Agriculture and Water Quality: Monetary Costs and Benefits across OECD Countries

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

Directorate for Trade and Agriculture

This report, which has been written by an outside consultant, is available only in its original language. It has been declassified by the Joint Working Party on Agriculture and the Environment of the OECD's Committee for Agriculture and the Environment Policy Committee, under the code COM/TAD/CA/ENV/EPOC(2010)43/FINAL.

This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Agriculture and Water Quality: Monetary Costs and Benefits across OECD Countries

Andrew Moxey

Pareto Consulting,
Edinburgh, Scotland, United Kingdom

Note

This document, *Agriculture and Water Quality: Monetary Costs and Benefits across OECD Countries*, by Andrew Moxey (Pareto Consulting, Edinburgh, Scotland, United Kingdom), assisted by Eva Panagiotopoulou (Department of Agricultural Economics and Rural Development, Agricultural University of Athens, Greece), is one of the background reports supporting the OECD study (2012) *Water Quality and Agriculture: Meeting the Policy Challenge*, which is available at *www.oecd.org/agriculture/water.*

The report was carried out under the auspices of the OECD Joint Working Party on Agriculture and the Environment of the Committee for Agriculture and the Environment Policy Committee.

The report is published on the responsibility of the author and does not necessarily reflect the views of the OECD or its member countries.

The other background reports (also available at *www.oecd.org/agriculture/water*) are:

Water Quality Trading in Agriculture
James Shortle, Environmental and Natural Resources Institute, Penn State University, United States;

New and Emerging Water Pollution arising from Agriculture
Alistair Boxall, Environment Department, University of York, United Kingdom;

Agriculture's Impact on Aquaculture: Hypoxia and Eutrophication in Marine Waters
Robert Díaz, Institute of Marine Sciences, United States; Nancy N. Rabalais, Louisana Universites Marine Consortium, United States and Denise L. Breitburg, Smithsonian Environmental Research Center, United States. This paper has also been published in OECD (2010) *Advancing the Aquaculture Agenda: Workshop Proceedings.*

TABLE OF CONTENTS

Boxes

EXECUTIVE SUMMARY

Agricultural activities influence water quality. Depending on production patterns and baseline conditions, this can be a negative or a positive effect. For example, sedimentation, nutrient and chemical run-off can all be increased or decreased through adjusting management practices. Equally, abstraction for livestock or irrigation can affect the volume and flow of water and thus alter the concentration (i.e. dilution) of contaminants. However, although policy responses may be in place, such effects are often mis-priced or un-priced externalities. Accounting for them more explicitly would result in improved resource allocations.

Changes in water quality have a variety of economic impacts, including upon human health, ecosystem health, agricultural and fisheries productivity, and recreational and amenity uses. Although some of these effects are tangible, many are not and their monetary quantification entails non-market valuation techniques. Valuation also requires some prior underpinning scientific monitoring and understanding of complex biophysical relationships. For example, to differentiate between agricultural and non-agricultural sources of pollution or to trace the passage of diffuse pollution through complex hydrological systems. The latter point is important since the separation of cause-and-effect by both physical distance and by time-lags adds complexity to the measurement and comparison of monetary values.

A search for information across OECD member countries confirmed the existence of agricultural impacts on water quality in all cases. In most cases, reported effects were negative. This does not deny the potential for beneficial mitigation activities, merely that current production patterns and management practices are generally polluting in nature. An important exception is paddy fields, where mimicking natural wetlands can contribute to improvements in water quality. Achieving mitigation in other production systems may incur more of a trade-off with commodity production.

Explicit valuation studies are rarer than biophysical reports of impacts, are often not related specifically to agriculture and do not encompass all categories of economic impact. Moreover, they are often conducted at a regional rather than national level and deploy a variety of methodological approaches, including in relation to whether reporting marginal, average or total costs. As such, results are difficult to interpret out-of-context and cross-country or cross-study comparisons can be misleading. Nevertheless, valuation estimates were identified for most OECD members and serve to illustrate the existence of externalities and a need to adjust agricultural water usage and other management practices to reduce negative impacts.

However, the fragmented, incomplete and variable quality of valuation figures suggests various themes for further research. These include improvements to the underpinning science, continued refinement of non-market valuation techniques and more routine inclusion of water quality in environmental accounts. In addition, given that not all categories of impact are addressed equally, there are gaps to be filled at both the national and regional level.

Whilst detailed discussions of policy issues are beyond the scope of this paper, as are more detailed discussions of the technical aspects of improving valuation figures, the externality effects identified and the reported illustrative valuations for them across OECD countries are hopefully indicative of the nature and scale of the issues remaining to be addressed.

AGRICULTURE AND WATER QUALITY: MONETARY COSTS AND BENEFITS ACROSS OECD COUNTRIES

by

Andrew Moxey[1]

1. Introduction

As an economic activity, agriculture generates a number of marketed goods such as grain, milk and meat. However, the process of agricultural production also generates a number of effects felt externally to any market. Some, such as attractive landscapes, are beneficial to society. Others, such as pollution, are costly to society. In either case, failing to account for such non-market goods and services means that the allocation of resources to and within agriculture is sub-optimal from society's perspective. This short paper reviews agriculture's (but not the broader food sector's) externality impacts on water quality and collates illustrative valuations of these impacts reported across OECD countries. Some supporting literature is offered in Annexes A and B.

Identifying and estimating the significance of agriculture's impact on water quality is of relevance to policy makers seeking to promote sustainable agricultural and wider economic development. A failure to account correctly for externality effects leads to a misallocation of resources, to an inappropriate mix of land uses and inappropriate management of individual parcels of land. For example, too much arable land relative to grazing land or to livestock densities and fertilizer applications that are too high. Such misallocations result in a loss of economic efficiency that lowers the overall gains to society and should be considered alongside other agricultural policy issues. Beyond the immediate agricultural policy interest, quantification of externalities is also relevant to improving the treatment of natural capital and environmental degradation in systems of national economic accounting as a guide to the sustainability of resource usage.

Globally, despite more rapid growth in other sectors' usage, agriculture dominates the usage of freshwater. Although some of this water remains within final crop and livestock products, much of it is returned to rivers, lakes and groundwater stores. As it flows across fields as surface runoff or percolates down through the soil, this water can pick-up a number of contaminants from farmland. For example, sediments from eroded soil, salts from irrigation, nutrients from organic and mineral fertilisers, pathogens from livestock, and chemicals from pesticides and farm machinery.

The level of contamination varies considerably and can be influenced by a number of local factors. For example, the timing and intensity of management activities, the slope and soil in a field, and whether weather conditions are wet or dry. Importantly, agricultural use of water can also influence the concentration level of contaminants by altering the volume and rate of flow of water

1. Pareto Consulting, Edinburgh, Scotland, United Kingdom.

entering rivers and lakes (i.e. affecting the diluting effect of water). For example, via abstraction for watering livestock or for irrigation of crops. Land management practices can also improve as well as degrade water quality. For example, unfertilized and ungrazed buffer strips alongside watercourses can absorb and disperse pollutants. The same is true of paddy fields and of wetlands created on farms.

The impacts of contamination also vary depending on the types of pollutant and how they impact on other uses of water. For example, sensitivity to pollution in drinking water is higher than in water used for industrial cooling, visible pollution may matter more to tourists looking at a river or lake than invisible chemical pollution. The costs of some of these effects are revealed through expenditure on protective or avertive measures, others may be inferred through estimated lost output.[2] The latter includes tangibles such as lower crop yields or fish catches but also intangibles such as recreational enjoyment, meaning that non-market valuation techniques are required. From an economic perspective, information on total or average costs is of less policy relevance than information on how they vary with changes in water quality and management – the costs and benefits of marginal changes. Whether mitigation practices are interpreted as delivering environmental performance that is expected by society with or without reward depends upon how reference levels and property rights are perceived. For example, on whether pollution levels are compared to a pristine environment without any agricultural activity or to existing agricultural production patterns and management practices and on whether mitigation is viewed as voluntary and meriting reward under the "provider-gets-principle" or as obligatory under the "polluter-pays-principle".

Assessing the economic significance of agriculture's influence on water quality thus requires some understanding both of how farming practices influence water quality and also of how and why changes in water quality matter and can be achieved. The next two sections outline a framework to aid such understanding by identifying various categories of impact and then outlining the information needed to quantify them.

2. Categories of impacts

As a key component of life on Earth, water is clearly central to economic activities linked directly to biological health and productivity but freshwater and saltwater are also used directly or indirectly in a variety of other ways too. Although sensitivity to water quality varies across these different uses, some more important categories may be relatively easily identified and are described briefly below. As with most such categorizations, some categories may overlap to a certain extent and there is scope for further refinement. Nevertheless, it is hopefully sufficient to help frame subsequent analysis and discussion.

Human health

Given the essential nature of drinking water to human survival, degraded water quality has implications for human health whether from pathogens or chemicals. Extreme contamination can render water physically undrinkable, posing an immediate health risk and/or recourse to expensive short-term alternative provision (e.g. bottled water). More typically, contamination poses a potential longer-term risk and is addressed through routine treatment of drinking water to remove pollutants (e.g. pathogens, nitrates, pesticides) that can cause immediate illness and/or longer term diseases. However, such treatment is not costless and represents an additional burden on water companies and

2 Typically, there is some scope for substitution between these different responses although protective expenditure is often driven by regulatory requirements (e.g. treatment of drinking water) and does not necessarily relate precisely to avoided damage costs.

thus consumers. The more degraded water is, the more costly it is to treat. Additional water treatment may incur not only significant capital costs, but also an increase in energy and chemical costs. There may also be secondary pollution issues regarding how extracted contaminants are then subsequently disposed of.

Ecosystem health

The presence of pollutants in water can alter ecosystems, changing habitat characteristics and wildlife species composition. For example, chemicals such as pesticides or oils can directly kill plants and animals in-stream whilst nutrient enrichment (eutrophication) can indirectly alter the relative prevalence of different species. Such impacts extend beyond rivers and lakes into the marine environment, particularly around coasts or in enclosed seas with relatively shallower water and/or weaker currents where pollutants can accumulate and persist. For example, sediment loadings can cause river mouths to silt-up and nutrient loadings can lead to coastal eutrophication and algal blooms. In some cases, the species affected are of extractive commercial interest (i.e. for fishing), in others they are not – but may still have economic value through contributions to wildlife tourism (e.g. whale watching) or the background maintenance of ecosystem services which implicitly underpin many economic activities.

Agriculture

Agriculture can be both a source of water pollution and a victim. For example, water courses contaminated with pathogens, chemicals or salts can pose a health risk to both livestock and crops and leading to lower the productivity. In some cases, such effects may be felt on farms causing them but more often will spill-over onto other farms leading to lower yields and/or higher expenditure on counter-measures elsewhere.

Fishing

Commercial and recreational fishing activities can be directly affected by water quality issues. For example, toxic contaminants can directly or indirectly, through bio-accumulation of contaminants, kill target species or they can simply render species unfit for human consumption – in both cases reducing catch volumes and values. Such problems have been encountered in relation to both free-swimming species and shellfish, with both being highly susceptible to eutrophication effects.

Recreational/amenity activities

Not all uses of water are consumptive in the sense of extracting water or something tangible from water. For example, swimming in, canoeing on or looking at a river, lake or sea. Yet such activities may be also limited by the presence of pollutants, either because they pose an actual health risk and/or merely reduce potential enjoyment, but also in some cases pollution can lower riparian property and land values. For example, some algal blooms associated with eutrophication are toxic and thus preclude recreational contact activities but can also impair the visual appeal of a water body, as can murky, sediment-carrying or smelly water. Such changes can impair values for visitors and residents alike, leading to, for example, less tourism or lower waterfront property values. In addition, in some cases, particular bodies of water may have specific local cultural significance and visually apparent quality degradation may reduce spiritual value. Less easily detectable pollutants, such as some chemicals or pathogens, may degrade habitats and affect ecosystems without altering the appearance of water bodies, highlighting how different water users may be affected in different ways. This is sometimes expressed as a "ladder" of water use, with progressively higher quality water permitting more uses.

Other uses

Other industries can also be affected by water quality issues. For example, over time, sedimentation of navigable waterways can disrupt water-based transportation networks and/or incur additional (dredging) maintenance costs. Equally, sediment, chemical and salt loadings can increase cleaning and corrosion maintenance requirements where water is used for industrial cooling (e.g. power generation). Similarly, as with drinking water, treatment of water used in bottled mineral water, food processing or textile manufacturing may be necessary to avoid contamination of final consumer products.

3. Information needs

Although it may be possible to identify categories of agriculture's impact on water quality, translating these into quantitative estimates of their economic significance requires more detailed information on their physical scale and their value. That is, for example, some effects may be relatively insignificant economically if they occur on only a minor scale and/or cause relatively little inconvenience to other water users. A comprehensive review of information needs is beyond the scope of this report but a number of issues identified in the supporting literature are described briefly below.

Linkage complexity

The precise biophysical mechanisms linking agricultural activities to pollutant levels are complex and imperfectly understood. This largely reflects the (predominantly) diffuse, non-point nature of agricultural pollution which makes it difficult both to observe polluting activities directly and to link them explicitly to pollution outcomes. For example, originating activities may be separated from pollution outcomes by both physical distance and time as pollutants move slowly from upstream fields to downstream sites through transboundary hydrological systems that can span several countries. Moreover, pollutants may be reduced during their movement through natural assimilation processes or dilution, or conversely increased from other sources. In addition, observed impacts may not be solely attributable to pollution. For example, lower fishing catches may also arise due to over-fishing. Improved monitoring data on management practices and water quality can help in this regard as can modelling to identify linkages within hydrological systems, but both can be expensive.

Spatial and temporal variability

The polluting effect of any given agricultural activity is highly context-specific, depending not only on an activity's characteristics but also upon local site conditions, prevailing weather conditions, the management of neighbouring land and past management practices. For example, the same application of fertiliser can lead to different in-stream nitrate levels depending on the type of soil and topography in a field, the intensity and duration of rainfall immediately following application, and the timing and level of fertiliser treatments on surrounding fields. Again, improved monitoring data on site conditions and management actions can help. However, the time-lag between pollution entering an hydrological system and becoming detectable can also be highly variable. For example, whilst contamination of surface water may become apparent almost immediately, contamination of groundwater may not become apparent for years or even decades. This poses a challenge for monitoring but also for policy responses since observed water quality may reflect past rather than current agricultural practices and policy-induced changes may take considerable time to appear. Such time-lags also make comparing costs and benefits less straightforward and necessitate the use of discounting of future impacts, a topic in its own right.[3]

[3] See, for example, Price (1993), Portney & Weyant (1999), http://nordhaus.econ.yale.edu/stern_050307.pdf

Non-agricultural sources

Agriculture is not the only potential source of water pollution. For example, forestry operations can also involve soil disturbance and the application of fertilizers and chemicals, as can activities across private and municipal gardens, golf courses, airports and road and rail networks. Equally, municipal sewage from private residences and commercial premises also typically contains a mix of chemicals, nutrients and pathogens. Consequently it is often necessary to apportion any changes in water quality between different sources, something that can be difficult to do accurately.

