

Economics of the Water Framework Directive: Purpose, Principles and Practice

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Increased demand for water to meet human needs, including its use as a conduit and receptor for waste, has led to a deterioration in the state of inland surface, groundwater and coastal waters in many parts of Europe (EEA 1997, OECD 2003), with consequences for people and the water environment. Initially, EU legislation on water tended to focus on specific environmental problems associated with public health risks, such as drinking and bathing water quality. During the late 1990s, in response to calls for concerted action to improve the ecological quality of surface waters and the state of groundwaters, the European Commission compiled and adopted the Water Framework Directive (WFD) (CEC, 2000) which seeks to provide an integrated and strategic approach to the sustainable management of water resources.

Following a brief review of the Water Framework Directive, this paper explores the role of economics as prescribed in the Directive with particular reference to determining the value of water use, cost recovery, incentive pricing and cost effectiveness analysis. It briefly reviews estimates of possible benefits and costs of the WFD, and of who can be expected to pay for its implementation. It concludes that, in spite of data management and methodological challenges, economics is well placed to support the integrated approach explicit within the Directive.

1. The Water Framework Directive: Aims and Methods

The WFD “aims to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and ground waters” (CEC, 2000). More specifically its purposes (Article 1) are:

- to prevent deterioration of, and where necessary enhance, the status of aquatic and related ecosystems;
- to promote sustainable water use;
- to aim to progressively reduce, and for priority substances eliminate, pollution from hazardous substances;
- to ensure reduction/prevention of groundwater pollution;
- to contribute to the mitigation of floods and droughts.

In the language of European Directives, terms such as ‘prevent’ and ‘ensure’ indicate a strong obligation, ‘promote’ and ‘contribute’ imply weak obligation, and ‘aim’ rests somewhere between the two. The Directive commits Member States (MS) to putting in place a framework which will achieve ‘good’ surface water and ground water status by 2015. Although the focus is on protecting and enhancing the ecological quality of the aquatic environment, the WFD is seen as a means of contributing to ‘the provision of a sufficient supply of good quality surface water and groundwater as needed for sustainable, balanced and equitable water use’.

The WFD adopts a ‘pressure-state-response’ approach to sustainable water resource management, setting ecological standards indicative of a desired ‘state’ of water, identifying the human induced ‘pressures’ responsible for failure to meet these standards, and undertaking ‘responses’ in the form of corrective actions. The ‘Framework’ prescribes a common implementation strategy and timetable for EU MS (Table 1) (EC, 2004).

Table 1 WFD Timetable

2003	Identify river basins and districts
2004	Characterise river basins in terms of pressures, impacts and uses
2006	Monitor water status
2009	Identify programme of measures, and publish river basin management plans
2010	Implement water pricing policies
2012	Implement measures
2015	Completion of implementation

The WFD attempts to protect the stock and flows of natural capital through the delivery of ecologically defined 'safe minimum standards'. The purpose is to ensure the integrity of the water environment and its associated eco-system functions, thereby achieving sustainable water resource management. It does this through two main regulatory methods. First, as explained below, it uses environmental quality objectives to set standards that are needed to ensure that a particular function or use continues unimpaired. Second, it uses emission limit values to control the discharge of potentially hazardous substances as well as the processes that are associated with such discharges. This latter approach is similar to that contained within the prescriptions for Best Available Techniques under the IPPC Regulation (96/61/EC). This combined approach, involving both environmental standards to be met and limits on prescribed practices emissions and practices, has the explicit intention (Article 10) of controlling both point source and diffuse pollution of the water environment.

The selection of the criteria to define water quality standards, and the target or 'reference' level which defines the perceived safe minimum standard, is a critical step in the WFD process. The WFD directive places entitlement for the definition of standards (and targets to be met) firmly within the (natural) scientific community, acting through a responsible implementing agency (the Environment Agency in the case of England & Wales). Other stakeholder engagement is largely confined to deciding how these will be met, given that their activities are associated with existing water quality status and the achievement of improvements. While this is consistent with other European environmental directives which set high environmental standards requiring measures to prevent or minimise pollution, it is seen by some as an 'ecologist's charter' which could result in costs borne by society which are disproportionately high compared to the benefits obtained. There are, however, provisions in the Directive to guard against this.

Annex V of the Directive sets out the process for assessing the status of surface and ground waters defining the 'normative' characteristics of water associated with high, good and moderate qualities. For river water for example, it does this in terms of biological (for example the composition and abundance of aquatic flora and fauna), hydromorphological (river flows and levels and channel features) and physico-chemical (eg oxygen balance, nutrient loads and pollutant concentrations) quality. Emphasis is placed, however, not only on biodiversity but on how the biological community interacts with itself and other environmental components to produce self-sustaining eco-system functions and processes. A similar approach is defined for lakes (Moss et al., 2003), groundwater and transitional waters such as estuary and coastal waters.

