh/realignment vs concrete flood defences)	Coasts/estuaries	
Fish passes to enable fish migration and benefits to fish and fishing from removing pollution and low flow barriers to fish	Rivers/lakes	
Improving natural habitats and ecosystems	All	
Shellfish waters measures	Coasts/estuaries	
Sediments	Rivers	
Alien species	All	
Acidification	Rivers/lakes	

Conclusion on Way forward for Tackling the Challenges

We therefore need to seek an agreed method that tackles and copes with **adequately all** the challenges and can thereby provide useful valuations to aid decisions on measures that can be implemented. This methodology should be agreed by all the main parties as being the best available before any survey is undertaken.

As a possible way forward, the following seem worthwhile:

- Need to focus on developing a method tailored for the specific context and trade offs for the issue and decision in question.
- Combine focus group in-depth elicitation to specify and clarify the impacts in question followed up by a contingent valuation survey of a larger more representative sample of beneficiaries (as in NERA (2007)).
- This valuation survey should cover a whole programme (and the individual schemes within it) with extra emphasis on opportunity costs in terms of goods and services potentially foregone for the stated sums. This would effectively use £values as a medium of exchange to represent goods foregone.
- Do overall studies for national or regional component of non-use benefits at national (eg as per NERA (2007)) and/or regional level.
- Highlight switching values for how large the uncertain or non-monetised benefits would have to be for a measure to be worthwhile or not. Report ranges especially for these uncertain benefits and indicate likelihood of exceeding the switching values.
- Validate and cross check that the valuations given make sense and are plausible. These checks should be built into the survey and analysis. For example, include in a CV survey a follow up question to check that the respondent is really willing to forego goods or services that would cost the same as their stated sum (see approach (iv) in Table 6).

5. Summary and Conclusions

In section 1, this paper first sets out the key value added contributions that economics can provide to aid decision-making. This paper then draws on 30 years experience of applying economic analysis to various environmental issues to highlight challenges and lessons for the environmental economics community to enhance the practical application of Cost-Benefit Analyses and benefit valuations so that they can best aid environmental decision-making in practice.

Carrying out economic appraisals can be expensive and time consuming. So it is essential to specify clearly the question and issues and then focus the economic analyses on delivering value added information to improve decisions on them. Moreover, there must be proportionality in determining the type and level of economic analysis needed, for which it is necessary to examine the costs and benefits of the options. Hence it is essential to ensure that the findings of the appraisal will actually aid and improve the decisions.

Section 2 demonstrates the importance of careful analysis of the costs of proposed measures. But this subject gets relatively little treatment and

discussion in the environmental economics literature, which tend to be dominated by papers on the valuation of environmental benefits.

A cost analysis should be completed before any valuation of the benefits is conceived for the appraisal of the options. It can help clarify and firm up the trade offs and issues involved which should help frame and target any benefits valuation study so that it can best aid decisions on them.



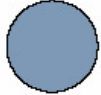
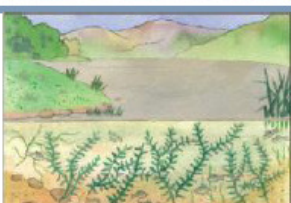
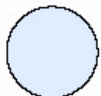
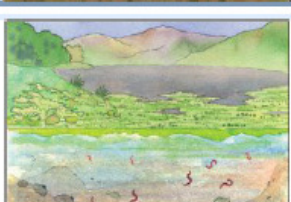
Section 3 reviews recent practice in the application of benefit valuations for recent reviews of the environmental programme for the water industry and preparation for the implementation of the Water Framework Directive (WFD).

Section 4 then draws on this experience to highlight major challenges for the valuation of environmental benefits. The most important outstanding challenges concern how to address income constraints (challenge 9) and cover an overall programme of measures and schemes (8), especially where a policy comprehensively covers many wide ranging measures (as is the case for the WFD); while providing full information on the likelihood of each of the impacts arising so that respondents can properly perceive and value them (challenge 5). It is not clear whether even the best practice stated preference techniques can overcome all of these conflicting challenges. But the alternatives cannot measure up to these challenges and in fact fare worse. So the environmental economics community must address and overcome all of these challenges so that valuations of environmental benefits can effectively aid environmental decision-making in the future.


Section 4 concludes that it is necessary to derive and agree on a methodology that *adequately* tackles **all** the challenges. We need to be wary of a proposed simple 'solution' that might provide the perfect answer to one challenge but would fall seriously short on other challenges. Section 4 then suggests a way forward. This includes using focus group in-depth elicitation to specify and clarify the impacts in question followed by a contingent valuation survey of a larger more representative sample of beneficiaries. This contingent valuation (CV) survey should cover a whole programme (and the individual schemes within it). The survey and analysis should include validation and cross checks that the valuations given are plausible. For example, a CV survey should include a follow up question to check that the respondent is really willing to forego goods or services that would cost the same as their stated sum.