Total economic value, non-market valuations and commercial confidentiality

Even if the causal links between specific agricultural activities and resultant water quality can be clarified, the economic significance of such linkages may still not be clear. That is, the total economic value of water quality encompasses several components lacking market prices. For example, in contrast to a tangible "direct use" such as irrigation, "indirect use" though amenity and recreational activities is less tangible and often unpriced, as are "non-use" values associated with altruistic and bequesting behaviour. Hence recourse is required to non-market valuation techniques such as hedonic pricing, contingent valuation and conjoint analysis to identify citizens' or households' willingness to pay (WTP) for different levels of water quality per year. Although widely used, such approaches are not without criticisms, including assumptions about the ability of people to articulate their WTP for non-market effects and difficulties in transferring valuations between different locations and contexts.[4] Separately, information on the market costs of some mitigation and adaptation activities may be obscured by commercial confidentiality. For example, private water companies are often reluctant to reveal treatment costs.

Other externalities

Jointness between producing agricultural commodities and water pollution also extends to other externalities. For example, sedimentation of watercourse arises from soil erosion which itself represents an environmental degradation cost in terms of lowering capacity for agricultural production and carbon sequestration. Equally, air quality can be reduced by nitrous emissions but subsequent deposition may also cause water pollution. This means that care needs to be taken to avoid misallocating values between different externality effects and/or to avoid double-counting. It also means that attention needs to be paid to pollution-switching. For example, whether reductions in water pollution cause an increase in other pollutants such as greenhouse gas (GHG) emissions.

4. A survey of impact estimates

Across OECD members, a search for information relating to agriculture's impact on water quality revealed a variety of studies both in academic journals and in the "grey" literature of government and NGO reports. The search was primarily conducted on-line, using personal recommendations and web search engines to identify and access published studies, academic databases and official websites.

Many studies focused on physical impacts, far fewer on economic valuations. The coverage of impact categories varied and relatively few countries had consistent or comprehensive figures for all impact categories. Moreover, studies varied greatly in the time period to which they related and the methodologies that they followed. Many were focused on water quality in general rather than agricultural aspects specifically. Given this variation, selecting studies to include in the report was

4. A detailed discussion of such issues is beyond the scope of this paper, but see (e.g.) Turner (1977), Navrud (2007) & Bateman et al. (2009).

essentially a subjective process, guided by the reputation of journals, authors and funding bodies but also in some cases simply by the availability and vintage of any published information. Local contacts and/or familiarity with the situation in any given country would be expected to reveal further information in many cases.

The variation in coverage, methodology and provenance of studies makes it difficult to present figures on a like-for-like basis and comparisons over time and/or between countries will be misleading. Nevertheless, brief summaries are offered below to outline the reported nature and scale of water quality issues associated with agriculture in each OECD country. To avoid cluttering the text with numerous references, only the most recent and/or relevant are cited explicitly with selected others listed in Annex B for each country.

The emphasis of most valuation exercises cited here was on the degradation costs arising from current production patterns and management activities rather than the mitigation potential of adjusting agriculture. This is neither to deny the importance of potential mitigation through agricultural adjustments nor to deny the range of positive externalities associated with agriculture, merely to highlight the current negative externalities and thus the scale of resource misallocations needing attention. Importantly, some current production systems do already deliver water quality improvements. For example, paddy fields in Japan and Korea. Adjustments to other production systems may entail more explicit trade-offs with commodity production. For example, through devoting land to created wetlands or buffer strips rather than to cultivation or grazing. That is, although some “win-win” situations may exist[5], improved water quality is generally not produced jointly with agricultural commodities and improving quality will in many cases entail some reduction in agricultural output.

The need for caution in making comparisons and interpretations needs to be stressed again. In particular, although agricultural impacts were acknowledged in all countries, relatively few valuation studies related exclusively to agriculture. Rather, they mostly addressed water quality in more general terms as summarised in Table 1. Conversely, because few studies encompassed all of the categories of impact suggested in section 1 the cited figures may under-state overall impacts. As such, all figures must be viewed as purely illustrative rather than definitive. The survey of studies in this section estimating household WTP to improve water quality cover a range of situations over the period late 1990s to 2010, although are rarely applicable to only agriculture. Household WTP for improvements in non-use values of surface water, including lakes and marine waters damaged by eutrophication, are typically in the range of EUR 10 – 50. But for improvements to drinking water quality household WTP estimates can be much higher up to EUR 250-270, while there are very few WTP estimates for improvements to groundwater quality.

---

5. For example, farmers themselves may benefit from lower input costs and/or higher yields by reduced nutrient and soil losses.

Box 1. National costs of water pollution (not necessarily all due to agriculture)

Country (Sources)	Type of water quality impact	Cost (millions)		
		National currency	EUR	USD
Australia (Atech, 2000)	Algal blooms associated with excessive nutrients in freshwater	AUD 180–240[1]	109 – 145	116-155
Belgium (Dogot *et al.*, 2010)	Drinking water treatment costs		120-190	167-264
France (Bommelaer, 2010)	Eutrophication of surface and coastal waters		70 – 1 000	97-1 389
Netherlands (Howarth *et al.*, 2001)	Nitrate and phosphate damage		403 – 754[2]	371 – 695
Spain (Hernandez-Sancho *et al.*, 2010)	Nitrate and phosphate damage		150	208
Sweden (Huhtala *et al.*, 2009)	Costal eutrophication Baltic Sea eutrophication		860 492 – 1 466	1 257 719 – 2 143
Switzerland (Pillet *et al.*, 2000)	Agricultural pollution[3]	CHF 1 000	608	690
United Kingdom (Jacobs, 2008)[4]	Agricultural pollution of surface water, estuaries and drinking water treatment costs	GBP 229	335	458
United States (Dodds *et al.*, 2009)	Freshwater eutrophication		1 500	2 200
(Pimentel *et al.*, 2005)	Pesticide contamination of groundwater		1 610	2 000
(Anderson *et al.*, 2000)	Marine algal blooms		32 – 46	34 – 49

Source: see main text for references.

1. Of this total around AUD 60 million were costs incurred by agriculture itself, and about AUD 100 million due to lost recreational value.
2. This estimate is a projection to 2010.
3. Agricultural pollution estimated for 1998.
4. This is the total of the costs shown in Box 2.

Australia

The importance of water resources is acknowledged with natural resource monitoring and management policies in place with respect both to agriculture's impact on water quality but also water quality impacts on agriculture. Problems arising from agricultural contaminants and salinity have been exacerbated by low flow conditions caused by abstraction and less rainfall in recent years. Most rivers exhibit a high degree of degradation, particularly within the Murray-Darling catchment. Drinking water quality is impaired in many locations and coastal regions downstream of large agricultural areas suffer from sediment and nutrient loadings.

Atech (2000) report estimated national costs arising from algal blooms associated with excessive nutrients in freshwater to be between AUD 180 (EUR 109) and AUD 240 million (EUR 145 million). Of this, around AUD 60 million (EUR 36 million) were incurred by agriculture itself and around AUD 100 million related to lost recreational value. Coastal eutrophication has contributed to a number of incidents harming commercial fish and shellfish catches, imposing smaller periodic losses (ABS, 2003 & 2006; OzCoasts, 2010). Total environmental protection expenditure related to water quality is in excess of AUD 3 billion (EUR 1.7 billion), of which around AUD 350 million (EUR 202 million) may be inferred as attributable to sedimentation and groundwater issues caused by agricultural activities (Trewin, 2003).

Austria

The influence of farming practices on the quality of freshwater is recognised particularly in terms of deterioration of groundwater and eutrophication throughout the Danube river basin. Although industrial and municipal sources are important, agriculture is estimated to account for around half of Austrian nutrient loadings into the Danube and onwards to the Black Sea. This contributes significantly to around 3% of groundwater sources failing to meet domestic standards for nitrates and nearly 20% of surface waters failing to meet "good ecological status" relating to nutrient pollution under the EU's Water Framework Directive.

Although drinking water treatment costs arising specifically from agricultural contaminants are not available, Zessner *et al.* (2010) imply total annual treatment costs of around EUR 200m. Studies relating to impacts on freshwater recreational or biodiversity values are apparently scarce, but Aquamoney (2009) results for Austria report household WTP for water quality improvements of EUR 45 to EUR 75. Partial estimates of eutrophication costs in the Black Sea are available, although apportioning contributions between neighbouring countries and different sectors is difficult (Borysova *et al.*, 2005).

Belgium

Although industrial and municipal sources are important, intensive agricultural practices are acknowledged to have increased nutrient loadings to rivers and to Belgian coastal waters. Nitrate concentrations are elevated in a proportion of groundwater sources and rivers. Almost all coastal bathing water meets mandatory quality standards, but between 10% and 20% of freshwater fails due to the presence of algal blooms and/or bacterial contamination. Nitrate concentrations are also excessive in over 15% of groundwater and over 10% of surface water sources.

Although estimates of drinking water treatment costs arising specifically from agricultural contaminants are not available, Dogot *et al.* (2010) imply that total treatments costs amount to between EUR 120m and EUR 190m. Whilst noting caveats, Brouwer *et al.* (2007) imply household WTP for primarily non-use values from improved freshwater quality of between EUR 19 and EUR 33.

Canada

Agricultural runoff is acknowledged to contribute to freshwater pollution and eutrophication in some locations, but coastal eutrophication is not currently a major problem. Moreover, industrial and municipal sources are more important around several of the Great Lakes and problem coastal areas. Water quality in rivers and lakes is generally good, but 18% of monitored sites are rated as “marginal” or “poor” in terms of aquatic ecosystem health. Similarly, drinking water quality is also generally good but bacterial and chemical contamination is an issue in over 1/3 of rural supplies.

Although national level valuation studies are apparently absent, Olewiler (2004) and McCandless *et al.* (2008) imply that altering agricultural practices could yield water quality value improvements of between CAD 28/ha (EUR 19/ha) and CAD 60/ha (EUR 41/ha) on a local scale. Similarly, for Novo Scotia alone, Wilson (2000) estimates that degraded water reduces recreational fishing and commercial shellfish values by CAD 8 million (EUR 5 million) and imposes water treatment costs of around CAD$ 40 million (EUR 25 million), although agriculture’s share in these totals is not made explicit.

Chile

Farming has an acknowledged impact on water quality arising both from the intensity of chemical and nutrient applications but also changes in land use from (e.g.) forestry. Impacts include contaminating drinking water and eutrophication of lakes and coastal water that lowers recreational and fishing values. However, biophysical measurement of impacts is relatively scarce and actual valuations of costs incurred are not reported. Moreover, pollution from other sources such as aquaculture, heavy industry and municipal sewage are generally regarded as more pressing issues. Progress with general policies and investments addressing water quality issues has been made, and a need for research into the size and relative importance of agricultural impacts has been recognised if problems observed in other countries are to be avoided (Pizarro *et al.*, 2010).

No economic valuation studies relating specifically to agriculture and water quality were identified.

Czech Republic

Although greater attention has been paid to industrial and municipal pollution, agricultural influences on water quality are acknowledged. Bathing water quality is generally good with over 90% of sites meeting mandatory standards, and heavy metals are a more common contaminant of ground water than agricultural sources. Nevertheless, agriculture accounts for around 65% of nutrient loadings to the Danube River, causing surface water eutrophication problems and contributing to eutrophication of the Black Sea.

Melichar & Ščasný (2005) note a scarcity of valuation studies relating to water, but Czajkowski & Ščasný (2010) suggest a WTP for improvements to eutrophication status in case study lakes of EUR 31 – EUR 45 per household.

Denmark

Agriculture has an acknowledged impact on water quality. Policy measures have reduced nitrate loadings in recent decades but have been less successful for phosphates. Groundwater quality for drinking is generally good and treatment is typically restricted to oxygenation rather than removal of contaminants, but there are localized problems and public concern is rising over nitrates and pesticides. Curbs on industrial and municipal sources have improved river quality but many rivers and most lakes, particularly in intensive agricultural areas, still suffer from eutrophication. Some coastal areas are also affected by eutophication and Denmark contributes to nutrient loadings into the Baltic Sea.

Hasler *et al.* (2008) note a scarcity of consistent information, but review a number of valuation studies. In particular, different studies offer estimates of the value of waterside amenity and some recreational activities. A comparison of remedial and preventative actions suggests a WTP for improved surface water quality of up to EUR 171 per household. Although current drinking water treatment costs are low, the WTP for naturally clean drinking water was estimated at up to EUR 269 per household..

Finland

Agricultural loadings of sediment and nutrients are acknowledged to contribute significantly to water quality degradation. This applies particularly to the coastal Gulf of Finland and the rest of the Baltic Sea, but also to some inland surface waters. Although large lakes and reservoirs are generally of good ecological status, smaller lakes and a high proportion of rivers are not. Such problems are typically associated with more intensive agricultural areas, meaning that they are more common in the south than the north. A high proportion of coastal sites are not of good quality, although agriculture is not solely responsible and neighbouring countries also pollute the Baltic Sea.

Although not explicitly separating agricultural and non-agricultural influences, Vesterinen & Pouta (2008) imply that improvements to inland surface water quality would deliver recreational benefits of EUR 75 million to EUR 227 million. Similarly, Kosenius (2010) suggests that reduced eutrophication of the Gulf of Finland could be valued at EUR 271 to EUR 448 per Finnish household. Ahtiainen (2009) estimates the water quality effects using a meta-regression analysis, which summarises the findings of existing valuation studies on the benefits of protecting the Baltic Sea (see also Huhtala *et al.*, 2009). The annual mean WTP per person range from EUR 40 to EUR 120. Artell (2010) assesses water quality value held in summer houses in Finland. Compared to a summer house lot with satisfactory, the middle category, water usability status, a lot in excellent status, the best category, commands a price premium of between 20 and 30% of the property price, or, compared to an average lot costing approximately 40 000, a premium of between EUR 5 600 and EUR 9 700. Agricultural effects would account for a proportion of all of these values.

France

Agricultural influences on water quality are acknowledged, particularly with respect to nitrate and pesticide contamination but also via abstraction effects. Around 20% of drinking water sources breach standards and eutrophication of surface and coastal waters is common. Less than half of surface waters are in good ecological condition and meeting tighter EU standards in 2015 is likely to be challenging.

Citing analysis undertaken in 2005/06 and updated in 2009/10, Bommelaer *et al.* (2010) report cost estimates for a range of impacts. For example, eutrophication of surface and coastal waters is estimated to cost between about EUR 70 million – EUR 1 billion whilst additional water treatment costs are estimated to lie between EUR 540 million – EUR 1.2 billion (approximately doubled if bottled water usage is included). Aquamoney (2009) estimated a WTP of around EUR 40 per household to improve groundwater quality in Eastern France.

Germany

Agricultural influences on water quality are acknowledged, particularly with respect to nitrate leaching into groundwater and soil phosphate runoff into surface waters. Although both have reduced in recent decades, agricultural loadings have become relatively more significant as industrial and municipal point sources have been addressed. Coastal eutrophication of both the North and Baltic Seas is acknowledged, as is eutrophication of many lakes and rivers. Around 14% of surface waters are not in good ecological condition. Pesticide contamination of ground water is limited but nitrate concentrations are high in some areas.

No valuation studies were identified relating directly to agricultural influences on water quality. However, Meyerhoff & Dehnhardt (2007) estimate individual WTP for water quality benefits of EUR 12 from wetland restoration whilst Lienhoopm & Messner (2009) estimate household WTP of EUR 10 – EUR 16 for lake restoration in East Germany.

Greece

Despite some monitoring gaps, agricultural influences on water quality are acknowledged. These include pesticide and nitrate contamination as well as phosphates from soil erosion. In addition, irrigation usage has contributed to many aquifers being over-exploited and sea water intrusion is a problem in some coastal areas. Around 20% of groundwater sources have raised levels of pesticides and nitrates, although these are declining. Phosphate levels remain and eutrophication is an issue for some surface and coastal waters.