Prior to the WFD, the approach in England and Wales (E&W) has been to define water quality objectives in terms of 'fitness for purpose', for example for freshwater fisheries or bathing. For rivers, these have been captured in a system of five River Quality Objectives (or River Ecological Standards) which classifies according to biological quality assessments based on oxygen status, related organic pollution and ability to support specified types of environmentally sensitive macro-invertebrates. These objectives are not regarded as sufficiently complete for the purpose of the WFD which takes a much broader view of water flora and fauna and their part played in ecological communities and processes, of potential pollutants, and of environmentally damaging activities including diffuse pollution from farm land. Notwithstanding reservations about the current quality assessment methods, it is perceived that 'RE2' as presently defined is likely to conform to the WFD standard of good ecological status. According to the EA for E&W (Table 2), about 36% of total river length

fails to meet the RE2 standard, mostly in the lower reaches of rivers. Identifying the reasons for this shortfall and taking appropriate remedial action is the essence of the WFD. Information on the status of lakes and artificial water bodies is currently not sufficiently complete to determine the extent of the challenge.

Table 2 River Quality Objective for Rivers in E&W and their Achievement, 2000

Quality Band	Total length km	Compliant (km)	Failed (km)
RE1	12109	10596	1512
RE2 (WFD good?)	14897	13492	1404
RE3	7823	7112	711
RE4	4994	4275	719
RE5	435	427	7
Total	40260	35904	4355

Source: Environment Agency (2001a)

The Framework requires that relevant measures of good ecological status are set for waters at the scale of river basin districts. These comprise an area (or a collection of neighbouring areas) that share a common catchment and surface water regime. Following conditions laid down in the Directive, Member States are required (Article 5), for each river basin district, to characterise physical, and hydrological attributes, and the biological reference conditions for water quality. The anthropogenic uses of water must be identified together with the pressures on water quantity and quality that arise as a consequence. This analysis also involves an economic analysis of water use as discussed below.

Where existing standards fall short of good status, responsible authorities must develop and implement a programme of measures to put this right. These measures include 'basic' (regulatory) measures that are already in force under various Directives and policies, such as: Urban Waste Water Treatment (91/271/EEC), Sewage Sludge (86/278/EEC), Bathing Waters (76/160/EEC) Freshwater Fish (78/659/EEC), Habitats (92/43/EEC), Groundwater (80/68/EEC), IPPC (96/61/EC), Shellfish (79/932/EEC), Abstraction (75/440/EEC), Drinking Water (76/160/EEC) and Nitrates (91/676/EEC).

Where basic measures are perceived to be insufficient, additional 'supplementary' measures may be used to help deliver 'good' ecological status. These include a range of extra regulatory actions such as abstraction controls, economic or fiscal instruments such as pollution charges or tradeable permits, voluntary measures such as the promotion of good practices, the provision of research, technical assistance, education and training, and projects to address specific pressures such as wetland restoration.

Thus in some cases, the WFD takes the definition of water quality above and beyond that required by the existing and substantial raft of water related directives by including a long term ecological perspective which accounts for the inherent dynamics of the natural environment. It must be assumed that the perceived benefits of existing directives exceed their costs, and that this condition also applies to the incremental benefits and costs of the WFD. This said, it was noted by The House of Commons Environment, Food and Rural Affairs Committee (HCEFRAC, 2003a), however, that it would be helpful if Member States (MS) agreed to new Directives 'after the practical and economic implications of their implementation have been fully assessed and costed', implying that some aspects of the WFD may not be cost beneficial, at least within the proposed time frame.

Reflecting a commitment to public participation, once competent authorities have set the standards to be met they are required (Article 14) to 'encourage the active involvement of all interested parties'... 'especially concerning the identification and review of measures to deliver the targets at river basin level'. Stakeholder values find expression therefore in the choice of delivery mechanism rather than in the setting of standards. They are however likely to influence the setting of water quality standards for artificial, 'heavily

modified water bodies' (HMWB) and other cases where the cost of delivering the standards can be shown to result in disproportionate costs or an unacceptable social burden.

The Directive sets down how all this should be done, hence the label 'Framework'. Given the magnitude of the task, the schedule is tight, and there is a feeling that not all members states will achieve 'full and proper' implementation within the timescale set out in the Directive' (HCEFRAC, 2003a)

2. Economics and the WFD

The Directive promotes the concept of water as an economic commodity and the use of economic principles to guide decisions in accordance with the objectives of the WFD. It uses the term 'economics' 22 times, seeking to apply economic principles in four main respects, namely:

- The estimation of the demand for and the valuation of water in its alternative uses (Article 5)
- The identification and recovery of costs associated with water services having regard for the polluter pay principle and the efficient use of water (Article 9)
- The use of economic appraisal methods to guide water resource management decisions (Article 11)
- The use of economic instruments to achieve the objectives of the WFD, including the use of incentive pricing and market mechanisms (Article 11) .

