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West of England

Everard, M. (2012) Why does good ecological status matter? *Water and Environment Journal*, 26 (2). pp. 165-174. ISSN 1747-6585
Available from: <http://eprints.uwe.ac.uk/25053>

We recommend you cite the published version.

The publisher's URL is:

<http://dx.doi.org/10.1111/j.1747-6593.2011.00273.x>

Refereed: Yes

This is the accepted version of the following article: Everard, M. (2012) Why does good ecological status matter? *Water and Environment Journal*, 26 (2). pp. 165-174. ISSN 1747-6585, which has been published in final form at <http://dx.doi.org/10.1111/j.1747-6593.2011.00273.x>

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Why does 'good ecological status' matter?

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Abstract

Achievement of 'good ecological status' under the EU Water Framework Directive (WFD), and various 'environmental outcomes' under other legislation and strategies, are accepted as important by environmental interests. However, support from the wider public may be largely altruistic. 'Ecosystem services' can better relate ecosystem health to societal benefits, helping communicate the advantages of achieving good status and securing support for environmental priorities. A series of ecosystem services case studies provides lessons about promoting public understanding of the benefits of achieving environmental targets. Framing desired WFD goals in terms of ecosystem service outcomes can optimise societal benefits proved by 'programmes of measures' and avert unintended consequences, compared to traditional, discipline-specific management approaches. It can also highlight potential contributions from ecosystem-based technologies to achieving multiple benefits across ecosystem service categories. 'Siloed' institutions and budgets are likely to perpetuate fragmented approaches unless explicit measures are taken to achieve more systemic outcomes.

Keywords

Good ecological status, Water Framework Directive, environmental outcomes, public benefits, ecosystem services, communication, public understanding

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Introduction

'Good ecological status' is one of the key targets of the EU Water Framework Directive (European Parliament, 2000), to be met in all 'water bodies' (groundwater and surface waters including fresh and estuarine waters and marine ecosystems up to one mile from shore). The Directive sets out three cycles of 'River Basin Planning and Management' leading towards the eventual achievement of 'good ecological status'. However, the WFD also recognises that there are circumstances in which full ecological recovery may be impossible where substantial modifications provide many benefits and where the impacts of removing them will be significant (including for example port facilities or cities encroaching on rivers and estuaries over centuries). In these cases, waters can be designated as 'heavily-modified water bodies' for which a less prescriptive target of 'good ecological potential' may apply. The Directive also allows for the setting of lower objectives or extended deadlines where measures to achieve good status or good potential would be technically infeasible or disproportionately expensive.

The Directive devotes detailed consideration to the meaning of 'good ecological status'. Water Framework Directive Annex V sets out the characteristics of component elements including various biological, physicochemical and hydromorphological parameters of surface water systems. Across Europe, Member States have collaborated in a range of intercalibration groups to ensure that the development of classification ranges for some of these elements are consistent (European Union, 2008). European- and State-level work has also been undertaken to establish standards for other parameters (e.g. Defra, 2008a). The net result is that ecological status has been assessed for designated water bodies in the UK and across Europe on the basis of a matrix of such standards addressing different attributes of their quality. In the current state of implementation, quality standards can be applied from more than 50 such parameters.

Meeting the statutory requirement to achieve 'good ecological status' or 'good ecological potential' requires the support of a wide range of state, voluntary and business organisations as well as the wider public. Many of these stakeholders will be required to take action, and ultimately to pay, under 'programmes of measures' identified for implementation of the Directive. Payment mechanisms include, for example, changed industrial and farming practices, targeted agri-environment incentives recirculated from taxation, water service bills, and development planning controls. It can not be safely assumed that all of these diverse stakeholders will automatically support the

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achievement of ecological objectives under the Directive when the necessary investment is considered in the context of other priorities for expenditure including health care, transport, infrastructure, food security, targeted nature and heritage conservation, sporting and other national priorities. These conflicts can only be exacerbated by downward pressures on public sector budgets and wider austerity measures across the European economy.