Annex 1: Show Cards used in Survey of Valuation of Environmental Benefits of the Water Framework Directive

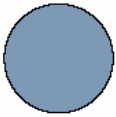
CARD 4 – Lake

 <p>High Quality</p>		<p>A diversity of underwater plants, floating lilies, and tall flowering plants. Varied fish population, including trout and coarse fish. Insects such as dragonflies are present. Water with right degree of clarity and no noticeable pollution. Natural and seasonal variations in water levels. Suitable for contact activities.</p>
 <p>Medium Quality</p>		<p>Some underwater and floating plants in shallow areas and around the lake. Some coarse fish and other animals present but limited. Insects are rare. Slightly unclear and occasionally discoloured water. Suitable for contact activities in some areas but not others.</p>
 <p>Low Quality</p>		<p>Very few plants, except blanket weed, and very few fish or other animals, except worms and leeches. Cloudy, discoloured and possibly bad-smelling water. Unsuitable for contact activities.</p>

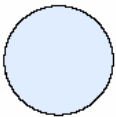
CARD 4 – Quality Levels

- 

Dark Blue – quality is “High”.

 - There will be a diverse and natural range of plants, insects, fish, birds and other animals.
 - Water will generally have the right degree of clarity and there will be no noticeable pollution.
 - Water will generally be suitable for contact activities, such as rowing or wind surfing.
- 

Mid-Blue – quality is “Medium”.

 - There will be plants, insects, fish, birds and other animals, but there will be some fish and other wildlife missing.
 - Water will be slightly murky or discoloured in parts, and there will sometimes be visible pollution in some places, and some algal blooms.
 - Water will be suitable for contact activities in some areas but not others.
- 

Light Blue – quality is “Low”.

 - There may be limited or no plants or wildlife, or the water may be dominated by a single plant species.
 - Water will generally be murky or discoloured, and may sometimes be bad-smelling in some places. There may also regularly be visible pollution in some places, and frequent algal blooms.
 - Water will be unsuitable for contact activities.

Source: NERA (2007)

References

Arrow, K.J., Solow, R., Portney, P. R., Leanmer, E., Rander, R., Schuman, E., (1993), **Report of the NOAA Panel on Contingent Valuation**. Federal Register, 58, 4602 – 4614.

Bateman et al (2002), **Economic Valuation with Stated Preference Techniques: A Manual**. Edward Elgar.

Department of the Environment (1991) **The Macroeconomic Consequences of Controlling Greenhouse Gas Emissions: A Survey**. Report by Professor Alan Winters, Rosemary Clarke, Gianna Boero. HMSO. IASBN 0 11 752540 8.

Defra (2007a), **The Ecosystems Approach Project – Action Plan**
<http://www.defra.gov.uk/wildlife-countryside/natres/eco-actionp.htm>

DEfra (2007b) **Introductory Guide to Valuing Ecosystem Services**
<http://www.defra.gov.uk/wildlife-countryside/natres/eco-value.htm>.

Eftec (2007) **Flood and Coastal Erosion Risk Management: Economic Valuation of Environmental Effects: A handbook for Environment Agency Practitioners**. Environment Agency.

European Commission (2002) **Economics and the Environment: The implementation of the Water Framework Directive: A Guidance Document (The Wateco Guidance)**.

Environment Agency (2002) Integrated Appraisal for River Basin Management Plans. Report by K Andrews, R. Montgomerie (WRc), J Burgess, J Clark (UCL).

Environment Agency (2003a) **Economic Appraisal for the Environment Programme in PR04** http://www.environment-agency.gov.uk/commondata/103599/eapprenvprog_852140.doc

Environment Agency (2003b) **Review of Non-use Values for Water Quality and Water Resources and Values for Bathing Water Improvements**. Report of an Expert Workshop in Peterborough, May 2003. Camille Bann, Jonathan Fisher, Bruce Horton, Environment Agency. http://www.environment-agency.gov.uk/aboutus/512398/516810/516841/554371/?version=1&lang=_e

Environment Agency (2003c) **Report of the Environment Agency's Assessment of benefits and costs of 'Choices will be made'/'Subject to Policy Decisions' Schemes: PR04 Environment Programme**.
http://www.environment-agency.gov.uk/aboutus/512398/516810/516841/554371/?version=1&lang=_e

Environment Agency (2004) **Overall Benefits of the Environment Programme for the Periodic Review of the Water Industry (PR04).**

http://www.environment-agency.gov.uk/aboutus/512398/516810/516841/554371/?version=1&lang=_e

ENVIRONMENT AGENCY (2005a) **Lessons from Evaluation of Economic appraisal of the Environment Programme for the Review of the Water industry (PR04).** [http://www.environment-](http://www.environment-agency.gov.uk/aboutus/512398/516810/516841/554371/?version=1&lang=_e)

[agency.gov.uk/aboutus/512398/516810/516841/554371/?version=1&lang=_e](http://www.environment-agency.gov.uk/aboutus/512398/516810/516841/554371/?version=1&lang=_e)

Environment Agency (2005b) **Review of economic appraisal of the National Environment Programme for the Periodic Review of the Water**

industry. http://www.environment-agency.gov.uk/aboutus/512398/516810/516841/554371/?version=1&lang=_e

Environment Agency (2005c), **The Environmental Damage Costs Of Current Water Quality And Abstractions In England And Wales**

ERM Economics (1996), **Costs and Benefits of the Reduction of VOC emissions from Industry.** ERM Economics and Chem Systems. Report for the Department of Trade and Industry.