Annex III of the Directive refers to the requirements for economic analysis and, although short on detail, is long in terms of the challenge of implementation. It requires that 'the economic analysis (of water use) shall contain enough information in sufficient detail':

- to apply the principle of recovery of costs of water services (Article 9) , taking into account long term forecasts of supply and demand for water in river basin districts, and where necessary;
 - estimates of volumes, prices and costs of water services
 - estimates of relevant investments
- to make judgements about the most cost effective combinations of measures (Article 11).

Thus Annex III is at the heart of the implementation of the WFD. It recognises that: anthropogenic use of water determines water quality (and quantities); that understanding and influencing water use is a key to sustainability; that decisions on water management must take into account benefits and costs to the environment and society; and, that economic instruments can help deliver sustainable water resource management. Recognising the brevity yet significance of the reference to economics in the Directive, the EC has produced guidance a Common Implementation Strategy for the economic analysis which maps out what needs to be done, and how best to do it (WATECO, 2003). The procedures are being tested in a number of selected case study areas, including the River Ribble in north west England (EA, 2004)

The application of economic principles in this way is relatively new in practice, although the relevance of such an approach has been promoted for some time, for example in the [Dublin Principles \(1992\)](#). In the UK, for example, the economic value of water and the use of economics to guide water resource decision-making have received recent attention as part of the switch to demand management (Defra 2001, EA 2001a,b). However until recently, prompted by the need to justify environmental spending by privatised water companies, the application of economics to the water sector has been somewhat muted, partly because the information, methodologies and resources to apply economic analysis have not been in place.

Whilst the WFD provides an incentive to address this deficit, it largely focuses the role of economics on assessing the value of water in use, appreciating the costs associated with

the degradation of water resources and the water environment, and determining best ways of delivering predefined targets. Thus economics has the role of shaping the delivery mechanisms rather than defining the standards to be met: that is cost effective rather than economically efficient delivery of environmental standards. This suggests the dominant view, shared by a number of economists, that economics and the subset of environmental economics is insufficiently complete or robust to provide a total basis for a sustainable water management strategy: water is much too valuable to be left to economists. Although the economic perspective may be incomplete, it is helping to justify considerable spending on environmental protection in the water industry's Asset Management Plans (OFWAT, 2003).

3. Economic Analysis of Water Use: demand, supply and pricing

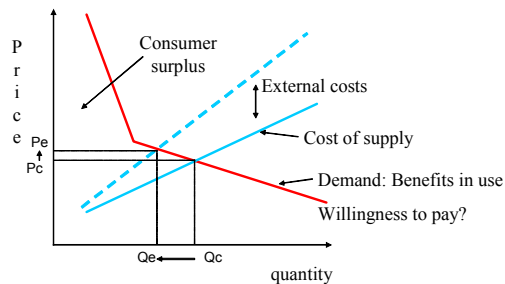
The WFD requires by the end of 2004 that an economic analysis of water use is carried out for each river basin district, together with an assessment of the balance of demand and supply and the pressures and impacts on the water environment. The WFD recognises the economic dimensions of water in terms scarcity, value and, in theory at least, prices which reflect the cost of supply and the benefit in use.

This is illustrated in Figure 1 which can be taken to represent the total market demand and supply for water in any one sector, such as public water supply, or across all sectors taken together. The demand curve shows the marginal (extra) benefit obtained from consuming extra units of water, and reflecting this, the willingness to pay by users for additional units of water. The latter tends to decline as consumption increases and water is committed to less valuable uses (Rees 1993, Merret 1997, Green 2003). It may be possible to distinguish broad categories of use for example in-house uses of water for drinking versus out-of-house uses for car washing, with different price elasticities of demand, and hence differences in the impact on consumer surplus of a given price change. The theoretical demand curve also reflects ability to pay as determined by income distribution and, in the case of water for household consumption may not adequately reflect the utility of water use. In sectors such as agriculture, benefit derived and willingness to pay may be influenced by government price support for irrigated produce such as sugar beet. The WFD requires that estimates of demand and user derived benefits are derived for all major users of water within a river basin, together with an assessment of affordability and the extent to which price changes would impact on income or welfare.

Figure 1 also shows the marginal cost of supplying additional units of water and the willingness of agents to supply water at given prices. In theory, supplying additional water involves increased extra costs per unit supplied as the cheapest sources are usually exploited first. Additional supplies are likely to involve higher unit costs associated with abstraction, for example from groundwater rather than surface sources, storage, transport and distribution, and administration, although there may be scope for economies of scale which can reduce unit costs. Costs also include water treatment or disposal of dirty water, and the external impacts on other water users and the environment associated with abstractions and discharges. The WFD advocates that these external costs, whether in the form of damage or mitigation measures, should be included in the assessment of water supply costs. The effect of this will be to raise unit costs and other things remaining constant, increase price (P_c to P_e in Figure 1) and reduce consumption (Q_c to Q_e). Guidance (WATECO, 2003) recommends a detailed assessment of the financial, resource and environmental costs associated with the provision of water services, as well as an indication of how these might vary over time as a result of technology change, changes in demand and the possible strategic responses of supply organisations.