There is evidence of public support for proactive environmental investment. For example, Defra's '2009 Survey of Public Attitudes and Behaviours towards the Environment' (Defra, 2009) revealed that 47% of respondents "...said they would like to do a bit more to help the environment" (compared with 43% in 2007). Furthermore, 51% of respondents "...disagreed that 'being green is an alternative lifestyle it's not for the majority'" (compared with 30% in 2007). Also, 85% "...agreed that 'I do worry about the loss of species of animals and plants in the world'". However, a very real risk arises from the way that WFD goals are perceived, if they are communicated (as they largely have been to date) as a set of standards implying that 'bugs in streams' are the primary beneficiaries. Without a clear understanding of how these standards relate to human wellbeing, achievement of Directive targets may be perceived as an altruistic luxury achieved through substantial public and private cost and disruption over and above other policy priorities. Whilst the public may support attainment of 'environmental outcomes' in an altruistic sense, where the societal value of these outcomes is not understood then

public support can not be assured when faced with rising bills or restrictions on operations.

This represents an important communication gap in putting forward the case for how these desirable 'environmental outcomes' are also integral to the needs of people and the economy. This paper addresses the adequacy of presentation of 'good ecological status' as a societal goal in the current UK implementation of WFD. The principles apply equally to broader government and public sector aspirations to achieve 'environmental outcomes'.

Establishing wider contexts

Sustainable development principles identify the need to found development on simultaneous ecological, social and economic progress (IUCN/UNEP/WWF, 1980; World Commission on Environment and Development, 1987; HM Government, 2005; Millennium Ecosystem Assessment, 2005). Practical application of sustainable development remains complex, conflicting with vested interests and a legacy of assumptions about rights, business and economic models and regulatory responses based largely on established narrowly-framed principles of industrialisation and economic growth (Johnston *et al.*, 2007). Implicit assumptions that 'nature' is a boundless resource that can be exploited without regard for natural limits, or that negative impacts upon it have no wider repercussions, is manifestly no longer valid (Everard, 2009a). Instead, sustainable development recognises

ecosystems as the fundamental resources supporting human health and wellbeing, economic opportunity and realisation of individual potential (Convention on Biological Diversity undated, TEEB 2008, Everard 2011).

For understandable historic reasons, the bulk of inherited environmental legislation and management has been framed around the dominant world view of largely unconstrained economic progress within which it was formed. Health and environmental considerations have largely been addressed only when gross impacts have manifested rather than with foresight of potential consequences. For example, Everard (1994) documents transitions in management of river quality, dating from pre-industrial prohibitions on the dumping of animals remains in watercourses, industrial era controls to limit gross effects determined by the nature of the trade creating the effluent, through to recognition in the 1970s of the need to base discharge consenting on required standards in the receiving water. Much established regulation is consequently inconsistent with modern and emerging systemic understanding of the nature of environmental problems and their longer-term solutions, acting only retrospectively on primarily economically-driven decisions. 'End of pipe' controls on industrial processes are evidence of this, seeking to mitigate gross environmental impacts at perceived net cost to production processes to address limits on emissions to environmental media. Practical implementation includes IPPC/IPC, landfill management, and a range of other environmental regulatory processes.

Due to the piecemeal manner in which adverse (generally human health-related) consequences stemming from environmental problems have been prioritised in regulatory responses, the ensuing legislation, management structures and associated budgets are heavily 'siloed'. For example, the EU's statutory 'Air Quality Management' framework (under the EU Air Quality Framework Directive) deals with a different set of gases to those of concern for climate change, with different subdivisions of local authorities responsible for their management notwithstanding the fact that they are generally emitted from the same sources (Baldwin *et al.*, 2009). Similar cases can be made for the disjointed management of both water and soil quality and their associated biodiversity (for example with conflicting subsidies for ecologically destructive and protective farming practices) (Randall 2007). This leads to a fragmented and reactive perception of, and equally disjointed management responses to, the value and protection of ecosystems. The benefits of protecting environmental quality may therefore be unclear to the wider public, perhaps perceived as altruistic outcomes achieved only through constraints on economically-framed development.

If 'good ecological status' is framed outside of broader social and economic contexts then there is a strong likelihood that the value of aquatic ecosystems in good status will not be widely appreciated. For this reason, it is necessary to look deeper into precisely why 'good ecological status' matters for society, and to frame this in terms that can be more readily appreciated by a wide range of stakeholders.

Evolving understanding of societal interdependence with ecosystems

Interdependencies between ecosystems, social aspirations and the economy have been poorly recognised throughout the economically-focused pathway of industrialisation, which has framed many of the assumptions of the developed-world economy (Everard, 2009a). Recognition of the need for a paradigm shift towards a more integrated model of development has been emerging during the latter decades of the twentieth century. However, there remains a significant lag in its internalisation across regulatory frameworks and resource use habits.