No valuation studies were identified relating directly to agricultural influences on water quality. However, Genius & Tsagarakis (2006) and Aquamoney (2009) report household WTP for improved water quality of EUR 60 and EUR 23 – EUR 277 respectively. Similarly, Jones *et al.* (2008) estimate household WTP for improved coastal water quality of around EUR 20.

Hungary

Although improving, water quality issues remain challenging in many areas. Over half of water bodies and rivers are possibly at risk of failing tighter EU standards from 2015. The same applies to around 40% of groundwater sites, mainly due to nitrate concentrations. Although industrial and municipal sources are present, agriculture is considered responsible for the majority of nutrient loadings to the Danube and the Black Sea.

Although environmental water accounts have been compiled, they relate to physical rather than monetary flows. However, Mourato (1998) estimated WTP of around USD 27 (EUR 25) for quality improvements to Lake Balaton and Aquamoney (2009) estimated household WTP of EUR 25 – EUR 53 for quality improvements in the Altaler Basin.

Iceland

Although monitoring efforts are being increased, agricultural water quality issues are not prominent with industrial and municipal sources more problematic. This largely reflects the limited spatial coverage of agriculture and relatively limited use of fertilizers and pesticides. Nevertheless, there is an awareness of the potential for localized pollution incidents and of more diffuse runoff and soil erosion problems from over-grazing. Water quality is generally good.

No valuation studies relating to water quality were identified.

Ireland

Agricultural influences on water quality are acknowledged, with bacterial, pesticides and nitrate contamination causing localized groundwater and drinking water problems and sediment and nutrient loadings causing eutrophication issues. Such problems vary spatially with nitrates being more of an issue in the South and South East and inland eutrophication a problem in the midlands. Over 90% of coastal bathing waters meet mandatory standards, but many inland surface waters and around 25% of rivers are in poorer condition.

Although environmental accounts have been constructed, monetary water values are not included. However, O'Leary *et al.* (2004) report WTP values of EUR 115 – EUR 249 per person for adjusting agricultural practices to achieve improved river and lake quality.

Italy

Eutrophication from industrial, municipal and agricultural sources has long been recognized as an issue. Many inland rivers and lakes are of a poor standard, as are some coastal regions – most notably the north Adriatic Sea. Over 90% of monitored coastal bathing waters meet mandatory and guide standards, but less than 50% of inland bathing waters do. Contamination problems are often exacerbated by excessive abstractions, including for agricultural irrigation. Meeting tighter EU standards is likely to be challenge.

Although environmental accounts have been constructed, monetary water values are not included. However, Aquamoney (2009) report household WTP estimates of EUR 62 – EUR 136 for improved water quality in the Po river basin. Raggi *et al.* (2007) suggest that agriculture accounts for 1/3 of pollution in the Po basin. Similarly, Travisi & Nijkamp (2008) estimate household WTP of EUR 23 for modest reductions in pesticide contamination.

Japan

Efforts over recent decades to address point-source pollution from industrial and municipal sources has greatly improved water quality in Japan. However, problems remain and whilst over 90% of rivers meet domestic standards, around 25% of coastal waters and lakes do not. Nitrates, pesticides and sediments from agricultural activities are acknowledged to be among the causes of these problems and monitoring and mitigation efforts have been improved. Moreover, the potential of paddy fields to mimic natural wetlands and filter excess nutrients is emphasized.

Although some progress has been made with environmental and economic accounting, agricultural impacts on water are not separated explicitly from those of other sectors and physical rather than monetary measures of water quality are used. In two older studies of freshwater eutrophication, Kitabatake (1982) estimates costs to aquaculture of JPY 1.5 million (EUR 6 110) to JPY 22 million (EUR 89 600) whilst Magaraa and Shoichi (1986) suggest that algal blooms can easily double water treatment costs, although neither study reports agricultural effects explicitly. Aizaki *et al.* (2006), Shiratanie *et al.* (2006) and MAFF (undated) all report significant net environmental benefits from agriculture. These include gains to water and soil quality from paddy fields, although Matsuno *et al.* (2006) note that this can depend on local circumstances and management practices.

Korea

Despite some recent improvements, around 1/3 of rivers fail to meet domestic quality standards and over 1/4 of lakes are eutrophic. Groundwater quality is higher, but 6% still fails domestic standards. Coastal eutrophication is a localized problem for fisheries and aquaculture. Diffuse pollution, including from agriculture, is acknowledged as an issue and is being addressed by specific policy measures. Increases in livestock numbers and associated imported animal feed are a particular concern. However, the potential of paddy fields to mimic natural wetlands and improve water quality is emphasized.

Although some progress has been made with environmental and economic accounting, agricultural impacts on water are not separated explicitly from those of other sectors and physical rather than monetary measures of water quality are used. However, Kim *et al.* (2000) suggest agricultural eutrophication costs of around KRW 155 billion (EUR 123 million), mostly attributable to livestock. By contrast, Dong-Kyun (undated) cites the total amount of contaminated water which is purified in paddy fields each year as an estimated 704 mt with a value of USD 1.65 billion (EUR 1.55 billion).

Luxembourg

Groundwater quality is generally acceptable, but nitrate levels can be excessive in some rural areas. The vast majority of watercourses are of a satisfactory standard, but less than half are of good ecological or bathing quality and may struggle to meet tighter EU standards from 2015. Mitigation efforts to reduce agricultural pollution are in place, but nutrient and pesticide application rates and implied surpluses remain relatively high. Although landlocked, Luxembourg is a signatory to the convention on reducing agricultural loadings to the North Atlantic.

Despite some progress with environmental and economic water accounts, neither estimates of treatment costs nor degradation costs were identified.

Mexico

Agriculture is the dominant user of both groundwater and surface water. Irrigation is widespread and has caused salination and drainage problems in some areas. Many groundwater sources are over-exploited, leading to low river flows that concentrate pollution levels and degrade ecological conditions. Around 25% of surface water is considered contaminated or highly contaminated. Monitoring of water quality is improving, but nitrate and pesticide levels cause less concern than bacterial contamination which has promoted significant investment in water treatment and infrastructure to address industrial and municipal pollution sources. Mexico shares major watersheds with the Belize, Guatemala and the USA, meaning that some effects are transboundary.

Valuation studies are apparently scarce, but Vásqueza *et al.* (2009) estimate that Mexican citizens would be willing to pay up to 7.6% more for cleaner drinking water. It is difficult to relate this figure to agriculture specifically. By contrast, Ojeda *et al.* (2008) explore the value of restoring environmental conditions through improving surface water flow and quality in a river affected by agricultural irrigation. They estimate a WTP for quality improvement of MXN 876 (EUR 58) per household.

Netherlands

Agriculture is estimated to account for around 75% of nutrient loadings to inland and coastal waters. Although there has been an improvement in recent decades, some water quality issues remain. Some areas are below sea-level and more generally the watertable is close to the surface. Although surface, ground and coastal water quality has improved, tighter EU standards represent a challenge. Four major European rivers end in Dutch coastal waters, meaning that surface and coastal water quality is also highly dependent on upstream as well as domestic activities.

Ligtvoet *et al.* (2008) identify potential benefits from improved water quality, but cite a scarcity of relevant valuation studies as a barrier to quantifying such benefits. Similarly, water quality is not monetized in the environmental economic accounts. However, Joosten *et al.* (1998) estimate treatment of drinking water to remove nitrates to cost USD 35 million (EUR 31 million – USD 70 million (EUR 62 million) and, whilst noting numerous caveats, Howarth *et al.* (2001) suggested total damage costs arising from nitrogen and phosphorus might amount to EUR 403 million to EUR 754 million by 2010. More recently, again noting caveats, Brouwer *et al.* (2007) estimate household WTP of EUR 24 to 43 for improvements in freshwater quality.

New Zealand

Point sources of water pollution have largely been addressed, leaving diffuse sources such agriculture as the dominant concern. This has been exacerbated by increased use of fertilizers and higher livestock densities, including a switch from sheep into dairy cattle. Surface water quality is generally good, but is highly spatially variable with upper sections of river catchments cleaner than lower sections. Similarly, most ground water sources are of good quality but nitrate concentrations are an issue in some locations. About 5% of drinking water sites breach domestic standards. Eutrophication is a problem in some lakes and reservoirs and around 10% of freshwater bathing sites regularly fail domestic recreational standards, but only 1% of coastal sites do so.

Although water accounts are compiled, these are for physical rather than monetary flows and in any case do not feature quality adjustments. However, water quality impacts are acknowledged and in a several related studies, Baskaran *et al.* (2009a & b) and Takatsuka *et al.* (2009) estimate household WTP for reduced nitrate pollution of NZD 11 (EUR 5) – NZD 79 (EUR 38).

Norway

Agricultural influences on water quality are acknowledged, particularly with respect to sediment and phosphate loadings from soil erosion plus nitrates from fertilizer applications. These contribute to eutrophication issues in some inland lakes and coastal areas, particularly in the south. However, surface water quality is more commonly degraded by acidification unrelated to farming activities. Similarly, although agricultural loadings to coastal waters are significant, they are exceeded by those from aquaculture, especially with respect to phosphates. Nonetheless, attention is being paid to mitigating agricultural sources.

Although Norway has compiled environmental economic accounts for over 30 years, explicit separation of agricultural influences on water quality from other sources has been hindered by data issues. However, Navrud (2001) suggests improved recreational fishing associated with improved water quality would be valued at EUR 80 million to EUR 154 million. Similarly, Aquamoney (2009) suggest household WTP for water quality improvements in selected lakes of between NOK 1070 (EUR 129) and NOK 2000 (EUR 242). In both cases a proportion of the value will be attributable to reduced agricultural influences.

Poland

A legacy of severe pollution from heavy industry has overshadowed concerns about agricultural impacts on water quality. Moreover, reductions in farming intensity since the 1990s have further reduced perceived pressures. Nevertheless, agricultural loadings of nutrients to surface and groundwaters are acknowledged to occur and are being targeted by policy measures. The relative significance of agricultural sources is not identified explicitly, although eutrophication of some lakes and reservoirs is reported along with excessive nitrate concentrations in some groundwater sources. Polish agricultural nutrient loadings add to eutrophication pressures in the Baltic Sea.

Howarth *et al.* (2001) cite studies from the mid 1990s that estimated WTP to improve water quality in the Baltic of EUR 28 to EUR 200 per Polish citizen. Czajkowski & Ščasný (2010) suggest a WTP for improvements to eutrophication status in case study lakes of EUR 13 – EUR 17 per household.

Portugal

Agriculture is acknowledged to influence water quality through nutrient and pesticide contamination. This is often exacerbated during summer months when agricultural abstractions can lead to reduced flow levels. However, pollution issues are highly variable spatially. Freshwater eutrophication of rivers, lakes and reservoirs is commonplace. Around 35% of surface waters are not of a good standard and although over 90% of inland waters meet mandatory bathing standards, only 42% meet guide standards. Coastal eutrophication is not a significant issue with around 90% meeting guide standards and 99% mandatory standards.

No economic valuation studies relating specifically to agriculture and water quality were identified. However, Machado & Mourato (2002) estimated WTP for cleaner coastal bathing water at selected locations. This was not restricted to agricultural influences, but suggested total amenity and recreational costs of water degradation of between USD 10 million (EUR 11 million) and USD 51 million (EUR 57 million) with health costs raising this to around USD 80 million (EUR 89 million) for the Estoril Coast near Lisbon.

Slovak Republic

Agricultural influences on water quality are acknowledged, particularly for nitrate and phosphate loadings. However, although some local problems persist, significant reductions in fertilizer applications and livestock numbers since the 1990s have generally reduced these pressures. Over 90% of surface waters and groundwater sources meet current mandatory standards, although meeting tighter standards may be challenging. Industrial pollution is more problematic on the East, agricultural pollution in the West.

No valuation studies relating to agriculture and water quality were identified.

Slovenia

Almost all drinking water is taken from groundwater sources and these are of a generally good quality, but contamination from industry and agriculture is an issue. Industrial pollution of surface waters had diminished, possibly due to changes in neighbouring countries, but agricultural loadings of nitrate and phosphate remain high. Over 25% of surface waters are not in good condition. Several river catchments are shared with neighbouring countries and Slovenian agriculture contributes to nutrient loadings into the Adriatic and Black Seas.

No valuation studies relating to agriculture and water quality were identified.

Spain

Agriculture is the major user of both surface and ground water, with irrigation being widespread. Nutrient surpluses are high and increasing. Nitrate, phosphate and pesticide contamination of surface water is acknowledged as an issue. Many groundwater sources are over-exploited and quality is degraded in some areas. The nature of the Atlantic coastline limits marine eutrophication but localized problems do occur on the Mediterranean coast.

Although satellite accounts for water are available, they report physical rather than monetary flows. However, Sánchez-Chóliz & Duarte (2005) and Morilla *et al.* (2007) use the accounts to explore economy-wide pollution effects and imply that agricultural production is inefficient in its use of water. Hernandez-Sancho *et al.* (2010) estimate general improvements in water quality from reduced nitrate and phosphate levels to be worth around EUR 150 million.

Sweden

Farming practices, particularly the application of fertilisers but also the (often historical) draining of land and clearance of natural vegetation are acknowledged to have led to degradation of water quality. Although problems are noted in relation to freshwater, particular concern has been expressed about eutrophication in the Baltic Sea. Here, agriculture's share of Swedish nutrient loadings is estimated to be between 50% and 65%, although this varies year to year and is also affected by loadings from neighbouring countries. Efforts to improve coastal water quality are being made, but problems persist and impacts are felt in various ways including on commercial fishing, recreational water sports, visual amenity and ecosystem health.

Various economic valuations have been conducted, mainly focused on coastal rather than freshwater eutrophication although Ahlroth (2007) suggests the latter may impose costs of around EUR 860 million. Huhtala *et al.* (2009) conduct a meta-analysis of over 40 previous studies and suggest annual Swedish social costs of between EUR 492 million and EUR 1 466 million for Baltic eutrophication from all sources. The range reflects differences arising from different valuation techniques and assumptions. Similar, but less severe, impacts on Sweden's other coast means that such figures are likely to be under-estimates of total marine eutrophication costs. Aggregate figures for removing agricultural contaminants from drinking water are not readily available but reported incidences of nitrate or pesticide levels breaching standards are relatively rare and declining and current expenditure on all water treatment is around EUR 20 million against total supply costs of EUR 600 million.

Switzerland

The quality of most ground and surface water is good but some local problems do occur, particularly with respect to nitrate and pesticides levels in intensive agriculture areas. Three-quarters of nitrate leaching into groundwater is estimated to be from farmland, leading to some eutrophication problems and breaches of drinking water standards. Mitigation policies are in place, but have been more successful for phosphates than nitrates.

National water treatment costs are low at around CHF 130 million (EUR 84 million) (Vermont, 2005) although total infrastructure and operational costs for water supplies are around CHF 1.5 billion (EUR 947 million) (Moser *et al.*, 2009). Pillet *et al.* (2000) estimated total water pollution costs attributable to agriculture at approaching CHF 1 billion (EUR 608 million) in 1998, but declining steeply thereafter.