Figure 1

Water Demand, Supply and Prices



In theory, the market for water would tend towards an equilibrium position where a price for water prevails at which the demand for water is equal to the supply of water. This position theoretically maximizes economic efficiency defined in terms of the sum of welfare gain to water consumers and suppliers. Here, in theory, marginal benefits (£/m³) equal marginal costs, marginal benefit per unit of water is equal for all uses, and social welfare is maximized. In practice, and particularly for water as a commodity, demand, supply and prices rarely conform to this perfect model. The characteristics of water demand and supply, including features of the water services industry, mean that economic valuation of water is problematic and reliance on unregulated market mechanisms is inappropriate. In particular, water:

- Is a fugitive, re-usable resource which can be difficult to control and account for;
- Is often a common property, with open access and ill defined property rights;
- Provides public goods, such as the public health benefits of clean water;
- Is used in ways which often result in 'external' consequences;
- Is essential for life, without close substitute: a 'need' rather than a 'want';
- Is subject to uncertain supply associated with climatic variation;
- Has significant economies of scale associated with its managed supply; and,
- Is an integral part of the functioning of eco-systems.

Three main points arise here: access and affordability, eco system functions and risks. On the first point, access to 'traded' water services depends on ability to pay, and thus prices and consumption may reflect income distribution rather than real benefit (and welfare) to users. There is concern that social welfare may be compromised by reliance on market processes. The costs of delivery to some users may be high, and may exceed their ability to pay. To reduce access would further exacerbate the welfare of this vulnerable group, be unethical and probably lead to greater costs borne by society as a whole (HCEFRAC, 2003b).

With respect to eco-system functions, the WFD draws attention to the diverse functions of water which include those of consumption, production, carrier, sink and ecological system functions (Turner et al., 2000, de Groot et al., 2002). These in turn provide uses (and indeed 'non-uses') and hence values to society. This classification of functions can help to provide a framework for the characterisation and valuation of uses within river basins as part of the requirements of Annex III of the Directive. The WFD emphasises the importance of ecological system functions, which compared to other more obvious production and consumptions functions, are often unrecognised and undervalued until they are lost. For the most part, and probably wisely at this stage, the WFD avoids the problem of economic valuation of eco-system functions by specifying good ecological status as a minimum environmental standard.

With respect to the management of risks, the WFD recognises the vulnerability of ecosystems by setting reference standards and adopting a precautionary approach to the specification of emission levels. Regarding vulnerability of human systems, WFD recognises the need to allow for affordability and the avoidance of disproportionate costs in special cases.

The WFD requires that the amount and value of water used by major user groups is identified for each river basin. By way of example, Table 3 summarises water use and the possible basis for valuation of water uses by major sector.

Table 3 Water Uses, Benefits and Valuation Methods

Sector	Use/Type of Benefit.	Basis for Estimating the Value of Water (per unit of water at the margin of supply)
Off-Stream Uses		
Agriculture	Irrigation, livestock and related uses, process application. Value added by irrigation water in terms of type, quality and quantity of produce. Very seasonally dependent.	Gain/loss of value added, including contracts to supply high value domestic produce. Costs of alternative sourcing. Winter storage reservoirs. Water saving practices and technologies. Willingness to pay, water trading
Industry: by sub sector: food processing, chemicals, manufacturing etc	Use in processing and production, cleansing agent, heat and waste transfer. Value of water as an input, Expenditure on water as % of industry costs.	Gain/loss of value added due to curtailed/extra supply. Alternative sourcing cost in short and long term. Cost of water saving and recycling technologies. Willingness to pay
Domestic Water, Water Companies	Drinking water, other in-house uses and sanitation, out-of house less-essential uses. Grey water uses. Benefits of treated water returned to water system.	Public health impacts, especially on vulnerable groups Costs of alternative provision, costs of water saving technologies. Supplements to surface and groundwater Value in use/willingness to pay, loss of consumer surplus
In-Stream Uses		
Waste Assimilation	Discharges to water and land. Water as a conduit for waste. Avoidance of water quality reduction, Savings in alternative waste disposal routes.	Impacts on water quality (and values), Cost of pre-treatment, costs of alternative disposal methods, costs of flow supplementation.
Commercial Fisheries	Water as medium for production, food source and waste sink. Value added by fisheries production where water is key growth medium	Gain/loss of value added by operators due to changes in river flow and quality. Alternative sourcing and water treatment technologies
Navigation	Transport function and related value added	Gain/loss of value added, costs of alternative transport provision
Hydro-power	Energy production	Value of power generation, alternative sourcing, Water mills as tourist attraction
Recreation Amenity, and Heritage	Benefits to users of the water environment (e.g. recreational anglers), and non users, Property values. Regional development. Tourist attractions (wetland sites, water space amenity, water mills)	Value added by operators, willingness to pay (contingent valuation), travel cost based estimates, hedonic (market based) price differentials, Costs of protection and mitigation,
Nature Conservation (incl abstraction to off-stream sites)	Indirect functional benefits associated with hydrological and ecological processes, biodiversity. Non-user, option, existence, altruism and bequest values	Impacts of changes in eco-functions. Cost of protection and mitigation, replacement cost, Contingent Valuation