The paradigm of 'ecosystem services', developed and applied to natural resource and development problems since the late 1980s, explicitly recognises the multiple benefits provided to society by ecosystems. It also exposes the inevitable negative human consequences likely to result from their degradation. This is graphically demonstrated by analyses under the UN's Millennium Ecosystem Assessment (2005), which extrapolate dire implications for continuing human wellbeing if degradation of the planet's major habitat types is allowed to continue unabated. This assessment by the Millennium Ecosystem Assessment (MA) was based on a consistent new classification scheme of ecosystem services, integrating the many disparate categorisations developed previously for discrete ecosystem types and bioregions. Whilst not perfect, the MA classification of ecosystem services has since proved useful and achieved wide global consensus. It divides

ecosystem services into the four categories of: provisioning services (tangible goods that can be extracted from ecosystems such as fresh water, food and fibre); regulatory services (processes that regulate the natural environment including air quality, climate and pests); cultural services (diverse aspects of aesthetic, spiritual, recreational and other value); and supporting services (processes essential to maintaining the integrity, resilience and functioning of ecosystems). The complete MA classification of ecosystem services is listed in Table 1.

Table 1. The MA classification of ecosystem services (from Millennium Ecosystem Assessment, 2005)
Provisioning services
Fresh water
Food (e.g. crops, fruit, fish, etc.)
Fibre and fuel (e.g. timber, wool, etc.)
Genetic resources (used for crop/stock breeding and biotechnology)
Biochemicals, natural medicines, pharmaceuticals
Ornamental resources (e.g. shells, flowers, etc.)
Regulatory services
Air quality regulation
Climate regulation (local temperature/precipitation, greenhouse gas sequestration, etc.)
Water regulation (timing and scale of run-off, flooding, etc.)
Natural hazard regulation (i.e. storm protection)
Pest regulation

Disease regulation
Erosion regulation
Water purification and waste treatment
Pollination
Cultural services
Cultural heritage
Recreation and tourism
Aesthetic value
Spiritual and religious value
Inspiration of art, folklore, architecture, etc.
Social relations (e.g. fishing, grazing or cropping communities)
Supporting services
Soil formation
Primary production
Nutrient cycling
Water recycling
Photosynthesis (production of atmospheric oxygen)
Provision of habitat

Ecosystem services are an inherently anthropocentric framework, defining the many real or potential benefits that humanity derives from ecosystems and integrating a range of value systems. The focus on benefits means that they are also amenable to economic valuation. Ecosystem services thereby provide a valuable tool to understand and manage ecosystems in the context of their interdependence with societal needs and economic aspirations

(Everard, 2009a). An ecosystem services-based assessment of the outcomes of environmental interventions can therefore be helpful in exploring and communicating how 'good ecological status', as indeed other 'environmental outcomes', matter as investments in the basic ecological resources supporting broader social and economic goals.

Lessons learned from ecosystem service case studies

Everard (submitted) critically discusses key criteria to be addressed in conducting an evaluation of ecosystem services, drawing lessons from a set of published case studies (listed in Table 2) pertinent to the future 'mainstreaming' of ecosystem services into the policy environment. These lessons include explaining to wider groups of stakeholders why 'good ecological status' matters to their particular interests.

Table 2: Ecosystem services case studies reviewed by Everard (in press)

The Tamar 2000 SUPPORT project on the River Tamar catchment (Everard, 2009b). This EU-funded programme, conducted by the Westcountry Rivers Trust, sought to stabilise farm incomes by improving agricultural practices and farm diversification in the predominantly rural River Tamar catchment (south west England). It did so by recommending farm interventions to protect or enhance the river ecosystem, including some farm business diversification. The case study found that multiple ecosystem service benefits resulted across

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all four (MA) categories of ecosystem services. The cumulative benefit-to-cost ratio for services that could be valued was 109:1.