Turkey

Approximately 5.3 million ha are irrigated, and agriculture is estimated to account for about 75% of total water consumption. Surface water quality in most agricultural catchments is degraded to some extent and groundwater contamination from nutrients and pesticides occurs locally, as do salinity problems in some cases. Coastal pollution, particularly of the Black Sea, is problematic, although sectors other than agriculture and neighbouring countries also contribute significantly to this situation.

Cost estimates for drinking and waste water treatments are dominated by a need to address industrial and municipal sources. However, Dadaser-Celika *et al.* (2009) suggest that wetland degradation due to irrigation abstractions for around 35 000 ha in the Devali Basin imposes subsequent treatment costs of around USD 0.3 million (EUR 0.2 million). Similarly, Atis (2006) identifies significant costs to cotton production from salinisation and water-logging due to poor irrigation practices in the Gediz delta. Impacts on recreational values are acknowledged, but empirical studies are scarce.

United Kingdom

Widespread agricultural influences on water quality are acknowledged and various policy efforts to mitigate negative impacts on drinking water and ecological conditions are in place. The majority of nitrate loadings and almost half of phosphate loadings into surface and coastal waters are attributed to agriculture, with freshwater eutrophication common and elevated nitrate concentrations found in some groundwater and drinking water sources.

Numerous valuation studies have been conducted, with formal Environmental Accounts for Agriculture offering a recent and useful collation mechanism (Box 2). Hence Jacobs (2008) report that the removal of agricultural contaminants from drinking water incurs costs of GBP 129 million (EUR 190 million) and degradation of rivers, lakes and estuaries imposes social costs of over GBP 100 million (EUR 151 million). Such estimates are broadly in-line with previous figures, but are acknowledged to probably be under-estimates due to incomplete geographical coverage and on-going refinement of scientific understanding.

Box 2. Water quality costs as reported in the UK Environmental Accounts for Agriculture (2007)

Category	Description	Value (GBP) million	Comments
Rivers	Rivers of less than "good" quality due to agricultural diffuse pollution	62 (EUR 91)	Likely to be under-estimate in light of more recent work
Lakes	Eutrophication in lakes due to agricultural diffuse pollution	27 (EUR 40)	Under-estimate in light of more recent work and lack of spatial coverage.
Bathing waters	Bathing waters failing to meet FIO standards	11 (EUR 16)	Under-estimate in light of more recent work and lack of data on marine eutrophication.
Estuaries	Estuaries of less than "good" quality due to agricultural diffuse pollution	3 (EUR 4)	Likely to be under-estimate in light of more recent work
Drinking water	Removal of contaminants	129 (EUR 190)	Uncertainty due to data gaps and lack of spatial coverage.

Source: derived from Tables 30/31, pages 104/105 in Jacobs (2008).

United States of America

Although varying regionally in nature and severity, agricultural influences on water quality are acknowledged. In particular, sediment loadings, bacterial contamination and chemical run-off all contribute to problems in various locations. Indeed agriculture is estimated to account for around 60% of river pollution, 30% of lake pollution and 15% of estuarine and coastal pollution. For the latter, for example, agriculture accounts for around 75% of nitrogen and 50% of phosphate loadings into the Gulf of Mexico and into Chesapeake Bay.

A large number of valuation studies have been conducted, encompassing different impacts and/or different regions. At the national level, Dodds *et al.* (2009) examined freshwater eutrophication and estimated total costs of USD 2.2 billion (EUR 1.5 billion), of which USD 813 million (EUR 556 millon) were attributed to drinking water treatment and the remainder was dominated by effects on recreational and waterside property values. Similarly, Tegtmeier & Duffy (2004) estimated national drinking water treatment costs of USD 419 million (EUR 371 million) whilst Pimentel (2005) estimated the costs of pesticide contamination of groundwater to be USD 2 billion (EUR 1.6 billion). Anderson *et al.* (2000) report estimated national costs arising from marine algal blooms of USD 34 million (EUR 32 million) to USD 49 million (EUR 46 million). Bockstael *et al.* (1988) estimate water quality improvements in Chesapeake Bay to range up to US USD 100 million (1984 values) with Morgan & Owens (2001) updating this to USD 358 million – USD 1.8 billion (1996 values).

5. Further research requirements and some concluding observations

The preceding section identified water quality impacts of agriculture as reported across all OECD members. In some cases, impacts were reported purely in biophysical terms, in most cases they were also reported in monetary terms. Many studies were unclear about the precise category of costs being estimated, but eutrophication effects on amenity, recreational and ecosystem values were reported most commonly and tended to have higher values than other impacts. Treatment costs were less readily available and explicit valuation of health costs was rare. Treatment costs can provide a fairly reliable source of data compared to other cost estimates of pollution (e.g. estimates of non-market costs). However, calculation of treatment costs depends on: the sources of pollution, and thus may over estimate specific costs related to agriculture: and the stringency of health and environmental objectives and policies across countries. Comparisons over time are difficult to make, with costs apparently rising in some countries as agricultural intensification and/or regulatory standards increased but falling in others as resource allocations and technologies adjusted.

The variation in figures reflects a range of causes including differences in national situations in terms of regulatory standards, monitoring and baseline water quality but also differences in the coverage and methodology of cited valuation studies. For example, studies varied in terms of the degree of degradation or improvement they considered and in how specific they were to agriculture. Equally, inclusion of more impacts tended to increase overall costs with, in particular, inclusion of marine eutrophication sometimes leading to significantly higher cost estimates. Consequently, comparisons between countries are likely to be misleading.

Importantly, some studies reported total costs whilst others reported marginal costs. From an economic policy perspective the latter are of greater interest since it is *changes* in water quality and how such changes might be achieved and valued that are of most relevance. However, cross-study and cross-country comparisons are difficult if not impossible since the magnitude of change in water quality (e.g. poor to good, good to excellent) investigated varies considerably across studies.

That the reported impacts related overwhelmingly to degradation rather than improvement of water quality through agricultural practices reflects the general relationship between commodity production and pollution. Specifically, with the exception of paddy fields, higher water quality is not generally produced jointly with agricultural outputs. Of course, the relationship is not linear and it is perfectly possible to adjust management practices to reduce negative impacts on water quality. For example through establishing farm wetlands, improving on-farm nutrient management or lowering the intensity of grazing. The degree to which such adjustments impose on-farm costs varies, with some actually improving farm profitability but many reducing it.

However, interpretation of water quality improvements delivered by on-farm mitigation activities as an agricultural benefit depends on both the degree of jointness between commodity production and water quality and on the reference baseline level of water quality. For example, arguably, mitigation activities that displace agricultural production may be land-based but are not agricultural per se. Equally, improvement from a current level of degradation may be viewed as a benefit delivered by agriculture or simply as removal of an undesirable agricultural impact on a more pristine water system. Discussion of such competing perspectives is beyond the scope of this paper, but is clearly relevant to policy choices and the distribution of mitigation costs across farmers, other industries, taxpayers and consumers.

This short survey exercise also revealed that the existing evidence base is fragmented, incomplete and of variable quality. That is, although numerous relevant studies have been conducted in many countries, their results are rarely collated consistently at a national level and individual studies vary greatly in terms of their focus and sophistication. This suggests several (related) themes requiring further work.

Underpinning science

Economic valuation cannot be attempted without some prior information on biophysical impacts. Yet, although the types of water quality externalities associated with agricultural activities may be identified relatively easily, scientific understanding and measurement of the underlying biophysical relationships is often imperfect. For example, simply distinguishing between agricultural and non-agricultural sources of nutrients is often difficult and the consequences of nutrient loadings depend upon volumes of water as well of the nutrients themselves. Such imperfect understanding reflects both a lack of monitoring data in some instances but also that biophysical relationships are highly complex. For example, pollutants from a given agricultural activity can vary across different locations and time periods and can be difficult to trace as they pass through, and are transformed, by hydrological systems.

This points to a continuing need for scientific research into the underlying processes but also, at least in some countries, better monitoring of conditions. Both tasks are made more complicated by the typically transboundary nature of water pollution, with river catchments and marine areas often encompassing more than one country, and by the time-lags between cause-and-effect in complex hydrological systems. Hence international efforts are needed in some cases to co-ordinate monitoring and modelling activities in order to better inform joint policy responses over time.

Non-market valuation

Consensus on how to conceptualize and value changes to water quality does not yet exist. Some commentators disagree with the premise of monetary valuation, whilst others accept the premise of non-market valuation but are critical of the design and interpretation of particular valuation techniques. This applies particularly to the aggregation or transfer of results between locations and to differences between public and scientific perceptions of quality where the former's typical reliance on visual condition may be at odds with alternative indicators of chemical or ecological purity. The time-lags involved in some diffuse pollution processes add a further complication by necessitating some form of discounting to compare costs and benefits accruing at different rates over a longer period of time.

Such issues have long been acknowledged (Turner, 1977; Vatn & Bromley, 1994) and may be reduced if it is stressed that policy and resource allocation decisions must and will be taken, that they are likely to be improved by access to information and that valuation estimates are but one source of information on the nature and scale of environmental issues.[6] There is clearly a need to continue arguing this case. With respect to technical design, continual improvement is being sought through academic research into the framing and implementation of valuation studies and into how "benefit transfer" can be used to draw wider inferences from limited studies. For example, recent work related to the Water Framework Directive (WFD) in the European Union has suggested guidelines for standardizing techniques and using more spatially-explicit data to account for heterogeneity in both environmental conditions but also the values held by different sections of society (Bateman *et al.*, 2009). Continuation of such research effort is merited.

Environmental Accounts

Summarizing impact estimates at a national level through environmental accounts provides a convenient means of reporting water quality externalities alongside more conventional economic statistics. By avoiding the need to collate individual results in an ad hoc manner and by systematically placing impact estimates in context, such an approach should facilitate clearer and more routine recognition of the scale of problems requiring policy attention.

Several countries already have environmental accounts. However, many do not and of those that do, not all express water quality impacts in monetary terms. Hence there is scope for further work to develop environmental accounts.

Collation and aggregation

Assembling national-level estimates, however, is not necessarily straightforward since valuation studies often focus on a sub-national scale and/or on a sub-set of water quality impacts. For example, many studies are conducted at a catchment scale and aggregation from this to a national scale requires additional data and/or assumptions about how representative local results are. Equally, aggregation across different types of impact can be problematic if not all impacts have been valued and/or if different valuation techniques have been used in different studies. In addition, whilst on-line databases and previous meta-analysis of valuation studies are extremely helpful, collating results from individual studies remains impaired by the practicalities of searching across varied and scattered sources and by the variable degree of methodological detail reported in different studies.

Such aggregation difficulties are encountered regardless of whether the task is attempted in an ad hoc manner or more routinely for environmental accounting purposes. However, the discipline and repetition of environmental accounting is likely to improve the consistency of aggregation process by imposing some standardization to allow comparisons and refinement over time. Hence there is scope for further work on clarifying both how aggregation may be attempted and in commissioning studies to address valuation gaps. For example, Hunt & Ferguson (2010) note that health impacts of water

6. See http://cyllene.uwa.edu.au/~dpannell/pd/pd0175.htm for a nice discussion of some points related to this.

pollution are less well researched than for air pollution. Indeed, perhaps reflecting perceived policy priorities, it is notable that air pollution and especially greenhouse gas emissions from agriculture are generally addressed more prominently and comprehensively than water issues (Olmstead, 2010).

Diminishing marginal returns

Notwithstanding their endorsement above, further efforts to improve the evidence base are not costless. That is, improved monitoring data, scientific understanding and valuation accuracy are desirable but all incur effort. Moreover, insights gained will typically be subject to diminishing marginal returns. Hence there is a trade-off to be made between striving for a possibly unattainable level of information necessary to achieve an optimal resource allocation and accepting a level of information sufficient to achieve a desirable direction of travel towards an improved position. That is, pragmatically, even partial and imperfect valuation estimates may still be sufficient to demonstrate the need for change when viewed alongside estimates of positive externality values and the mitigation potential of agricultural activities. Importantly, the need for accuracy may differ between national-level strategic decisions and regional-level implementation decisions. For example, relatively crude national figures may be sufficient to shape overall policy directions but more accurate figures may be needed to guide practical (marginal) design issues for individual catchments and negotiations between local stakeholder groups.

Some concluding observations

That degraded water quality imposes costs on society is generally accepted. Point sources of pollution, such as sewage works or factories, are highly visible and are often subject to early policy interventions to mitigate their negative effects. By contrast, diffuse sources of pollution, such as agriculture, are less easily observed and often remain relatively free of relevant policy interventions.

This difference in treatment partly reflects uncertainties about complex diffuse processes. For example, agricultural effects vary both geographically and temporally and vary with both the level of pollutants emitted and the volume of water diverted. Yet the difference in treatment also often reflects policy priorities relating to agricultural production and farming income plus the historical tendency for property rights to favour land managers in terms of water usage. The latter point is important since it sets the baseline or reference point against which reductions in pollution are viewed under the "polluter pays principle".

Yet agricultural activities clearly do influence water quality in terms of emitting contaminants and altering water levels and this affects society in a number of ways. Whilst the valuation figures reported here are partial and almost certainly contain inaccuracies, they do confirm the existence of and convey a sense of the scale of such impacts across OECD countries. Moreover, in most cases, they are acknowledged as probably being under-estimates since they do not encompass all impact categories. As such, whilst more accurate figures would be desirable, the figures presented may be sufficient to demonstrate the need for policy interventions to correct resource misallocation even without identifying an optimal solution.

How this is translated into policy responses depends on a number of factors. For example, whilst it may be cheaper to reduce agricultural pollution at source than to remove contaminants from drinking water at a later stage, doing so may need to work with existing or legacy policy support measures that inadvertently encourage polluting activities. Reconciling such policy differences may not be easy and the distribution of costs across, for example, farmers, taxpayers and water company customers may be politically contentious. Scientific uncertainty in attributing cause-and-effect when sources and manifestation of pollution can be separated by considerable physical distance and time-lags further complicates policy decisions.

Equally, presumed property rights may lead to policy incentives rather than regulatory requirements being applied to encourage the adoption of mitigation measures. For example, reductions in agricultural pollution through the use of buffer strips or farm wetlands can be interpreted as delivering water quality benefits that merit reward under the “provider gets principle”. By contrast, failure to mitigate pollution through adopting appropriate farm practices could be penalized via regulatory controls under the “polluter pays principle”.

To conclude, identifying and estimating the significance of agriculture’s impact on water quality is of relevance to policy makers seeking to promote sustainable agricultural and wider economic development. A failure to account for externality effects leads to a misallocation of resources, to an inappropriate mix of land uses and inappropriate management of individual parcels of land.

Whilst detailed policy issues are beyond the scope of this paper, as are more detailed discussions of the technical aspects of improving valuation figures, the externality effects identified here and the reported illustrative valuations for them across OECD countries are hopefully indicative of the nature and scale of the issues remaining to be addressed.

GENERAL BIBLIOGRAPHY

Bateman, I.J., Brouwer, R., Davies, H. & Day, B.H. (2006), Analysing the agricultural costs and non-market benefits of implementing the Water Framework Directive. *Journal of Agricultural Economics*, 57, 221–238.