For surface waters, it is useful to distinguish water users by in-stream (or in-lake) and off-stream categories. Off-stream uses involve withdrawals from the water system for consumptive use and delayed return of water to the hydrological cycle. They are commonly associated with more intensive use and greater benefits to people per unit of water than in stream uses, and tend to result in greater impacts on water quality when water is eventually returned. As referred to earlier some benefits in use and the relative strength of demand are easier to determine than others. Furthermore, price elasticities of

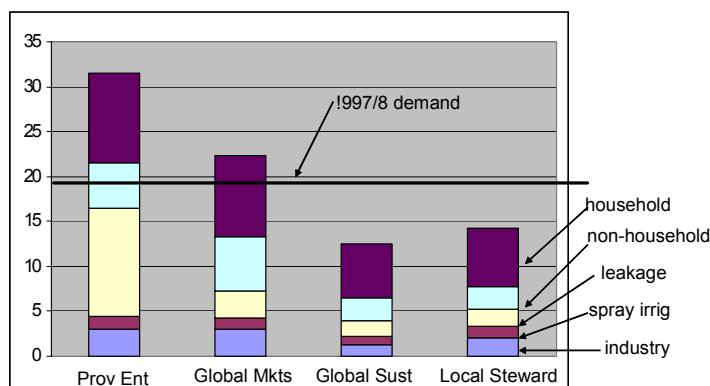
demand tend to be much lower in the short than the long term, reflecting user ability to adjust consumption habits given time.

Estimates of water values and guidance for methods for evaluation are available but tend to be context specific (Rees, 1993; FWR, 1996; Merret, 1997; Knox et al, 1999; Green, 2003). Significant progress has been made on the valuation of environmental aspects as part of the Water Industry Periodic Review (PR04) (Defra 2003a).

The WFD recommends that estimates are derived for water demand according to a 'business as usual' scenario at river basin level. The approach adopted by the Environment Agency has application here. Estimates of water demand were derived for England and Wales and its constituent regions (EA 2001) for the main sectors of Public Water Supply, Industry, and Agriculture, modified according to assumptions about the degree of control of leakage. These reflect a mix of likely economic, technology, water policy and sector specific policies (such as the EU Common Agricultural Policy) under alternative future scenarios. Figure 2 contains estimates of future demand derived by this method for England and Wales for the year 2025. The scenarios are based on those used by the Foresight Programme Office of Science and Technology (OST, 2003) to represent possible futures distinguished in terms of social motivation and governance.

Figure 2

Indicative Water Demand by Scenario (E & W),
000MI/day, 2025 (based on EA forecasts)



Source: EA, 2001, based on modified UKCIP type scenarios

The WFD is compatible with the water policy drivers implicit in Global Sustainability and Local Stewardship scenarios which contain a commitment to environmental conservation. By comparison, Global Markets and Provincial Enterprise scenarios are more utilitarian and demonstrate high rates of water consumption and less intervention to protect water quality. This type of analysis will be required at river basin level. In the longer term, beyond 2050, it is likely that climate change will also make an impact on water demand and supply.

4 WFD: Optimum Levels of Pollution and Cost Effective Measures

The WFD avoids the issue of economic efficiency by predefining the environmental standards to be met, only requiring an assessment of benefits and costs where there appears to be a case for derogation. Figure 3 applies the concepts of marginal private benefits (net of private costs) enjoyed by users of a resource (MPB) and marginal external costs (MEC) which are the net costs, including those to the environment, associated with that use but borne by third parties without compensation (Hanley et al., 2001; Teitenberg, 2003). Applying these concepts to water, unrestricted water use (including abstractions

and discharges) results in consumption at Q_{pw} , where $MPB < MEC$, and the latter is substantial. This could represent poor water quality status with consequences for the environment and society at large. An economic optimum, whereby some external costs are 'internalised' to water users and where $MPB = MEC$, results in consumption at Q_{mw} and moderate water quality status. Assuming that the WFD limits water use to Q_{gw} in order to deliver good water quality status, this could result in low environmental cost but high opportunity costs of potential benefits foregone. Here $MPB > MEC$. It is here that stakeholders may express concern that the WFD will impose intolerable costs on them, especially in the short term. This may also be the situation for HMWBs where good status represents an expensive enhancement rather than a cost effective reinstatement.

Thus the challenge of the WFD directive is to deliver water quality at minimum economic cost. Ecologists, however, may point out that differences that arise between ecological and economic optimum standards for water quality reflect shortcomings in economic models: the very concept of an externality reflects a failure of economic systems not of eco-systems.