Managed realignment at Alkborough Flats (Everard, 2009b). A degraded flood bank at Alkborough Flats (on the Humber estuary, north east England), erected following the Second World War to 'reclaim' arable land had become uneconomic to renew. Managed realignment was undertaken, permitting tidal inundation of more than 400 hectares of floodplain to form saltmarsh, mudflat, reedbed and other intertidal habitat. This fulfilled intertidal habitat mitigation obligations under the EU Habitats Directive and reduced flood risk elsewhere in the estuary. Multiple ecosystem service benefits resulted across all ecosystem service categories, with a cumulative benefit-to-cost ratio for services that could be valued of 3.22:1.

Sea trout restoration on the River Glaven (Everard, 2010). Restoration of habitat and improvement of access for sea trout recolonisation on the River Glaven (North Norfolk) brought together a range of statutory and voluntary organisations with common aspirations to rehabilitate the river ecosystem. Multiple ecosystem service benefits resulted across all ecosystem service categories, significantly including many regulatory and cultural service benefits and with fishery benefits constituting <1% of the total monetised benefits. The cumulative benefit-to-cost ratio for services that could be valued was 325:1.

Buffer zone installation on a formerly severely-poached river bank on the upper Bristol Avon (Everard and Jevons, 2010). Fishery interests instigated installation of fencing to exclude cattle from a field edge on the upper Bristol Avon (North Wiltshire, England). Regeneration of vegetation over the

subsequent growing season was significant, improving aesthetics and also narrowing the river channel which reinstated low diversity and sinuosity, bed scour, sediment and other pollutant attenuation, and supported fish recruitment whilst providing habitat for other wildlife. Benefits accrued across all ecosystem service categories with a benefit-to-cost ratio of 31:1, of which fishery benefits of this fishery-driven scheme constituted only around 10%.

The Mayes Brook restoration in Mayesbrook Park (Everard *et al.*, in press). The planned restoration of the Mayes Brook in Mayesbrook Park (East London) offers an opportunity to create an ecological and community focal point within a broader environmental regeneration project. Rehabilitation of a river reach within a currently barren park landscape also provides a chance to demonstrate synergistic approaches to flood storage and biodiversity enhancement. Assessment of likely benefits revealed no uplift in provisioning services but significant benefits across other service categories, contributing to regional regeneration and public health and bringing benefits worth up to seven times the cost of the regeneration scheme.

Coastal flood defence scheme at Wareham (Defra, 2007). Appraisal of options for tackling a degraded historic coastal flood defence bank at Wareham (Poole Harbour, southern England) explored likely outcomes and economic values associated with changes. Non-monetised weighting by stakeholders helped rule out certain options, directing attention towards the most important data gaps and uncertainties, and enabling identification of a preferred managed realignment option. Though monetisation was conducted, the weight of stakeholder consensus around a managed realignment option was strong enough to justify investment in the scheme.

❑ Set of five linked ecosystem services assessments in the east of England (Glaves *et al.*, 2009). These studies engaged stakeholders to address the implications of development in five discrete locations in the East of England. All studies took a consistent approach of defining the opportunity, summarising habitat types on the site, auditing and weighting likely ecosystem service outcomes from development options, and monetisation of some of the most significant ecosystem services. This information was used to assess likely differences between 'do nothing' and 'preferred development' scenarios. In all cases, monetisation was set aside in making final development decisions, as monetary values were perceived as skewed by current marketed services overlooking those important services outside of the market.

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❑ The proposed Pancheshwar Dam (Everard and Kataria, 2010). The proposed Pancheshwar Dam is planned to be the world's second-tallest dam on the Kali River, defining the India/Nepal border in the Himalayas. A non-monetised and non-quantified study was undertaken based on a variety of information sources. Benefits including water and power supply were included in official documentation, but there was no formal acknowledgement of wider local and catchment-scale impacts. The analysis revealed a major democratic failing in that the very many people who were not planned to be directly beneficiaries of this water and power were not only excluded from decision-making, but were disregarded in planning and dialogue and were also the most likely to lose out from degradation of ecosystem functioning.

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Further lessons include the necessity to consider the ecosystems as fully connected both across space (local sites to wider catchments), time

(decisions relating to climate regulation affect people in the long term) and disciplines (such as the impacts of hydropower and irrigation/water supply impoundments for fish and wildlife, sediment and nutrient flows, habitat-forming processes and many other services).