Bateman, I. J., Brouwer, R., Ferrini, S., Schaafsma, M., Barton, D.N., Dubgaard,.A , Hasler, B., Hime, S., Liekens,.I , Navrud, S., De.Nocker, L., Ščeponavičiūtė, R. & Semėnienė, D. (2009), *Quantifying and Valuing the Non-Market Benefits of Water Quality Improvements across Europe for the WFD* Envecon 2009 The UK Network of Environmental Economists (UKNEE) held at the Applied Environmental Economics Conference on Friday 20th March 2009, at The Royal Society in London. http://www.eftec.co.uk/UKNEE/envecon/2009_documents/envecon2009_WATER_Schaafsma_presentation.pdf

Barry, C. & Convery, F. (2002), The policy relevance of environmental protection expenditure accounting. *European Environment* (Special Issue: Environmental Policy in Europe: Assessing the Costs of Compliance), 12/5, 291–301.

Beaumais, O., Briand, A., Millock, K. & Nauges, C. (2010), *What are Households Willing to Pay for Better Tap Water Quality ? A Cross-Country Valuation Study.* CES Working paper, Paris. http://halshs.archives-ouvertes.fr/docs/00/49/74/53/PDF/10051.pdf

Benson, D. & Jordon, A. (2009), The Scaling of Water Governance Tasks: A Comparative Federal Analysis of the European Union and Australia. *Environmental Management*, 46/1, 7-16.

Dalrymple, G. (2006), *Valuing the water environment: a review of international literature*. Environment Social Research report, Scottish Executive, Edinburgh. http://www.scotland.gov.uk/Publications/2006/11/17092457/0

Dearmont, D., McCarl, B. & Tolman, D. (1997), *Costs of Water Treatment due to Diminished Water Quality: A Case Study in Texas.* http://agecon2.tamu.edu/people/faculty/mccarl-bruce/papers/535.pdf

EC (2002), *Water Accounts. Results of Pilot Studies*. European Commission, Luxembourg. http://unstats.un.org/unsd/envaccounting/ceea/archive/Water/WateraccountsPilot.PDF

EC (2010), *On implementation of Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources based on Member State reports for the period 2004-2007*. COM(2010)47 final Report from the Commission to the Council and the European Parliament. European Commission, Brussels, 9.2.2010. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0047:FIN:EN:PDF

Ecotech (2001), *The benefits of compliance with the environmental aquis for the candidate countries.* Report to European Commission, Brussels. http://ec.europa.eu/environment/enlarg/pdf/benefit_long.pdf

EEA (2009), *Nutrients in freshwater (CSI 020) - Assessment published Jan 2009* European Environment Agency, Copenhagen. http://www.eea.europa.eu/data-and-maps/indicators/nutrients-in-freshwater/nutrients-in-freshwater-assessment-published-1

EEA (2010), *Freshwater ecosystems. 10 messages for 2010.* European Environment Agency, Copenhagen. http://www.cbd.int/iyb/doc/prints/iyb-eu-biodiversitymessages-freshwaterecosystems-en.pdf

FAO (undated), *Fertilisers as water pollutants.* FAO Corporate Document Repository. http://www.fao.org/docrep/w2598e/w2598e06.htm

Fezzi, C., Hutchins, M., Rigby, D., Bateman, I., Posen, P., & Hadley, D. (2010), Integrated assessment of water framework directive nitrate reduction measures. *Agricultural Economics*, 41/2, 123–134.

Hunt, J. & Ferguson, J. (2010), *A Review of Recent Policy-Relevant Findings from the Environmental Health Literature.* OECD, Paris. http://www.oecd.org/officialdocuments/

IEFE *et al.* (2009), *The Links Between the Environment and Competitiveness. Final Report. Project Env.G.1/Etu/2007/0041 Part 1: Water Policies and Competitiveness.* Report to the European Commission, Brussels. http://ec.europa.eu/environment/enveco/economics_policy/pdf/part1_report_comp.pdf

Kramer, R. (2005), *Economic tools for valuing freshwater and estuarine ecosystem services.* Duke University, Durham. http://www.iwlearn.net/abt_iwlearn/events/ouagadougou/readingfiles/dukeuniversity-valuing-freshwater-estuarine-services.pdf

Ko, J-Y., Eckstrom, N. & Shelton, E. (2007), *Annotated Bibliography of Valuation of Ecosystem services for the Estuarine Environment.* Texas A&M University, Galveston. http://files.harc.edu/Projects/Nature/EcosystemBibliography.pdf

Kosoy, N. & Corbera, E. (2010), Payments for ecosystem services as commodity fetishism. *Ecological Economics* 69, 1228–1236

Myers, J. (1999), *The Cost of Pollution: A Survey of Valuation Methods and their Uses for Policy* World Wildlife Fund, Macroeconomic Program Office http://assets.panda.org/downloads/pollute.pdf

Navrud, S. (2007), *Practical tools for value transfer in Denmark – guidelines and an example.* Working Report No. 28, Danish Ministry of Environment, Copenhagen. http://www.mst.dk.

OECD (2008), *Environmental performance of agriculture in OECD countries since 1990: country chapters.* OECD, Paris. http://www.oecd.org/document/10/0,3343,en_2649_33793_40671178_1_1_1_1,00.html

OECD (2010), *OECD Member Country Questionnaire Responses on Agricultural Water Resource Management.* OECD, Paris. http://www.oecd.org/dataoecd/7/31/44763686.pdf

Ojea, E., Martin-Ortega, J. & Chiabai, A. (2010), *Classifying Ecosystem Services for Economic Valuation: the case of forest water services.* BIOECON Conference, Venice 27-28 September 2010. http://www.bioecon.ucl.ac.uk/12th_2010/Ojea.pdf

Olmstead, S. (2010), The economics of water quality. *Review of Environmental Economics and Policy* 4(1): 44–62.

Paerl, H.W. (2009), Controlling Eutrophication along the Freshwater–Marine Continuum: Dual Nutrient (N and P) Reductions are Essential. *Estuaries and Coasts*, 32/4, 593-601.

Peterson, M., Hall, D. Feldpausch-Parker, A. & Peterson, T. (2010), Obscuring Ecosystem Function with Application of the Ecosystem Services Concept. *Conservation Biology,* 24/1, 113–119.

Portney P.R. & J.P. Weyant (Eds, 1999) *Discounting and intergenerational Equity*, Resources for the Future, Washington D.C.,

Price, C. (1993) *Time, Discounting & Value*, Blackwell.

Remoundou, K., Koundouri, P., Kontogianni, A., Nunes, P. & Skourtos, M. (2009), Valuation of natural marine ecosystems: an economic perspective. *Environmental Science & Policy*, 12, 1040 – 1051. http://www.sesame-ip.eu/doc/Nunes_et_al.pdf

Ribaudo, M., Horan, R. & Smith, M. (1999), *Economics of Water Quality Protection From Nonpoint Sources: Theory and Practice.*. Resource Economics Division, Economic Research Service, U.S. Department of Agriculture. Agricultural Economic Report No. 782. http://www.ers.usda.gov/publications/aer782/aer782.pdf

Ross, N, (Ed, 2010), *Clearing the waters. A focus on water quality solutions*. United Nations Environment Programme. http://www.unep.org/PDF/Clearing_the_Waters.pdf

Smith, E., Eiswert, M. & Veeman, T. (2010), Current and Emerging Water Issues in Agriculture: An Overview Article. *Canadian Journal of Agricultural Economics, forthcoming.*

Sigman, H. (2002), International Spillovers and Water Quality in Rivers: Do Countries Free Ride? *American Economic Review*, 92(4): 1152–1159

Turner, K. (1977), The recreational response to changes in water quality: A survey and critique. *International Journal of Environmental Studies*, 11/2, 91 – 98.

Turner, K., Georgiou, S., Clark, R., Brouwer, R. & Burke, J. (1994), Economic valuation of water resources in agriculture. From the sectoral to a functional perspective of natural resource management. FAO. Rome. ftp://ftp.fao.org/agl/aglw/docs/wr27e.pdf

UN (2006), *Integrated Environmental and Economic Accounting for Water Resources.* United Nations Statistics Division. http://unstats.un.org/unsd/envaccounting/ceea/PImeetings/Handbook_Voorburg.pdf

UNEP (undated) *Economic aspects of eutrophication.* United Nations Environment Programme. http://www.unep.or.jp/ietc/publications/techpublications/TechPub-11/5-3-3a.asp

Vernon, B. (2000), *Producing National Estimates Of Environmental Protection Expenditure The application of PAC and SERIEE in Australia*. http://www.unescap.org/stat/envstat/stwes-16.pdf

Viscusi, W. Kip, Huber, Joel C. and Bell, Jason (2010), The Economic Value of Water Quality. *Environmental and Resource Economics*, Forthcoming; Vanderbilt Law and Economics Research Paper No. 08-02. Available at SSRN: http://ssrn.com/abstract=1084077

van Delden, H. *et al.* (2010), Integrated assessment of agricultural policies with dynamic land use change modeling. *Ecological Modelling*, 221/18, 2153-2166

Vatn, A. & Bromley, D. (1994), Choices without prices without apologies. *Journal of Environmental Economics and Management*, 26/2, 129-148.

Plus web portal sites:

http://www.teebweb.org/ *(Economics of Ecosystems and Biodiversity)*

http://danubs.tuwien.ac.at/ (*Nutrient Management in Danube Basin & its Impact on the Black Sea.)*

http://www.wri.org/project/valuation-caribbean-reefs/references#websites *Economic Valuation References, World Resources Institute*.

https://www.evri.ca/Global/HomeAnonymous.aspx (*Environmental Valuation Reference Inventory.)*

http://www.helcom.fi/ (Helsinki Commission Baltic Marine Environment Protection Commission)

http://www.ospar.org/ *(OSPAR Commission, Protecting & Conserving the NE Atlantic & its Resources.)*

COUNTRY BIBLIOGRAPHY

Australia

ABS (2006), *Australian System of National Accounts*. Australian Bureau of Statistics, Canberra. http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5204.02005-06

Anon (2007), *Australian Water Resources 2005.* http://www.water.gov.au/

Atech (2000), *Cost of algal blooms*. Report to Land and Water Resources Research and Development Corporation, Canberra, ACT 2601 ISBN 0 642. http://npsi.gov.au/files/products/river-landscapes/pr990308/pr990308.pdf

Beeton, R., Buckley, K., Jones, G., Morgan, D., Reichelt, R & Trewin, D. (2006), *Australia State of the Environment 2006.* Australian State of the Environment Committee, Independent report to the Australian Government Minister for the Environment and Heritage, Canberra. http://www.environment.gov.au/soe/2006/publications/report/index.html

Cork, S. & Shelton, D. (2000), *The Nature and Value of Australia's Ecosystem Services: A Framework for Sustainable Environmental Solutions.* CSIRO Wildlife & Ecology, Canberra. http://www.ecosystemservicesproject.org/html/publications/docs/Qld_Env_Conf_Paper.pdf

Hajkowicz, H., Spencer, R., Higgins, A. & Marinoni, O. (2008) ,Evaluating water quality investments using cost utility analysis, *Journal of Environmental Management*, 88/4, 1601-1610.

Hill, C.M. & Carter, G. (2009), *Determining an economic value for improved water quality in the Darling River.* Paper to National Cyanobacterial Workshop 12 August 2009 Parramatta NSW. http://www.wqra.com.au/Cyano/Hill_Economic_assessment_bga_impacts_conference_paper.PDF

Kandulu, J. & Bryan, B. (2009), *Evaluating alternatives for mitigating Cryptosporidium risk and generating environmental service benefits in water supply catchments*, Aares 53rd Annual Conference. http://ageconsearch.umn.edu/bitstream/48190/2/Kandulu.pdf

National Land and Water Resources Audit Advisory Council (2002), *Australian Catchment, River and Estuary Assessment 2002*. National Land and Water Resources Audit, Canberra. http://www.anra.gov.au/topics/coasts/pubs/estuary_assessment/est_ass_contents.html

OzCoasts (2010), *Economic consequences of algal blooms*. http://www.ozcoasts.org.au/indicators/econ_cons_algal_blooms.jsp

Pink, B. (2007), *Australia's Environment: Issues and Trends 2007. Special Issue Water*. ABS, Canberra. http://www.ausstats.abs.gov.au/Ausstats/subscriber.nsf/0/8062FE062727E272CA2573AA000F535D/$File/46130_2007.pdf

Steffensen, D. (2004), *Economic cost of cyanobacterial blooms*. Cooperative Research Centre for Water Quality & Treatment and Australian Water Quality Centre, Salisbury. http://www.epa.gov/cyano_habs_symposium/monograph/Ch37.pdf

Trewin, D. (2003), *Australia's Environment: Issues and Trends 2003.* ABS, Canberra. http://www.ausstats.abs.gov.au/Ausstats/subscriber.nsf/Lookup/F0F9E5FCC5898211CA256D740001012A/$File/46130_2003.pdf

Austria

Aquamoney (2009), *Austrian Case Study Fact Sheet.* Case study results from Aquamoney project. http://www.aquamoney.org/sites/download/Austrian%20Fact%20Sheet.pdf

Borysova, O., Kondakov, A., Paleari, S. Rautaalhti-Miettinene, E., Stolberg, F. & Daler, D. (2005), *Eutrophication in the Black Sea region; Impact assessment and Causal chain analysis.* Global International Waters Assessment http://www.unep.org/dewa/giwa/areas/reports/r22/giwa_eutrophication_in_blacksea.pdf

EEA (2009) *Bathing water results 2009 – Austria.* European Environment Agency. http://ec.europa.eu/environment/water/water-bathing/report2010/Austria.pdf

Garnier, J., Billen, G., Hannon, E., Fonbonne, S., Videnina, Y. & Soulie, M. (2002), Modelling the transfer and retention of nutrients in the drainage network of the Danube River. Estuarine, *Coastal and Shelf* Science, 54, 285–308.

ICPDR (1999), *Causes and Effects of Eutrophication in the Black Sea Summary Report*. Joint Ad-hoc Technical Working Group ICPDR – ICPBS. www.icpdr.org/wim07-mysql/download.php?itemid=8112&field=file1

ICPDR (2005), *Austria Facts & Figures*. Part results from the MONERIS (Modelling of Nutrient Emissions in River Systems) project. International Commission for the Protection of the Danube River. http://www.icpdr.org/icpdr-pages/austria.htm

Lenz, K., Nagy, M. & Windhofer, G. (2008), *Implementation of water flow accounts in Austria.* Eurostat Grant No 71401.2007.014-2007.481 Action 3 –A report for Eurostat. *Environmental Statistics and Accounts – Environmental Accounts.* http://epp.eurostat.ec.europa.eu/portal/page/portal/environmental_accounts/documents/AT%20UBA%20481%20Water.pdf

Pawson, M., Tingley, D., Padda, G. & Glenn, H. (2005), *EU contract FISH/2004/011 on Sport Fisheries (or Marine Recreational Fisheries) in the EU* Prepared for The European Commission Directorate-General for Fisheries http://www.cefas.co.uk/publications/files/sportsfishing-c2362.pdf

Reischer, G., Kasper, D., Steinborn, R., Mach, R. & Farnleitner, A. (2006), Quantitative PCR Method for Sensitive Detection of Ruminant Fecal Pollution in Freshwater and Evaluation of This Method in Alpine Karstic Regions. *Appl Environ Microbiol*. 72(8): 5610–5614.

Zessner, M., Lampert, C., Kroiss, H. & Lindtner, S. (2010), Cost comparison of wastewater treatment in Danubian countries *Water Science & Technology* 62/2 pp 223–230.