Figure 3

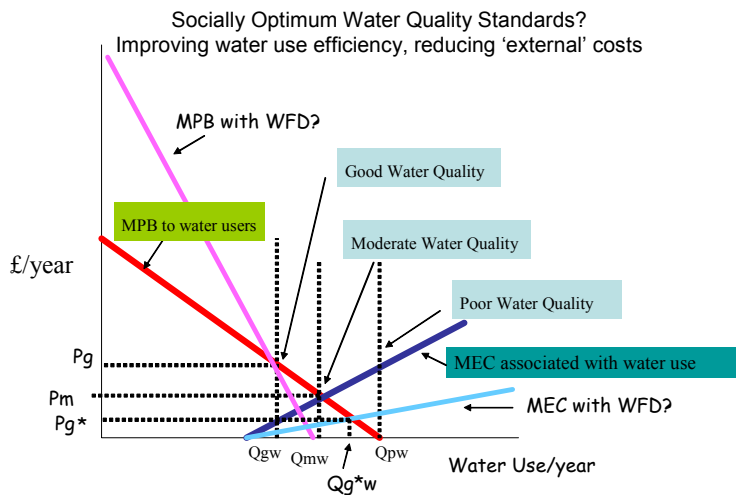


Figure 3 also provides a framework for the design and appraisal of intervention measures. Although the basic measures of WFD are regulatory (whereby Q_{gw} is predefined) supplementary measures may use economic instruments such as polluter taxes which would shift the MPB line towards the origin and hence reduce the margin of water use.

Overtime, however, the WFD seeks to increase the slope of the MPB line by achieving greater efficiency in use and thereby an overall increase in benefits at a reduced rate of water use. Measures to achieve this might include trickle irrigation which gives 'more crop per drop', water recovery and re-use, and adoption of water saving practices.

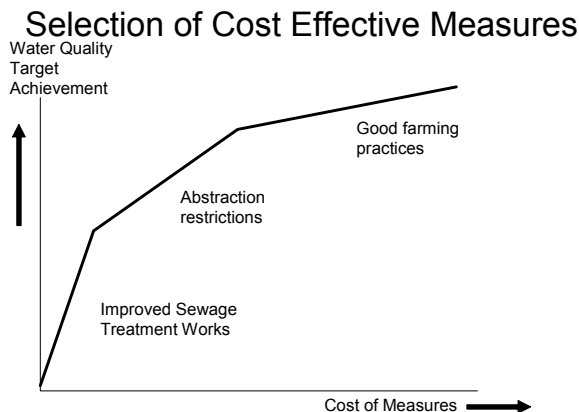
The Directive also seeks to reduce the slope of the MEC line through decoupling of water use and environmental damage through for example use of cleaner technologies which generate less pollution at source and avoid the use of water as a conduit for and receptor of potential pollutants. This might include improved sewage treatment processes or measures taken by farmers to reduce nutrient transfer to rivers. By appropriate measures, the purpose is to achieve a water use (Q_{g^*w}) and related benefits currently associated with moderate to poor water quality, but with the low environmental damage costs associated with good water quality (P_{g^*}). The challenge is to identify measures which reduce environmental damage without unduly compromising the 'profits' of water users: increasing the slope of the MPB curve while reducing that of the MEC curve, and reducing the extent to which they overlap.

This is the essence of cost effectiveness analysis: identifying options which will deliver good water quality and sustainable water use at minimum total cost. Guidance from WATECO (2003) suggests that the approach to cost effectiveness analysis involves identifying:

- the pressures responsible for gaps in water quality (such as abstraction or nutrient loads);
- measures to address these (such as restrictions on abstraction, limits on fertiliser use);
- the extent to which these measures will be successful (eg raised levels, reduced nutrient load), including consideration of time taken, probability of success, and flexibility;
- expected costs of the measure (in terms of financial, resource and environmental costs); and
- a derived measure of cost effectiveness (such as £/unit increase in level, £/ unit reduction in nutrient load) including allowance for risk and uncertainty.

This is a similar approach to that recommended in the IPPC regulations for the selection of Best Available Techniques. Figure 4 shows how this might apply. The procedure is complicated by the fact that in any one location, gaps in water quality are usually due to a variety of different pressures which will respond differently to different measures, with different costs and degrees of certainty. Furthermore, the potentially different impact of alternative measures on different water users and interests means that some assessment of benefits may also be required, with implications for the use of cost benefit analysis.

Figure 4



5 Measuring Environmental Costs and the Potential Benefits of the WFD

Overall, given that the EU WFD is an output of a negotiated political process (Chave, 2001, Kallis and Butler 2001), the Directive must be considered worthwhile. Similarly, in so much as Europe is a big place, the Directive must be considered worthwhile at a local level provided it is adapted to suit local conditions. This overlying assumption of positive net benefit justifies the use of cost effectiveness analysis rather than cost benefit analysis. Only where it appears to be demonstrably not worthwhile is there a perceived need for cost benefit analysis to confirm that this is the case.