An ecosystem services perspective exposes potential societal benefits or harm across the full range of ecosystem services, providing a basis for planning optimally beneficial management interventions. This is illustrated by post-hoc ecosystem service evaluations of the outcomes of interventions in the Tamar 2000 scheme, buffer zone installation on the upper Bristol Avon and the River Glaven sea trout restoration project, which exposed substantial service benefits from ecosystem restoration beyond those initially planned and yielding benefit-to-cost ratios of 109, 31:1 and 325:1 respectively. (In these case studies, benefits were calculated as net present values over a 25-year lifetime for all services that could be monetised, and these were divided by scheme costs to derive benefit-to-cost ratios.) These benefits flow to a wide range of stakeholders, some local to interventions and others at wider geographical scales from catchment scale (for example flood regulation and water quality enhancements), and including global beneficiaries from enhanced 'climate regulation' services. Conversely, where technical solutions are implemented for narrowly-framed benefits to targeted beneficiaries, such as large dams built on river systems or 'hard engineering' flood defences, wider impacts on ecosystem functioning may result in degradation of multiple disregarded ecosystem services and their often numerous beneficiaries. This was a key conclusion of the Pancheshwar Dam case study, which confirmed

the conclusions of the World Commission on Dams (2000) that large, engineered schemes such as major dams tend to benefit only a limited set of stakeholders, with many rural communities across the catchment largely excluded from decision-making yet likely to bear the substantial costs and risks of ecosystem disturbance. The Pancheshwar Dam ecosystem services assessment led to recommendations for a process of redesign and public engagement to ensure more sustainable decision-making and consistency with international protocols.

An ecosystem services perspective can support a more inclusive approach to decision-making, recognising that all services reflect different potential beneficiaries or victims of ecosystem management. Many of these stakeholders have been overlooked under the historic focus on discrete management disciplines, such as local flood control or water quality regulation. A broader consideration of all ecosystem services therefore provides a basis for longer-term value generation through scheme design to optimise outcomes for all services and their beneficiaries.

As one example, the urban setting of the planned Mayesbrook Park restoration revealed no likely direct uplift in provisioning services, contrasting markedly with other predominantly rural case studies, yet the planned environmental enhancements can make significant contributions to regulatory, cultural and supporting services of significant health, amenity and inclusion benefit to the dense and generally deprived neighbouring population. Over 80% of the total annual ecosystem service benefits that could be quantified for

the Mayebrook Park intervention related to contribution to health, risk and cultural value, emphasising the multiple societal benefits that can arise from environmental improvement. Ecosystem services assessment of the planned Mayesbrook Park redevelopment also identified a range of options for further enhancement of public value, for example through improved site hydrology, natural water purification processes, reduced carbon emissions, reuse of on-site organic waste, and optimisation of park layout for health and education resources. The potential contribution to health and urban renewal of the planned Mayesbrook Park intervention is consistent with the findings of wider urban river restoration studies (reviewed for example by Petts *et al.*, 2002) and the case for investment in urban 'green infrastructure' and the cost-effectiveness of improving the wellbeing of urban communities (Natural Economy Northwest, 2009).

The instigation of buffer zone installation on the upper Bristol Avon and sea trout restoration on the River Glaven by fisheries interests provide further examples of how wider public benefit may accrue from ecosystem restoration schemes. In both cases, the vast bulk of benefits accrued to a broad set of stakeholders beyond the focal interest group. The River Glaven sea trout restoration project not only yielded a substantial benefit-to-cost ratio of 325:1, but did so for a wide range of beneficiaries of which angling interests comprised less than 1% by economic value. Realisation of wider benefits is also borne out by the Bristol Avon buffer zone study which found that, of the significant benefit-to-cost ratio of 31:1, over 90% of the benefits accrued to

broader sectors of society beyond the fishery-related interests driving and investing in the scheme.

The Alkborough Flats managed realignment case study provides another example of how scheme design can optimise public value. In this example, reflooding of formerly defended arable farmland could have represented a 'trade-off' between benefit types and beneficiaries, with provisioning services lost through abandonment of arable farming to achieve a net gain in terms of regulatory and supporting service benefits. However, ecosystem service assessment of the outcomes of the change in stewardship to rare breeds grazing on periodically inundated land at Alkborough revealed that there was, in practice, no net loss of provisioning services, and indeed provisioning services might have been substantially enhanced were methods available to quantify the uplift in recruitment of valuable fish species on recreated intertidal habitat. Forethought then may enable innovations potentially leading to 'win-win' solutions, which should be sought in preference to an assumption that there 'win-lose' trade-offs are inevitable.