Belgium

Brouwer, R., Beckers, A., Courtecuisse, A., van den Driessche, L., & Dutrieux, S. (2007), Economic valuation of the non-market benefits of the European Water Framework Directive: An international river basin application of the contingent valuation method. Institute for Environmental Studies (IVM), Vrije Universiteit, De Boelelaan 1087, 1081 HV, Amsterdam http://www.lne.be/themas/beleid/milieueconomie/downloadbare-bestanden/ME13_Economic%20valuation%20of%20the%20nonmarket%20benefits%20of%20the%20WFD_%20Contingent%20valuation.pdf

Derous S., Verfaillie E., Van Lancker V., Courtens W., Stienen E., Hostens K., Moulaert I., Hillewaert H., Mees J., Deneudt K., Deckers P., Cuvelier D., Vincx M. & Degraer S. (2007), A biological valuation map for the Belgian part of the North Sea: BWZee, Final report, Research in the framework of the BSP programme "Sustainable Management of the Sea" – PODO II, March 2007, pp. 95 (+ Annexes). www.vliz.be/imisdocs/publications/125641.pdf

Dogot, T., Xanthoulis, Y., Fonder, N. & Xanthoulis, D. (2010), Estimating the costs of collective treatment of wastewater: the case of Walloon Region (Belgium). Water Science & Technology 62/3 pp 640-648.

EC (2010), On implementation of Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources based on Member State reports for the period 2004-2007 COMMISSION Staff Working Document Accompanying document to the Report from the Commission to the Council and the European Parliament, Brussels, 9.2.2010. SEC(2010) 118 final. http://ec.europa.eu/environment/water/water-nitrates/pdf/swd.pdf

EEA (2009), Nutrients in freshwater (CSI 020) - Assessment published Jan 2009 European Environment Agency, Copenhagen. http://www.eea.europa.eu/data-and-maps/indicators/nutrients-in-freshwater/nutrients-in-freshwater-assessment-published-1

EEA (2009), Bathing water results 2009 – Belgium. European Environment Agency. http://ec.europa.eu/environment/water/water-bathing/report2010/Belgium.pdf

Rousseau V., Lancelot C. & D. Cox, D. (2008), Current Status of Eutrophication in the Belgian Coastal Zone Universite Libre de Bruxelles. http://www.belspo.be/belspo/home/publ/pub_ostc/OA/OA14_en.pdf

Wustenberghs, H., Verhaegen, E., Lauwers, L. & Mathijs, E. (2003), Monitoring agriculture's multifunctionality by means of integrated nation-wide accounting. http://www2.vlaanderen.be/landbouw/downloads/cle/pap12.pdf

Canada

Agriculture & Agri-Food Canada (2000), *Agriculture in harmony with nature: Agriculture and Agri-Food Canada's Sustainable Development Strategy 2001-2004.* http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1175521719015&lang=eng

Chambers P.A., M. Guy, E.S. Roberts, M.N. Charlton, R. Kent, C. Gagnon, G. Grove, & N. Foster (2001), *Nutrients and their impact on the Canadian environment*. Agriculture and Agri- Food Canada, Environment Canada, Fisheries and Oceans Canada, Health Canada and Natural Resources Canada. 241 p. http://dsp-psd.pwgsc.gc.ca/Collection/En21-205-2001E-2.pdf

Corkal, D., Schutzman, W.C. & Hilliard, C.R. (2004), Rural Water Safety from the Source to the On-Farm Tap *Journal of Toxicology and Environmental Health*, Part A, Volume 67, Issue 20 - 22 October 2004, 1619 - 1642

EC (2010), *Water Quality.* Environment Canada website information. http://www.ec.gc.ca/eau-water/default.asp?lang=En&n=F2F43FC7-1

Lefebvre, A., Eilers, W. & Chunn, B. (eds., 2005), *Environmental Sustainability of Canadian Agriculture: Agri-Environmental Indicator Report Series – Report #2*. Agriculture and Agri-Food Canada, Ottawa, Ontario. (http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1181580371933&lang=e)

Statistics Canada (2006), *Concepts, Sources and Methods of the Canadian System of Environmental Resource Accounts.* Statistics Canada occasional report, Ottawa. http://www.statcan.gc.ca/pub/16-505-g/16-505-g1997001-eng.pdf

Dimple, R., Oborne, B. & Venema, H. (2009), *Integrated Water Resources Management (IWRM) in Canada: Recommendations for Agricultural Sector Participation.* Report to Agriculture & Agri-Environment Canada by the International Institute for Sustainable Development, Winnipeg. http://www.iisd.org/pdf/2009/iwrm_agriculture.pdf

McCandless, M., Venema, H., Barg, S. & Oborne, B. (2008), *Full Cost Accounting for Agriculture (Final Report) – Valuing public benefits accruing from agricultural beneficial management practices: An impact pathway analysis for Tobacco Creek*, *Manitoba.* Report to Agriculture & Agri-Environment Canada by the International Institute for Sustainable Development, Winnipeg. http://www.iisd.org/pdf/2008/measure_fca_2008.pdf

Olewiler, N. (2004), *The Value of Natural Capital in Settled Areas of Canada*. Published by Ducks Unlimited Canada and the Nature Conservancy of Canada. http://www.ducks.ca/aboutduc/news/archives/pdf/ncapital.pdf

Wilson, S. (2000), *The GPI Water Quality Accounts Nova Scotia's Water Resource Values and the Damage Costs of Declining Water Resources and Water Quality*. GPI Atlantic Report. http://www.gpiatlantic.org/pdf/water/waterquality.pdf

Chile

Arismendi, I. & Nahuelhual, L. (2007), Non-native Salmon and Trout Recreational Fishing in Lake Llanquihue, Southern Chile: Economic Benefits and Management Implications, *Reviews in Fisheries Science*, 15/4, 311 - 325

Carlos E. Oyarzún, C. E. & Huber, H. (2003), Nitrogen Export From Forested and Agricultural Watersheds Of Southern Chile. *Gayana Bot*. 60(1): 63-68

Donoso, G. & Melo, O. (2006), Water Quality Management in Chile: Use of Economic Instruments. *Water Resources Development and Management*, 2006, 229-251

Figueroa, E. & Calfucura, E. (2009), Sustainable development in a natural resource rich economy: the case of Chile in 1985–2004. *Environment, Development and Sustainability*, 12/5, 647-667

Iriarte, J.L., Gonzalez, H.E. & Natuelhual, L. (2010), Patgonian Fjiord Ecosystems in Southern Chile as a highly Vulnerbale Region: Problems and Needs, *Ambio*, 39/7, 463-466

Little, C., Soto, D., Lara, A. & Cuevas, J. (2010), Nitrogen exports at multiple-scales in a southern Chilean watershed (Patagonian Lakes district) *Biogeochemistry* 87/3, 297-309. http://www.scielo.cl/pdf/gbot/v60n1/art10.pdf

Mariela Valenzuela, M., Lagos, B., Claret, M., Mondaca, M., Pérez, C., & Parra, O. (2009), Fecal Contamination of Groundwater in a Small Rural Dryland Watershed in Central Chile. *Chilean Journal of Agricultural Research* 69(2):235-243

OECD (2005), *Environmental Performance Reviews Chile. Conclusions and Recommendations*. OECD, Paris. http://www.oecd.org/dataoecd/63/44/34856244.pdf

Pizarro, J., Vergara, P., Rodríguez, A., Sanhueza, P. & Castro, S. (2010), Nutrients dynamics in the main river basins of the centre-southern region of Chile. *Journal of Hazard Materials*. Mar 15;175(1-3):608-13. Epub 2009 Oct 20.

World Bank (2010), *Improving Wastewater Use in Agriculture: An Emerging Priority* June 30, 2010. Energy Transport and Water Department, Water Anchor (ETWWA), The World Bank. http://siteresources.worldbank.org/INTWAT/Resources/ESWWastewaterAg.pdf

O'Ryan, R., Díaz, M. & Pincheira, C. (2003) ,*Perceptions of the Environmental Role of Chilean Agriculture* Paper prepared for the Roles of Agriculture International Conference, 20-22 October, 2003 – Rome, Italy. ftp://ftp.fao.org/es/esa/roa/pdf/2_Environment/Environment_Chile2.pdf

UNEP (2004/5), *Chile: Integrated assessment of the Ministry of Agriculture's Environmental Agenda.* UNEP http://www.unep.ch/etb/areas/pdf/un%20chile%20reportfinal.pdf

Czech Republic

Ambrožová, J., Hubáčková, J. & Čiháková, I. (2009), Drinking Water Quality in the Czech Republic, *Czech. J. Food Sci.*, 27/2, 80-87. http://www.agriculturejournals.cz/publicFiles/06733.pdf

Czajkowski, M. & Ščasný, M. (2010), Study on benefit transfer in an international setting. How to improve welfare estimates in the case of the countries' income heterogeneity *Ecological Economics*, 69/12, 2409-2416

EEA (2010), *Bathing Water Results 2009 – The Czech Republic*. European Environment Agency, Copenhagen. http://ec.europa.eu/environment/water/water-bathing/report2010/Czech%20Republic.pdf

Havlikova, M., Kroeze, C. & Huijbregts, MA. (2008), Environmental and health impact by dairy cattle livestock and manure management in the Czech Republic. *Sci Total Environ*. 25; 121-31.

ICPDR (2007), *Czech Republic Facts and Figures.* International Commission for the Protection of the Danube River. http://www.icpdr.org/icpdr-pages/czech_republic.htm

Judová, P. & Janský, B.(2005), Water quality in rural areas of the Czech Republic: Key study Slapanka River catchment *Limnologica - Ecology and Management of Inland Waters*, 35/3, 160-168.

Langhammer, J. (2010), Water quality changes in the Elbe River basin, Czech Republic, in the context of the post-socialist economic transition *GeoJournal*, 75/2, 185-198

Markowska, A., Markiewicz, O., Bartczak, A., Scasny, M., Melichar, J. & Skopkova, A. (2007), Lake Water Quality Valuation - Benefit Transfer Approach vs. Empirical Evidence. *Ekonomia journal*, 19

Melichar, J. & Ščasný, M. (2005), *Introduction to Non-Market Valuation Methods and Critical Review of Their Application in the Czech Republic.* http://ies.fsv.cuni.cz/default/file/download/id/4646

Ministry of the Environment (2004) ,*State Environmental Policy of the Czech Republic 2004 – 2010*. Ministry of the Environment of the Czech Republic. http://www.mzp.cz/osv/edice-en.nsf/a02fcb9439f4537fc1256fbe00491592/d19a3a3f73abc1cbc125713800330a7c?OpenDocument

Denmark

Aquamoney (2009), *Odense River Basin Case Study Fact Sheet*. http://www.aquamoney.ecologic-events.de/sites/download/Odense_River_Basin_Fact_Sheet.pdf

Atkins, J.P. & Burdon, D. (2006), An initial economic evaluation of water quality improvements in the Randers Fjord, Denmark. *Marine Pollution Bulletin* 53 195–204

Atkins, J.P., Burdon, D. & Allen, J. H. (2007), An application of contingent valuation and decision tree analysis to water quality improvements. *Mar. Poll. Bull*., 55:591-602.

Hasler, B., Lundhede, T., Martinsen, L., Neye, S. T. & Schou, J.S. (2005), *Economic assessment of the value of drinking water management in Denmark by groundwater protection and purification of polluted groundwater*. Discussion paper for the seminar on environmental services and financing for the protection and sustainable use of ecosystems. Geneve, 10. & 11. October 2005. http://www.unece.org/env/water/meetings/payment_ecosystems/Discpapers/ecosystemvalue_drinkingwater_Denmark.pdf (based on full technical report available at http://www2.dmu.dk/1_viden/2_publikationer/3_fagrapporter/rapporter/FR543.pdf)

Hasler, B. & Lundhede, T. (2005), *Are agricultural measures for groundwater protection beneficial when compared to purification of polluted groundwater?* Paper prepared for presentation at the 11th Congress of the European Association of Agricultural Economists, The Future of Rural Europe in the Global Agri-Food System Copenhagen, Denmark, August 24-27 2005 http://ageconsearch.umn.edu/bitstream/24587/1/cp05ha04.pdf

Hasler, B., Martinsen, L., Pedersen, A., Fonnesbech-Wulff, A. & Sune, T.N. (2008), Annex I: Denmark. In Söderqvist, T. & Hasselström, L. (Eds) *The economic value of ecosystem services provided by the Baltic Sea and Skagerrak. Existing information and gaps of knowledge.* Swedish Environmental Protection Agency, Stockholm. http://www.naturvardsverket.se/Documents/publikationer/978-91-620-5874-6.pdf

Jacobsen, B., Abildtrup, J., Jensen, J. & Hasler, B. (2005), *Costs of reducing nutrient losses in Denmark - Analyses of Different Regulation Systems and Cost Effective Measures.* Poster Paper for presentation at the XI Congress of the EAAE (European Association of Agricultural Economists), Copenhagen, Denmark, August 24-27, 2005. http://ageconsearch.umn.edu/bitstream/24536/1/pp05ja03.pdf

Jeppesen, E., Søndergaard, M., Kronvang, B., Jensen, J., Svendsen, L. & Lauridsen, T. (1999), Lake and catchment management in Denmark. *Hydrobiologia*. 395-396:419–432.

Navrud, S. (2007), *Practical tools for value transfer in Denmark – guidelines and an example.* Working Report No. 28, Danish Ministry of Environment, Copenhagen. http://www.mst.dk.

NERI (undated) *Cleaner water in Denmark: Danish water management from the 1970s until today*. Report by National Environmental Research Institute to the Danish Ministry of the Environment. http://www.ecoinnovation.dk/NR/rdonlyres/A2CA7E9A-C7D1-4E73-A712-C1CBE7542A93/0/Vand_baggrundsartikel_4.pdf

NERI (2009), *State of the Environment in Denmark 2009*. National Environmental Research Institute. http://naturogmiljoe.dmu.dk/English/

Søndergaard, M., Jeppesen, E., Jensen, J.P. & Amsinck, S. (2005), Water Framework Directive: ecological classification of Danish lakes. *Journal of Applied Ecology*, 42/4, 616–629.

Finland

Ahtiainen, H. 2009. Valuing international marine resources: A meta-analysis on the Baltic Sea. MTT Discussion Papers 1. http://www.mtt.fi/english/publications/dp/2009/DP2009_1.pdf

Artell, J. A Spatial Hedonic Approach to Water Recreation Value. Conference paper. Presented 10.6.2010 at the IVth World Conference – Chicago of the Spatial Econometrics Association in Session 3.3: Housing and Land I. http://www.agecon.purdue.edu/sea_2010/Sessions/A%20Spatial%20Hedonic%20Approach%20to%20Water%20Recreation%20Value.pdf

Finnish Environment Institute (2008), *Finland State of the Environment 2008*. Finnish Environment Institute. http://www.ymparisto.fi/download.asp?contentid=105175&lan=en

Finnish Environment Institute (undated), *Ecological and chemical state of surface waters.* http://www.environment.fi/default.asp?contentid=332063&lan=EN

Hellsten, S. (2009), *Are river basin management plans answering the problems related to eutrophication and climate change?* WaterPraxis presentation, Finnish Environment Institute. http://www.waterpraxis.net/pdf/symposium_Climate_change_sustainable_water_management/07_river_basin_management_plans_Hellsten.pdf

Huhtala, A., Ahtiainen, H., Ekholm, P., Fleming-Lehtinen, V., Heikkilä, J., Heiskanen, A-S., Helin, J., Helle, I., Hyytiäinen, K., Hällfors, H., Iho, A., Koikkalainen, K., Kuikka, S., Lehtiniemi, M., Mannio, J., Mehtonen, J., Miettinen, A., Mäntyniemi, S., Peltonen, H., Pouta, E., Pylkkö, M., Salmiovirta, M., Verta, M., Vesterinen, J., Viitasalo, M., Viitasalo-Frösen, S., Väisänen, S. 2009. The economics of the state of the Baltic Sea : pre-study assessing the feasibility of a cost-benefit analysis of protecting the Baltic Sea ecosystem. The publications of Advisory Board for Sectoral Research and subcommittees (in English), Sektoritutkimuksen neuvottelukunnan julkaisuja 2:2009. (available online http://www.minedu.fi/OPM/Tiede/setu/julkaisut/?lang=en)Hyytiainen, K. *et al.* (2009), *An integrated simulation model to evaluate national policies for the abatement of agricultural nutrients in the Baltic Sea*. MTT Economic Research, Helsinki. http://www.mtt.fi/english/publications/dp/2009/DP2009_2.pdf

Kosenius, A-K. (2010), *Valuation of Reduced Eutrophication In The Gulf Of Finland. Choice Experiment with Attention to Heterogeneous and Discontinuous Preferences and Respondent Uncertainty.* Department of Economics and Management University of Helsinki. https://oa.doria.fi/bitstream/handle/10024/59195/valuatio.pdf?sequence=1 (see also *Ecological Economics*, 69/3, 528-538).