Fisher, J.C.D, (1991) **Transitional and Continuing costs of Climate change controls.** Paper presented at workshop in Washington DC USA on the uses and limits of economic models as tools for assessing climate change policies.

Fisher, J.C.D, Grubb, M, (1997) **The Use of Economic Models in Climate Change Policy Analysis.** Royal Institute of International Affairs, Energy and Environmental Programme Climate Change Briefing No 5. October 1997

Fisher, J.C.D.(2001), **Making Sustainability Operational: Challenges and Opportunities for Environmental Economics: Needs of the Environment Agency.** Presentation for EAERE Conference in Southampton, 2001.

Fisher, J.C.D, McMahon, P(2003) **Economics and Environmental Decision-Making.** <http://www.environment-agency.gov.uk/aboutus/512398/516810/516841/>

Georgiou, S., Bateman, I., Cole, M., and Hadley, D., (2000a) **Contingent Ranking and Valuation of River Water Quality Improvements: Testing Scope Sensitivity, Ordering and Distance Decay Effects.** CSERGE Working Paper GEC 2000-18.

Georgiou, S., Bateman, I., Langford, I, Day, R., (2000b) **Coastal Bathing Water Health Risks: Developing Means of Assessing the Adequacy of Proposals to Amend the 1976 EC Directive.** Centre for Social and Economic Research on the Global Environment. School of Environmental Sciences, University of East Anglia.

- Georgiou, S., Langford, I., Bateman, I., and Turner, R.K., (1998) **Determinants of Individuals' WTP for Perceived Reductions in Environmental Health Risks: A Case Study of Bathing waters Quality.** Environment and Planning, A, Volume 30: pp 577-594.
- Hanley, N, Shogren, J, F, (2005), '**Is Cost-Benefit Analysis Anomaly-Proof**', Environmental and Resource Economics 32: 13-34.
- HM Treasury (2003) **The Green Book: Appraisal and Evaluation in Central Government.** Treasury Guidance. London TSO.
- Jacobs Gibb (2002) **River Mimram Low Flow Public Preferences Study. Final Report – Phase 1.** In association with – Warwick Business School, Corporate Citizenship Unit and Glasgow University. Report to Environment Agency Thames Region.
- Jacobs (2006) **Report on non-use benefits valuation.** Report for the Environment Agency.
- NERA (2007), **The Benefits of the Water Framework Directive Programmes of Measures in England Wales.** Report by NERA and Accent for Defra. http://www.coastms.co.uk/cgi-bin/ftpex/FTPex_conferences.cgi?browse&Outputs%20and%20Reports/A%20%20WFD%20Benefits%20Report%20Nov%202007
- Sagoff M (1988), The Economy of the Earth. Cambridge University Press. Cambridge.
- Sugden, R, (2004), **Developing a Cost-Benefit Framework for the Appraisal of Flood and Coastal Defence Projects.** Report to the Department of Environment, Food and Rural Affairs.
- OECD (1984) **Environmental Policy and Technical Change.**
- Select Committee on Environmental Audit (2000) **Seventh Report: Water Prices and the Environment**
<http://www.publications.parliament.uk/pa/cm199900/cmselect/cmenvaud/597/59703.htm>
- Stern (2007) The **Stern Review of the Economics of Climate Change.**
www.sternreview.org.uk
- Turner, R, K, (2007), Limits to CBA in UK and European Environmental Policy: Retrospects and Future Prospects. **Environmental and Resource Economics, Special Issue: Environmental Economics and Policy: Essays in Honour of David W Pearce.**
- Willis, K.G and Garrod, G.D., (1996) **Economic Benefits of Improving Water Quality to Anglers and the General Public.** Report to WRc. Centre for Research and Environmental Appraisal and Management, Department of Town and Country Planning. University of Newcastle.

Willis, K.G. and Garrod, G.D., (1994) **Benefits of Low Flow Alleviation in Rivers: The Case of the River Darent**. Centre for Rural Economy Research Report. Research Report to The National Rivers Authority Southern Region.

Yorkshire Water (2002), **Yorkshire Water Services**, Prepared by Accent Marketing and Research and The Centre for Research in Environmental Appraisal and Management (CREAM), University of Newcastle.