These examples collectively provide compelling evidence of how environmental enhancements or protection may produce multiple benefits for a wide range of stakeholders. This is also reflected in the evolution of the UK's river trust movement, with many river trusts initially established by angling concerns but rapidly diversifying to address the many wider beneficiaries of improved river ecosystems (Everard, 2004).

The insight provided by an ecosystem services perspective reveals the potential to optimise public benefits through assessing different options for environmental interventions. This may include measures to achieve objectives required by the WFD, agri-environment subsidies, development planning and other public policy instruments. Many such opportunities today remain overlooked due to a narrower focus on discipline-specific statutory drivers and appraisal frameworks, hampered still further by 'ring-fenced' budgets.

The Wareham coastal flood defence case study demonstrated that neither perfect knowledge nor perfect ecosystem service valuation may be necessary for many appraisal purposes. Stakeholder-based identification of the relative magnitude and direction of likely changes in the provision of ecosystem services across different options proved adequate to support a practical operational decision. Quantification and monetisation of likely ecosystem service impacts was also impossible in the case study exploring the proposed Pancheshwar Dam scheme, but this did not inhibit the strong conclusions of the study nor its substantial recommendations for scheme reassessment. This finding that useful conclusions from ecosystem services assessments need not depend upon full quantification and monetisation was also arrived at independently in the set of five East of England case studies for which, although economic values were assigned for some services, identification of preferred outcomes from the selected 'scenarios' did not rest on deduced economic values which were perceived as potentially skewing conclusions.

It is revealing that lessons learned from these case studies were consistent from the largest scale (whole catchments) to the 330 metre, single-bank buffer zone intervention on the Bristol Avon. There was also consistency in lessons from hard engineering schemes (such as the Pancheshwar Dam) to various 'soft engineering' and river/habitat restoration schemes.

Environmental regulation today has still to escape 'silo' management, in terms of organisation, departmental, regulatory and budgetary constraints on looking beyond single or few focal interests. However, the ecosystem services case studies uniformly identify wider benefits or impacts beyond the narrow bounds of scheme design. Inadvertently persisting with a default 'silo' approach may result in opportunities for innovation and achievement of improved value for all stakeholders to be missed.

It is clear from all ecosystem services case studies that many and substantial identified benefits and costs are not reflected in market prices. Market prices are available for some provisioning services (food, fresh water, etc.) and cultural services (including some recreational values), albeit that many do not fully internalise full environmental and social costs (Everard, 2009a). Other markets such as 'carbon markets' are only now emerging. However, the benefits and costs of many services are simply external to a market still substantially reflecting the dominant model of industrialisation. To make progress towards sustainability, eventually accounting for all positive and negative impacts on the environment and its many beneficiaries and factoring them into decision-making processes, expansion of the market is essential.

Ecosystem services provide a powerful tool to reflect implications for present and future beneficiaries into the costs of actions and inaction. This also provides an influential means to communicate the benefits and costs of 'environmental improvements', and opportunities for mutually-beneficial action by organisations and individuals in common, ecosystem-mediated 'markets'

Notwithstanding the acknowledged substantial assumptions underpinning some aspects of ecosystem service evaluation, the range of case studies demonstrates the flexibility of the ecosystem services approach in addressing problems associated with single, a few or multiple services, and how scheme design may be optimised to maximise benefits. This approach therefore also helps escape narrow ways of thinking, break down cross-sectoral barriers, consider ramifications for more stakeholders, and promote consideration of issues and values that may previously have been overlooked.

These lessons are transferable not merely to further case studies but also to policy and operational challenges, including implementation of further cycles of Water Framework Directive (WFD).