Laukkanen, M., Ekholm, P., Huhtala, A., Pitkänen, H., Kiirikki, M., Rantanen, P. & Inkala, A. (2009), Integrating ecological and economic modeling of eutrophication: toward optimal solutions for a coastal area suffering from sediment release of phosphorus. *Ambio*. 38(4):225-35.

Vesterinen, J. & Pouta, E. (2008), Water recreation benefits from reduced eutrophication in Finnish surface waters. European Association of Agricultural Economists 2008 International Congress, August 26-29, 2008, Ghent, Belgium. http://ageconsearch.umn.edu/bitstream/43848/2/611.pdf

Vesterinen, J., Pouta, E., Huhtala, A. & Neuvonen, M. (2010), Impacts of changes in water quality on recreation behavior and benefits in Finland, *Journal of Environmental Management*, 91(4):984-94.

France

Aquamoney (2009), *French Case Study Fact Sheet.* http://www.aquamoney.ecologic-events.de/sites/download/Groundwater_Fact_Sheet.pdf

Bontemps, C., Simioni, M. & Surry, Y. (2005), *Hedonic Housing Prices and Agricultural Pollution: An Empirical Investigation on Semiparametric Models.* Paper to the American Agricultural Economics Association, 2005 Annual meeting, July 24-27, Providence, RI. http://ageconsearch.umn.edu/bitstream/19547/1/sp05bo07.pdf

Bommelaer, O., Devaux, J. & Noël, C. (2010), *Financing of water resources management in France - Case study for an OECD report*. OECD, Paris.

Cugiera, P., Billen, G., Guillaud, J., Garnier, J. & Ménesguen, A. (2005), Modelling the eutrophication of the Seine Bight (France) under historical, present and future riverine nutrient loading *Journal of Hydrology*, 304/1-4, 381-396

Ecology and sustainable development department (undated), *FRANCE : Water pollution from agricultural sources.* http://www.eau-international-france.fr/article.php3?id_article=199&idRubSel=2&id_parent=&id_rubrique=218&id_pere=

EEA (2010), *Bathing water results 2009 – France.* European Environment Agency, Copenhagen. http://ec.europa.eu/environment/water/water-bathing/report2010/France.pdf

IREP (undated) *Registre Francais des Emissions Pollunates* http://www.irep.ecologie.gouv.fr/IREP/index.php

Lacroix, A., Beaudoin & Makowski, D. (2005), Agricultural water nonpoint pollution control under uncertainty and climate variability, *Ecological Economics*, 53/1, 115-127.

Ledoux, E., E. Gomez, J.M. Monget, C. Viavattene, P.Viennot, A. Ducharne, M. Benoit, C. Mignolet, C. Schott & B. Mary (2007), Agriculture and groundwater contamination in the Seine basin. The STICS-MODCOU modelling chain. *Science of the Total Environment*, 375(1-3):33-47

Ministry of Ecology, Energy, Sustainable Development and the Sea (2010), *Water*.http://www.developpement-durable.gouv.fr/Directive-cadre-EAU.html

ONEMA (2010), *The French National Agency for Water and Aquatic Environments*. http://www.onema.fr/IMG/EV/index.html

Rinaudo, J-D., Arnal, C., Blanchin, R., Elsass, P., Meilhac, A. & Loubier, S. (2005), Assessing the cost of groundwater pollution: the case of diffuse agricultural pollution in the Upper Rhine valley aquifer. *Water Sci Technol*, 52(9):153-62.

Rinaudo, J-D. & Aulong, S. (2006), *Case study status report Upper Rhine, France*. Aquamoney. http://www.aquamoney.ecologic-events.de/sites/download/rhinefr.pdf

Rogers, V. (2000), Agriculture, Water Pollution and the Regional Dimension in French Public Policy *Journal of Contemporary European Studies,* 8/1, 35-56.

Germany

EEA (2010), *Bathing water results 2009 – Germany*. European Environment Agency, Copenhagen. http://ec.europa.eu/environment/water/water-bathing/report2010/Germany.pdf

Federal Statistical Office of Germany (2010), *Sustainable Development in Germany Indicator Report 2010.* Federal Statistical Office of Germany. http://www.destatis.de/jetspeed/portal/cms/Sites/destatis/Internet/EN/Content/Publikationen/SpecializedPublications/EnvironmentEconomicAccounting/Indicators2010,property=file.pdf

Gömann, H., Kreins, P. & C. Müller, C. (2004), Impact of nitrogen reduction measures on nitrogen surplus, income and production of German agriculture. *Water Science & Technology* 49/3, 81–90.

Görlach, B. & Interwies, E. (2005), *Economic Valuation of Environmental and Resource Costs: the Case of Germany.* Paper presented at the 45th Congress of the European Regional Science Association on "Land Use and Water Management in a Sustainable Network Society", Vrije Universiteit Amsterdam, 23-27 August 2005. http://ecologic.eu/download/vortrag/2005/goerlach_interwies_ersa_05_paper.pdf

Graveline, N. & Rinaudo, J-D. (2007), Constructing scenarios of agricultural diffuse pollution using an integrated hydro-economic modeling approach, *European Water*, 17/18, 3-16. http://www.ewra.net/ew/pdf/EW_2007_17-18_01.pdf

Kastens, B. & Newig, J. (2007), The Water Framework Directive and agricultural nitrate pollution: will great expectations in Brussels be dashed in Lower Saxony? *European Environment*, 17: 231–246.

Lienhoopm, N. & Messner, F. (2009), The Economic Value of Allocating Water to Post-Mining Lakes in East Germany. *Water Resources Management*, 23/5, 965-980.

Meyerhoff, J. & Dehnhardt, A. (2007), The European Water Framework Directive and Economic Valuation of Wetlands: the Restoration of Floodplains along the River Elbe *European Environment,* 17/1, 18–36.

OECD (2008), *Environmental Performance of Agriculture in OECD Countries Since 1990: Germany Country Section*. OECD, Paris. http://www.oecd.org/dataoecd/12/28/40797690.pdf

Schmidt, T.G. & Osterburg, B. (2010), Environmental and Economic Accounting for the German Agricultural Sector. Institute of Rural Studies of the Johann Heinrich von Thünen-Institute. http://ageconsearch.umn.edu/bitstream/91268/2/Schmidt_et_al._IATRC_Summer_2010.pdf

Stonner, R. & Goemann, H. (2003), *Quantifying Benefits for Improved Environmental and Water Quality*. Paper to Diffuse Pollution Conference Dublin 2003. http://www.ucd.ie/dipcon/docs/theme09/theme09_07.PDF

UBA (2009), *Data on the Environment – State of the Environment in Germany.* German Federal Environment Agency (in German). http://www.umweltbundesamt-daten-zur-umwelt.de/umweltdaten/public/theme.do?nodeIdent=2266

Greece

Aquamoney (2009), *Greek case study fact sheet*. Aquamoney Policy Brief No. 4-10. http://www.aquamoney.ecologic-events.de/sites/download/Lesvos_Basin_Fact_Sheet.pdf

Daskalaki, P. & Voudouris, K. (2008), Groundwater quality of porous aquifers in Greece: a synoptic review. *Environmental Geology,* 54/3, 505-513

EEA (2010) *Bathing water results 2009 – Greece.* European Environment Agency, Copenhagen. http://ec.europa.eu/environment/water/water-bathing/report2010/Greece.pdf

Filintas T., Christakopoulos, E., Stamatis ,G., Hatzopoulos N., Retalis, D. & Paronis, K. (2006), *Ground water nitrate pollution from agricultural sources in agriculture-dominated watersheds.* http://www3.aegean.gr/environment/labs/Remote_sensing/publications/Filintas_Hatzopoulos_EUC2006_.pdf

Genius, M. & Tsagarakis, K. (2006), Water shortages and implied water quality: A contingent valuation study, *Water Resour. Res*., 42, W12407, doi:10.1029/2005WR004833.

Jones, N., Sophoulis, C. & Malesios, C. (2008), Economic valuation of coastal water quality and protest responses: A case study in Mitilini, Greece. *Journal of Socio-Economics,* 37/6, 2478-2491.

Konstantinou, I.K., Hela, D. & Albanis, T. (2006), The status of pesticide pollution in surface waters (rivers and lakes) of Greece. Part I. Review on occurrence and levels, *Environmental Pollution*, 141, 555-570.

Kotti, M., Vlessidis, A., Thanasoulias, N. & Evmiridis, N. (2005), Assessment of River Water Quality in Northwestern Greece. *Water Resources Management*, 19/1, 77-94

Mahleras, A., Kontogianni, A. & Skourtos, M. (2007), *Pinios River Basin – Greece*. Aquamoney Status report. http://www.aquamoney.ecologic-events.de/sites/download/piniosgr.pdf

MoE (2004), *Country Profile Greece, National reporting to the twelfth session of the Commission on Sustainable Development of the United Nations (UN CSD 12), Athens, Greece*. Ministry of Environment, Physical Planning and Public Works, Athens. www.minenv.gr/4/41/000/csd12_final%20edition.pdf

Nikolaidis, C., Mandalos, P. & Vantarakis, A. (2008), Impact of intensive agricultural practices on drinking water quality in the EVROS Region (NE Greece) by GIS analysis. *Environmental Monitoring and Assessment*, 143/1-3, 43-50.

OECD (2008), *Environmental Performance Review of Greece.* OECD, Paris. http://www.oecd.org/dataoecd/10/29/40800494.pdf

Simeonov, V., Stratis, J., Samara, C., Zachariadis, G., Voutsa, D., Anthemidis, A. , Sofoniou, M. & Kouimtzis, T. (2003), Assessment of the surface water quality in Northern Greece. *Water Research,* 37/17, 4119-4124.

Voudouris, K., Daskalaki, P. & Antonakos, A. (2005), Water Resources and Groundwater Quality in North Peloponnesus (Greece). *Global NEST Journal*, 7/3, 340-353. http://www.gnest.org/Journal/Vol7_No3/paper_15_Voudouris_302.pdf

Hungary

Aquamoney (2007), *Altaler case study characteristics.* http://www.aquamoney.ecologic-events.de/sites/download/danubehu.pdf

Aquamoney (2009), *Altaler case study fact sheet.* http://www.aquamoney.org/sites/download/Altaler_Basin_Fact_Sheet.pdf (NB. Weblink on site is miss-spelt, this link is correct).

EEA (2010), *Bathing water results 2009 – Hungary*. European Environment Agency, Copehagen. http://ec.europa.eu/environment/water/water-bathing/report2010/Ireland.pdf

Hungarian Central Statistical Office (2008), *First NAMEA Water emissions accounts in Hungary*. Hungarian Central Statistical Office, Budapest. http://epp.eurostat.ec.europa.eu/portal/page/portal/environmental_accounts/documents/HU%20483%20NAMEA%20Water.pdf

ICID (undated) *Hungary.* International Commission on Irrigation & Drainage. http://www.icid.org/v_hungary.pdf

ICPDR (2006), *Hungary Facts & Figures*. International Commission for the Protection of the Danube River. http://www.icpdr.org/icpdr-pages/hungary.htm

Krajnyik, Z. (2009), *Monetary valuation of natural resources in Hungary and Slovakia using the choice experiment method.* University of Budapest. http://phd.lib.uni-corvinus.hu/417/2/krajnyik_zsolt_ten.pdf

Leone A, Ripa MN, Uricchio V, Deák J, Vargay Z. (2009), Vulnerability and risk evaluation of agricultural nitrogen pollution for Hungary's main aquifer using DRASTIC and GLEAMS models. *J Environ Management* 90(10):2969-78.

Lisanyi, J.B. (2009), The place of agriculture in the green national accounts. *Computational Cybernetics.* ICCC 2009. IEEE International Conference, 75 – 80.

Mourato, S. (1998) Economic Valuation in Transition Economies: An Application of Contingent Valuation to Lake Balaton in Hungary, in M. Acutt and P. Mason (eds.) *Recent Advances in Environmental Economics*. Edward Elgar, London.

OECD (2002), *Loss of Value of The Szigetközwetland due to the Gabcikovo-Nagymaros Barrage System Development: Application of Benefit Transfer in Hungary*. OECD, Paris. http://www.ecnc.org/file_handler/documents/original/view/274/benefittransferhupdf.pdf

OECD (2008), *Environmental Performance Review Of Hungary*. OECD, Paris. http://www.oecd.org/dataoecd/35/8/40917381.pdf

Pinter, L., Bizikova, L, Kutics, K. & Vari, A. (2008), Developing a System of Sustainability Indicators for the Lake Balaton Region. *Tajokologicai Lapok* 6(3): 271 – 293. http://www.iisd.org/pdf/2010/developing_sustainability_indicators_balaton.pdf

Iceland

Anon (2008), *Implementation Plan Iceland.* Ad hoc review group. http://www.nasco.int/pdf/implementation_plans/IP_Iceland.pdf

Anon (undated), *Icelandic Agriculture.* http://www.landbunadur.is/landbunadur/wgbi.nsf/key2/icelandic_agriculture

Anon (undated), *Agriculture.* http://www.iceland.is/economy-and-industry/agriculture//nr/29

EEA (undated), *Iceland summary*. European Envrionment Agency, Copenhagen. http://www.eea.europa.eu/publications/92-9167-001-4/page011.html

Gunnarsdóttir, M. & Gissurarson, L. (2008), HACCP and water safety plans in Icelandic water supply: Preliminary evaluation of experience. *Journal of Water and Health* 6/3, 377–382.

Ministry of Environment (2006), *Iceland's National Programme of Action for the protection of the marine environment from land-based activities*. Ministry of Environment. http://eng.umhverfisraduneyti.is/media/PDF_skrar/GPA.pdf

UN (1997), *Natural Resource Aspects Of Sustainable Development In Iceland*. United Nations Commission on Sustainable Deelopment. http://www.un.org/esa/agenda21/natlinfo/countr/iceland/natur.htm

Ireland

Buckley, C. (2010*), Efficient nutrient management - A win for the farmer and a win for the environment.* The 84th Annual Conference of the Agricultural Economics Society, Edinburgh 29th to 31st March 2010. http://ageconsearch.umn.edu/bitstream/91752/2/48Buckley.pdf

Curtis, J.A. (2003), Demand for Water-based Leisure Activity, *Journal of Environmental Planning and Management* 46/1, 65-77.