A number of recent studies have placed values on the economic functions of the environment to justify environmental protection and enhancement of the kind advocated by the Directive. Specifically with respect to the water sector, high level estimates from the Water Industry Periodic Review made by the Environment Agency for England and Wales

(EA 2003), identify annual environmental damages affecting the use of water bodies of between £393 mn and £423 mn per year (Sunman, 2003), of which damage to fishing and bathing were the biggest items. Additional non-use loss associated with biodiversity impacts bring the overall estimate to between £1.2 bn to £2.6 bn per year, equivalent to a net present value over 25 years of between £19 bn and £43 bn at 3.5% discount. About half of these damages are considered attributable to the activities of water companies. The proposed PR04 environmental measures are predicted to deliver present value benefits of between £4 bn and £12 bn at 3.5% discount rate. This leaves a gap of at least about £15 bn to be picked up later by the WFD, to be shared by water companies and by agriculture, now perceived to be 'the number one polluter of water in the country' (PCFFF, 2002).

Three recent studies (Table 4), drawing on secondary sources, have compiled estimates of environmental damage costs associated with agriculture. For the UK, Hartridge and Pearce (2001) and Pretty et al. (2001) estimate annual damage to the water environment at £428 mn and £231mn respectively, and for E&W the Environment Agency estimate this at £262 mn. In the case of farm land, damage to water by diffuse pollution is closely associated with damage to soils and biodiversity (English Nature, 2002), particularly through surface water and soil-water movement (Evans, 1996), such that particular environment effects and their mitigation should not be seen in isolation. Assuming an average of £300 mn per year water damage for E&W implies a present capital sum about £4.8 bn over 25 years at 3.5%. The justification for measures to reduce environmental damage from farming (RPA, 2003) is all the greater given the annual £3 bn subsidy provided by the Common Agricultural Policy.

Table 4 Estimates of the Environmental Damage Costs of Agriculture

£ mn/year	Hartridge & Pearce 1998 prices, for UK	Pretty et al., 1996 prices, for UK	Environment Agency , 2000 prices, for E&W
Water	428	231	262
Air	585	1113	760
Soil	21	95	205
Biodiversity & Landscape	38	126	-
Total	1072	1566	1227

6 Costs of WFD Implementation, Cost Recovery and Who Pays?

A preliminary assessment of the costs of implementing WFD for the UK was made by WRC (1999) on the basis of knowledge at the time of the likely gap in water quality status, and a mix of measures to control municipal and industrial point source pollution, diffuse pollution from agriculture and to protect habitats. Estimated incremental present value costs at 6% discount rate (in 1999 prices) ranged between £3.2 bn and £11.2 bn. These comprised: administration £5-6 mn, planning £37-54 mn, monitoring £144 mn, and intervention measures £3 bn to £11 bn. Of these latter costs, £0.4 bn -£1.4 bn relate to point source reductions for industry and £1 bn - £5 bn for water companies, between £1 bn and £3.5 bn for the control of diffuse pollution from agriculture, and between £150 mn and £1 bn for habitat protection and low flow alleviation. The range in the estimates reflected the high degree of uncertainty with respect to the scale of the challenge. They also tend to reflect end-of pipe rather than in process solutions that have the potential to be more cost effective in the long term. Defra's view (Defra, 2003b) is that reliable estimates of the costs of the WFD can only be obtained once the characterisation of river basins has been completed, confirming the challenge of acquiring robust ex ante appraisals of environmental policy.

The WFD requires that charges for water services, both for water treatment and the supply of clean water, should adopt the principle of full cost recovery and in accordance with the polluter pay principle. This means that users should not only pay for the costs of supply and

treatment, but also those associated with restoring and protecting environmental quality. Common methods to estimate these costs are yet to be determined (WATECO, 2003). It is necessary to distinguish the economic costs used to determine cost effective measures and the financial costs incurred by water supply organisation, inclusive of costs to protect the environment. The two are not necessarily the same. Economic costs (net of taxes and subsidies and inclusive of non-water resource and environmental costs) are used to select the most appropriate measures, such as improved sewage treatment works. Cost recovery will then be based on the actual financial cost of delivering these most economically cost effective services.

Member States must 'ensure' that water pricing policies should be designed to give 'adequate incentives for users to use water efficiently' and that there must be 'adequate contribution of the different uses, disaggregated into at least industry, households and agriculture to the recovery of the cost of water services, based on the economic analysis of uses and the taking account off the polluter pay principle' (Article 9). However, a MS can have regard to the 'social, environmental and economic effects' of recovery regimes and it 'will not be in breach of the Directive if it decides in accordance with established practices not to apply the(se) provisions', as long as they do not compromise the purpose of the Directive. So Article 9 is a recommendation which can be rejected if a case can be made.

Recovery of full capital and operating costs for water services, even excluding environmental costs, will be quite a challenge in a number of MS. There are considerable subsidies to water in the domestic and agricultural sectors in some countries, funded mainly by the tax payer. In Spain, Greece and Portugal, for example according to OECD (1999), domestic users in some regions pay less than 50% of total financial costs of water services, whereas in Italy, France, Germany, UK and Netherlands, this ranges between 80% and 100%. On the whole industry tends to pay full costs, but agricultural irrigation (which accounts for over 70% of abstraction in some Mediterranean MS) enjoys high levels of subsidies, with limited recovery of the capital costs of publicly funded supply systems. The move towards greater privatisation in the European water sector will however further promote greater recovery of costs as part of the process of self financing.