Relevance to implementation of the WFD and other environmental policies

The findings of the Defra 'Survey of Public Attitudes and Behaviours towards the Environment' suggests that there is general public support for goals such

as 'better habitat', 'enhanced ecosystems' or 'improved environmental quality'. However, there are significant risks associated with a perception that this is largely altruistic, and particularly so given competing investment priorities and financial hardship. It is then essential to secure continued support to communicate how investments in nature conservation and the functioning and quality of the environment contribute to a wide range of societal benefits. These benefits include, for example, protected quality and lower costs of treatment of water for abstractive uses, improved flood risk management, enhanced amenity and recreational opportunities and values, protection of rare species, fish populations and other culturally-valued biodiversity, and improved disease control. This kind of language, addressing the human benefits that stem from an enhanced environment and which comments with address different value systems, is far more persuasive to wider sectors of society than discourses relating to requirements to meet a set of technical standards. The benefits of 'good ecological status', as indeed wider 'environmental outcomes', may be more convincingly and intuitively explained in terms of the diverse provisioning, regulatory, cultural and supporting services that protected or enhanced ecosystems may provide. Issues such as health and wellbeing, economic opportunities, appreciation of nature, and safeguarding of species and habitats of conservation and leisure interest connect rather better with the way that the public perceives the environment.

Implementation of the WFD, as indeed other regulations, must in future necessarily be more inclusive of multiple stakeholders, as both potential beneficiaries and also who may be required to take action to achieve

regulatory goals. Ecosystem services provide a more effective means of communication of the benefits of implementing measures to deliver the WFD than a more mechanistic focus on compliance with technical standards. Appraisal of proposed measures to address perceived problems within catchments or water bodies under the WFD, and description of associated positive and negative impacts, can be expressed in more socially-relevant terms through the language of ecosystem services, and also quantified and potentially monetised on that basis to justify proposed investment.

All of the case studies addressed above underline the necessity of considering ecosystems as fully connected both across both space and time. Yet the first cycle of River Basin Management (RBM1) implementing the WFD in the UK fragmented catchments into 'water bodies' designated within catchments, focusing on problems at water body scale and proposing equally localised 'programmes of measures' related to those local problems (Defra, 2008b). It will be necessary to think at catchment scale in future rounds of RBM, consistent with long-established good practice in integrated water resources management (Calder, 1999). It is also essential to consider all ecosystem services as stemming from ecosystem functions which may operate across contiguous catchment systems, rather than 'siloed' on narrow spatial, temporal or disciplinary grounds and which therefore take into account only a small sector of potential beneficiaries and effective 'measures'.

This more systemic approach also has the advantage of identifying wider stakeholders potentially affected, beneficially or negatively, by proposed

actions. This provides a basis for more equitable and inclusive decision-making, and the identification of measures from which longer-term value may be achieved in scheme design and optimisation.

This type of high-level appraisal of likely impacts may avert 'locking in' regulatory thinking to a narrow set of options (Foxon, 2007), often reinforced by sunk costs is the design of preferred schemes (Wilson and Zhang, 1997). It may also provide a basis for a more adaptive approach to more risky 'programmes of measures' (such as the use of constructed, restored or integrated constructed wetlands with which English regulators have little experience or confidence), accepted in principle and on the basis of ecosystem services assessment as a wise decision yet for which responsive management will be required as the schemes come into operation.

Consideration of these wider stakeholders, and their different value systems, may in turn help regulators articulate the benefits of environmental protection or enhancement measures. Instead of communicating in terms merely of technical standards, stakeholder engagement will broaden the focus to consider the implications of meeting these standards for different sectors of society, including for example the protection or enhancement of health, fisheries, values landscapes and species, and educational resources.

A focus on ecosystem service outcomes may also broaden the definition of problems and their potential solutions, as both pressures and effective 'programmes of measures' affecting a locally-defined 'water body' may in

practice emanate from elsewhere within catchments. Furthermore, by making strategic interventions, for example through restoration of degraded wetlands in the headwaters of catchments, benefits may result in many water bodies across the catchment and across a range of disciplinary interests including, for example, fish recruitment, water quality and improved hydrology (for example Whitten and Bennett, 2005). An ecosystems perspective may also thereby help identify 'win-win' approaches to tackling perceived problems, such as strategic implementation of Integrated Constructed Wetlands (ICW) to reduce nutrient inputs to surface waters whilst delivering on landscape, aesthetic and biodiversity benefits (Scholz *et al.*, 2007) or emphasising clearance of non-native vegetation to reduce evapotranspiration, enhance native ecology and river habitat and promote community participation and skills development (Preston and Everard, 2008). Not only can novel, ecosystem-based solutions provide more enduring, low-energy means to deliver a wide range of targeted environmental benefits but, as proven by the Mayesbrook Park and other case studies, they can also be advantageous to wider health, education, urban regeneration and social inclusion agenda. These benefit across multiple ecosystem services may be achieved whilst overcoming established but often flawed assumptions about the inevitability of 'win-lose' trade-offs.

The fact that benefits across ecosystem service categories can not only be identified but also potentially quantified and monetised means that benefits can be expressed in socially-relevant terms. By contrast, there was no benefit assessment of WFD implementation under RBM1 beyond that of compliance

with regulatory requirements and under regulatory impact assessments. It is then to be expected that the public may question the value of this significant investment when its associated benefits are not made clear.

The case studies addressed in this paper collectively provide a substantive evidence base for expressing ecosystem services benefits in future rounds of RBM, supporting a more visionary, joined-up and participatory approach to future rounds of WFD implementation. This is essential given the emerging 'Big Society' agenda (Cabinet Office, 2010), and its implications for going beyond narrow thinking about study areas, definition of problems and potential solutions, organisational barriers, involvement of stakeholders, and achieving cheaper and more enduring outcomes through collaboration and pooled investment.

This in turn will further inform the necessary reform of the market progressively to internalise more currently 'missing markets' for ecosystem services, and their influence on other areas of public policy such as reform of the EU Common Agricultural Policy and various domestic agi-environment schemes, WFD based on clearly-expressed clear public benefits, and a range of other regulations and subsidies.

This review of why 'good ecological status' matters suggests that it will be essential to communicate in different ways about the broader social and economic values associated with protected and improved ecosystem quality. Communication must necessarily be meaningful to diverse stakeholders who,

by majority, do not have specialist environmental interests or education, justifying to them the importance of continuing investment in environmental outcomes on the basis of the substantial value that they provide. However, framing outcomes in terms of public benefits rather than technical standards will also change the cultural context within which regulations are implemented, inviting greater collaboration, participation and transparency.

In future, this may help avert accusation that WFD implementation has, for the RBM1 in the River Kennet as one example, "...failed to recognise the river's problems and has failed to produce a coherent programme of activities to deal with them..." due in large measure to "...a centrally driven approach to the plan... Rather than using the Water Framework Directive to coordinate and drive the existing activities, they have been subsumed into vague generic measures with no clear targets" (Royal Society for the Protection of Birds, 2009, page 4).

Beyond the positive advantages entailed in moving WFD implementation onto an ecosystem service footing, there are also requirements for policy implementation in England progressively to embed an ecosystem services approach. This is set out, for example, in a range of actions and requirements in the Defra (2007) 'Securing a healthy natural environment: An action plan for embedding an ecosystems approach' and Defra (2010) 'Delivering a healthy natural environment – An update to 'Securing a healthy natural environment: An action plan for embedding an ecosystems approach'.

Shifting future rounds of RBM onto an ecosystem services footing is a priority if this opportunity for better, more durable and resilient, equitable, partnership-based and mandatory outcomes is to be seized. Importantly, this will also enhance communication of the many benefits of improved ecological quality to the many beneficiaries and stakeholders that will be required to take action or invest in associated measures. Regardless of these compulsions, framing 'good ecological status' and broader environmental protection or enhancement as a sound investment in improved opportunity and quality of life is a more persuasive message than one perceived as an obligation, or as a net constraint on narrowly-framed economic development.

Conclusions

(1) Explanation of the need for 'good ecological status' or other 'environmental outcomes' is most effectively communicated to a wider public in terms of the multiple benefits that this will confer upon them, the narrative of ecosystem services serving as an effective means for dialogue.

(2) Consideration of the societal benefits of good status can also expand thinking about environmental management solutions by setting them in wider contexts of time and space and within a broad range of stakeholders.

(3) This may in turn help engage broader sectors of society in dialogue about potential solutions, including the innovation of novel 'win-win' solutions.

(4) Pragmatic assessment tools are available to make rapid systems-level assessments of potential management solutions, even in the face of imperfect knowledge and quantification, averting the risk of investment in pre-conceived solutions 'locking in' narrow thinking and outcomes.

(5) Ecosystem services also support the breaking down of organisational barriers and narrowly-framed sectoral interests, facilitating the engagement of wider constituencies of stakeholders in collaborative, and potentially adaptive, decision-making.

(6) Since ecosystem services relate to the ways people benefit from ecosystems, this approach is inherently amenable to monetisation further helping comply with WFD requirements, reflect different value systems in a common (monetised) basis, and making the case for 'why good ecological status matters'.

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