The WFD requires that pricing mechanisms should provide incentives for water use efficiency, encouraging water to move to its best use. This implies 'benefit pricing' based on willingness to pay. Given the nature of water as a commodity however, this could lead to discriminatory practices whereby users are exploited by the profit seeking suppliers. Indeed, where the demand for water is strong (and price inelasticity low), increasing water prices as a means of encouraging wise use may impact on income before it impacts on behaviour. The strong demand for irrigation water for vegetable production by farmers is a case in point. Increased abstraction charges may serve to transfer incomes to the supply agency without significantly reducing consumption (Morris et al., 2003). Furthermore, in water deficit areas, actions to improve efficiency in water use may actually reduce the amount and quality of water that is 'returned' to the environment unless specific actions are taken to prevent this.

In the UK, a recent review of abstraction charges levied by the Environment Agency (Defra, 2001) considered pricing options which varied according to objectives, namely whether cost recovery, revenue generation, water use efficiency, or internalising environmental costs. The outcome was to stick largely with the existing arrangements which recover the cost of administering the licensed system, at the same time strengthening other measures to improve water use efficiency. This reflects the view that charging users of water 'services' rather than direct abstractors of raw water is probably more effective, efficient, and practical, especially given the complications associated with entitlement to abstract.

The practice of full cost recovery including environmental costs is currently being rehearsed in the Water Industry's Periodic Review. Indeed, the privatisation of the water industry in E&W has helped to transfer this funding responsibility from the public purse to water companies under economic regulation by the Office of Water Services (OFWAT). With pressure from the Environment Agency and English Nature, and legally bound to meet the requirements of existing statutory obligations, water companies recently submitted

their draft spending programmes for period 2005-2010 (PR04) (OFWAT 2003). These include a substantial capital component totalling £4.6 bn for 'environmental improvement', justified against the avoidance of damage costs (estimated between £4 bn and £12 bn). These and other extra costs are expected to raise prices to households by an average 31% in real terms during the period (OFWAT 2003). Commenting on this, HCEFRAC (2003b) said that 'customers must not be expected to pay for every improvement to the aquatic environment, but where water companies are responsible for damage to the environment, they and their customers should pay to repair that damage'. With an eye on agriculture, the Committee demanded that 'those responsible for diffuse pollution should pay for it', and also that more should be done to 'manage the demand for water'. All these ring true with the sentiment of WFD.

Meantime, OFWAT, has express concern that customers cannot be expected to meet ever increasing bills to pay for environmental improvement, especially when sources of diffuse pollution remain relatively unchecked. The perception is that households are an easy target for recovering the cost of pollution caused by others, and that this is facilitated by a regulatory regime that uses the privatised water industry to reduce the burden on the public purse. WaterVoice (2003) representing the domestic payer argues that special provision should be made perhaps through tax and benefit credits to ensure that water is affordable for the poorest groups. At present UK domestic payers spend about 1.3% of their disposable income on water services. Water prices could double in some areas in real terms under WFD, with consequences for the less well off who may find themselves caught by a potentially regressive environment tax, especially if there is a move away from flat rate (based on house value) to meter based charging regimes. These issues of cost burden and affordability will no doubt feature strongly during WFD implementation, especially in areas where geographical and climatic factors result in high water costs per capita.

7 Conclusions

The preceding discussion has explored the role and potential of economics in the implementation of the WFD. The main applications relate to the assessment of the demand for water and the value associated with its use, together with the determination of the costs of water services, provision for full recovery and incentive pricing. Economics is a key criterion in the determination of a programme of cost effective measures to implement the Directive, including the use of economic instruments. It has an important role in assessing the case for derogation on grounds of disproportionate costs.

The task for economists in the WFD is sufficiently novel that data and methods are developing as part of the implementation process in order to establish a 'framework' that is itself fit for purpose, makes good sense and is robust and cost effective. Most of the challenges at present are operational: transposing the Directive into practical guidance, getting data, sorting out methods, applying them in selected cases, engaging stakeholders and in the process giving vent to the devils that are in the detail.

In the case of E&W, the PR04 process has undoubtedly sharpened economic swords in terms of linking theory with practice, and has helped to prepare the way for the economic assessments for WFD. But as the water industry cleans up its act, more attention is focussed on the significant environmental costs due to diffuse pollution from agriculture. The search for cost effective measures to address these 'land management' issues will become an important aspect of the WFD. Indeed, the WFD may in due course become the Land and Water Framework Directive and economists are well placed to support such an integrated approach.

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APPENDIX 1 Guidance on Economic Assessment for WFD from WATECO

Figure 1 – Proposed Key Steps of the Critical Path