CSO (2005), *Environmental Accounts for Ireland 1996 – 2003.*Central Statistics Office, Cork. http://www.cso.ie/releasespublications/documents/economy/enviracc1996-2003.pdf

del Prado, A., Scholefield, D. & Brown, L. (2006), *Eutrophication from Agriculture Sources*. Report to Environmental Protection Agency, Co. Wexford. http://www.epa.ie/downloads/pubs/research/water/Final%20Report%20LS-2311%20(Section%203%20of%203%20-%20%20NCYCLE_IRL)%20for%20web.pdf

EEA (2010), *Bathing water results 2009 – Ireland*. European Environment Agency, Copehagen. http://ec.europa.eu/environment/water/water-bathing/report2010/Ireland.pdf

EPA (2008), *2008 – State of Environment Report*. Environmental Protection Agency. http://www.epa.ie/downloads/pubs/other/indicators/irlenv/

EPA (2009), *Water Quality In Ireland 2007 – 2008*. Key Indicators of the Aquatic Environment. Environmental Protection Agency. http://www.epa.ie/downloads/pubs/water/waterqua/Water%20Quality%20in%20Ireland%202007%20-%202008%20%20Key%20Indicators%20of%20the%20Aquatic%20Environment.pdf

Nasr, A.E. & Bruen, M. (2006), *A Comparison of SWAT, HSPF and SHETRAN/GOPC Phosphorus Models For Three Irish Catchments*. A research project funded under the Irish NDP by EPA and TEAGASC. http://irserver.ucd.ie/dspace/bitstream/10197/2281/1/17..pdf

Kelly, M., F. Kennedy, P. Faughnan, and H. Tovey (2004), *Environmental Attitudes and Behaviours: Ireland in Comparative European Perspectives*. Dublin, Environmental Protection Agency. http://www.ucd.ie/environ/reports/envirattitudesthirdrept.pdf

O'Leary, T., McCormack, A., Hutchinson, G., Campbell, D., Scarpa, R. & Riordan, B. (2004), *Putting a Value on the Farm Landscape.* Report to Teagasc. http://www.teagasc.ie/publications/2004/20041103/paper02.asp

Italy

Aquamoney (2009), *Po Case Study Fact Sheet*. Aquamoney Policy Brief No. 4-5. http://www.aquamoney.ecologic-events.de/sites/download/Po_Basin_Fact_Sheet.pdf

Candiani, G., Floricioiu, D., Giardino, C. & Rott, H. (undated), *Monitoring Water Quality of the Perialpine Italian Lake GardaThrough Multi-Temporal Meris Data.* http://imgi.uibk.ac.at/sekretariat/Publikationen/pub_pdf/MERISworkshp2005_Floricioiu_1109.pdf

Costantino, C., Falcitelli, F., Femia, A. & Tudini, A. (2003), *Integrated environmental and economic accounting in Italy.* OECD Workshop on Accounting Frameworks to Measure Sustainable Development, OECD, Paris, 14-16 May 2003. http://www.oecd/org/dataoecd/19/54/2715388.doc

EEA (2010), *Bathing water results 2009 – Luxembourg*. European Environment Agency, Copehagen. http://ec.europa.eu/environment/water/water-bathing/report2010/Italy.pdf

Fortunato, C. & Mazzola, M. (2009), *Simulation versus optimization in the assessment of the resource opportunity cost in complex water resources systems – the case of Agri-Sinni in southern Italy Arena*, Paper to the 18th World IMACS / MODSIM Congress, Cairns, Australia 13-17 July 2009. http://www.mssanz.org.au/modsim09/I3/arena.pdf

Maran, S. (undated), *Environmental Flows and Integrated Water Resource Management: the Vomano River case study.* Report to IUCN. http://cmsdata.iucn.org/downloads/italy.pdf

Marchetti, R., Provini, A. & Gaggino, F. (1988), *Eutrophication of Inland and Coastal Waters in Italy*. Annals of New York Academy of Sciences, 534, 950-958.

Marson, A. (1996), Dealing with the problem of eutrophication in the Adriatic Basin: the institutional framework and policies. *Ocean & Coastal Management*, 30/2-3, 259-279

OECD (2002), *Environmental Performance Review of Italy.* OECD, Paris. http://www.oecd.org/dataoecd/17/7/2709780.pdf

Raggi, M., Ronchi, D., Sardonini, L. & Viaggi, D. (2007), *Po Basin Case study status report.* Aquamoney report. http://www.aquamoney.ecologic-events.de/sites/download/poit.pdf

Travisi, C.M. & Nijkamp, P. (2008), Valuing environmental and health risk in agriculture: A choice experiment approach to pesticides in Italy, *Ecological Economics*, 67/4, 598-607.

Trombino, G., Pirrone, N. & Cinnirella, S. (2009), A Business-As-Usual Scenario Analysis for the Po Basin-North Adriatic Continuum. *Water Resources Management,* 21, 2063-2074.

Japan

Ariyoshi, N. (2006), *The Development of Japanese NAMEA.* Paper to International Workshop for Interactive Analysis on Economy and Environment, Cabinet Office, 4th March 2006. http://www.esri.go.jp/jp/archive/hou/hou020/hou20-2a-1.pdf

Fukami, M. (1998), *Outline of Trial Estimates for Japan's Integrated Environmental and Economic Accounting.* Economic Planning Agency, Tokyo. http://www5.cao.go.jp/98/g/19980714g-eco-e/19980714g-eco-e.html

Kitabatake , Y.(1982), Welfare cost of eutrophication-caused production losses: aquaculture in Lake Kasumigaura *Journal of Environmental Economics and Management,* 9/3, 199-212

Kobayashi, H. (2005), *Japanese Water Management Systems from an Economic Perspective: The Agricultural sector*. OECD Workshop on Agriculture and Water: Sustainability, Markets and Policies 14-18 November, 2005. www.oecd.org/.../0,2827,en_21571361_34281952_35508748_1_1_1_1,00.doc

MAFF (undated) *Environmental Externalities of Japan's Paddy Fields & Upland Farming*. Ministry of Agriculture, Tokyo. http://www.maff.go.jp/soshiki/kambou/Environment/

Magaraa, Y. & Shoichi, K. (1986), Cost analysis of the adverse effects of algal growth in water bodies on drinking water supply. *Ecological Modelling*, 31/1-4, 303-313

Matsuno, Y, Nakamura, K., Masumoto, T., Matsui, H., Kato, T. & Sato, Y. (2006), Prospects for multifunctionality of paddy rice cultivation in Japan and other countries in monsoon Asia. *Paddy Water Environment* 4: 189-197.

Matsuno, Y. (2010), *Monitoring and Management of Irrigation Water Quality in Japan*. http://www.agnet.org/library/eb/610/

Midori, T. (2010), *Japan's Environmental Policy. Policy Update 039*. http://www.rieti.go.jp/en/special/policy-update/039.html

MoE (2008), *Environmental Quality Standards for Water Pollution.* Ministry of the Environment, Tokyo. http://www.env.go.jp/en/water/

MoE (2009), *Annual Report on the Environment, the Sound Material-Cycle Society and the Biodiversity in Japan 2009.* Ministry of Environment, Tokyo. http://www.env.go.jp/en/wpaper/2009/index.html

WEPA (undated), *State of water environmental issues: Japan.* Water Environment Partnership in Asia http://www.wepa-db.net/policies/state/japan/japan.htm

Yamamoto, M. (2006), *Developing an indicator for environment improvement potential in the agricultural sector.* Contributed paper for presentation at the International Association of Agricultural Economists Conference, Gold Coast, Australia, August 12-18, 2006 http://ageconsearch.umn.edu/bitstream/25375/1/cp060487.pdf

Korea

Anon (1998), *Pilot compilation of environmental-economic accounts Republic of Korea.* http://unstats.un.org/unsd/envaccounting/ceea/archive/Framework/korea_caseStudy.pdf

Anon (2000), *Environmental Accounting of Korea.* Ministry of Environment. http://www.unescap.org/stat/envstat/stwes-24.pdf

Cho, Y. & Kim, H. (2004), *The cost-benefit analysis of improvement in water quality*. American Agricultural Economics Association meeting, Denver, Colorado August 1-4 2005. http://ageconsearch.umn.edu/bitstream/19911/1/sp04ch02.pdf

Dong-Chan Koh, Eun-Young Kim, Jong-Sik Ryu & Kyung-Seok Ko (2009), Factors controlling groundwater chemistry in an agricultural area with complex topographic and land use patterns in mid-western South Korea. *Hydrological Processes* 23/20, 2915–2928.

Dong-Kyun, S. (undated) *Social and Economic Evaluation of the Multi-Functional Roles of Paddy Farming* http://www.agnet.org/library/eb/511/

Eom, K.C., Yun, S.H., Hwang, S.U., Yun, S.K. and Kim, D.S. (1993), Public benefits from paddy soil, *Journal of Korean Society of Soil Science and Fertilizer*. 26(4), 314-333.

Itahashi , S., Seo, M.C. & Takeuchi, M. (2007), Estimation and comparison of nitrogen loads and attenuation in agricultural catchments of Japan and Korea. *Water Sci Technol*. 56(1), 105-13.

Jae-Young Cho & Kwang-Wan Han (2009), Nutrient Losses from a Paddy Field Plot in Central Korea *Water, Air, & Soil Pollution*. 134/1-4, 215-228.

Kim, Chang-Gil et al (2008), *Analysis and Evaluation of Policy Linkage Using Agricultural Environmental Indicators* . Korea Rural Economic Institute. http://www.krei.re.kr/eng/publication/reports_view.php?reportid=C2008-57&cpage=4&skey=&sword=

Kim, U-S., Kim, T-H. & Kang, S-M. (2000), Pilot Study on Green GDP Estimation in Korean Agriculture. *Korean Journal of Agricultural Economics*, 2000, 59-75.

Kim, M-Y., Seo, M-C., Kim, M-K. (2007), Linking hydro-meteorological factors to the assessment of nutrient loadings to streams from large-plotted paddy rice fields. *Agricultural Water Management*, 87/2, 223-228.

Korea Environment Institute (undated), *Environmental Accounting of Korea.* http://www.unescap.org/stat/envstat/stwes-24.pdf

Korean Ministry of Environment (2009), *Management of Non-Point Pollution Source*. Korean Ministry of Environment, Gyeonggi-do. http://eng.me.go.kr/content.do?method=moveContent&menuCode=pol_wat_pol_man_nonPoint

WEPA (2007), *State of water environmental issues: Republic of Korea*. Water Environment Partnership in Asia http://www.wepa-db.net/policies/state/southkorea/southkorea.htm

Luxembourg

EEA (2010) *Bathing water results 2009 – Luxembourg*. European Environment Agency, Copehagen. http://ec.europa.eu/environment/water/water-bathing/report2010/Luxembourg.pdf

FAO (1988), *Europe's inland fisheries: Luxembourg.* http://www.fao.org/docrep/009/t0377e/T0377E19.htm

MoE (2006), *Améliorer la qualité des cours d'eau. Degré de pollution des cours d'eau Indicateurs de développement durable – mise à jour août 2006*. Ministère de l'environment, Le Gouvernement du Grand-Duché du Luxembourg. http://www.environnement.public.lu/developpement_durable/indicateurs/IDD_MAJ_06_08_ENV_PDF.pdf

OECD (2008), Luxembourg Country Section In OECD (2008) Environmental Performance of Agriculture in OECD countries since 1990, Paris, France. http://www.oecd.org/dataoecd/11/61/40803703.pdf

OECD (2010), *Environmental Performance Reviews: Luxembourg*. OECD, Paris. http://www.oecd.org/document/45/0,3343,en_2649_34307_44792621_1_1_1_37465,00.html

Willame, R. & Hoffmann, L. (2005), Belgium And Luxembourg: Cyanobacterial Blooms in Chorus, I. (ed) *Current approaches to cyanotoxin risk assessment, risk management and regulations in different countries* German Federal Environment Agency, Berlin. http://www.umweltdaten.de/publikationen/fpdf-l/2910.pdf

Mexico

Anon (2009), *Mexican government announcing publication of a national standard*. http://eflownet.org/newsletter/viewarticle.cfm?nwaid=102&nwid=39&linkcategoryid=999&siteid=1&FuseAction=display

Asad, M. & Dinar, A. (2006), *The role of water policy in Mexico: Sustainability, equity, and economic growth considerations*. Washington: World Bank. http://siteresources.worldbank.org/INTMEXICO/Resources/EnglishPERDec16.pdf

Drechsel, P., Giordano, M. & Gyiele, L. (2004), *Valuing nutrients in soil and water: Concepts and techniques with examples from IWMI studies in the developing world*. Research Report 82. Colombo, Sri Lanka: International Water Management Institute. http://www.iwmi.cgiar.org/Publications/IWMI_Research_Reports/PDF/pub082/RR82.pdf

Edmunds W., Carrillo-Rivera, J.& Cardona A. (2002), Geochemical evolution of groundwater beneath Mexico City *Journal of Hydrology*, 258/1, 1-24(24)

Gonzalez *et al*. (1996), Hydrogeology and groundwater pollution of Yaqui Valley, Sonara, Mexico. *Geofisica Internacional* 36/1, 49-54 http://redalyc.uaemex.mx/pdf/568/56836105.pdf

Holliday, L., Marin, L. & Henry Vaux, H. (2007), *Sustainable Management of Groundwater in Mexico.* Proceedings of a Workshop (Series: Strengthening Science-Based Decision Making in Developing Countries). National Academies Press, Washington. http://www.nap.edu/catalog.php?record_id=11875

Malhknecht, J. (undated), Microbiological groundwater quality and health indicators in Mexico City. http://www.igeograf.unam.mx/aih/pdf/T2/T2-78.pdf

Mazari-Hiriart, M., Cifuentes, E., Velázquez, E. & Calva, J. (2000), Microbiological groundwater quality and health indicators in Mexico City. *Urban Ecosystems*, 4/2, 91-103.

NWC (2010), *Statistics on Water in Mexico, 2010 edition*. National Water Commission of Mexico, http://www.conagua.gob.mx/CONAGUA07/Publicaciones/Publicaciones/SGP-6-10-EAM2010Ingles.pdf

Ojeda, M., Mayer, A. & Barry D. (2008), Economic valuation of environmental services sustained by water flows in the Yaqui River Delta, *Ecological Economics*, 65/1, 155-166.

Pacheco, J., Cabrera, A. & Marín, L. (2001), Nitrate temporal and spatial patterns in twelve water supply wells, Yucatan, Mexico, *Environmental Geology*, 40(6) 708-715.

Vásqueza, W., Mozumder, P., Hernández-Arcec,, J. & Berrens, R. (2009), Willingness to pay for safe drinking water: Evidence from Parral, Mexico. *Journal of Environmental Management* 90/11, 3391-3400

WWAP (2006), State of Mexico. Water: A Shared Responsibility. UNESCO World Water Assessment Programme. http://www.unesco.org/water/wwap/wwdr/wwdr2/case_studies/pdf/mexico.pdf

Netherlands

Brouwer, R., Beckers, A., Courtecuisse, A., van den Driessche, L., & Dutrieux, S. (2007), Economic valuation of the non-market benefits of the European Water Framework Directive: An international river basin application of the contingent valuation method. Institute for Environmental Studies (IVM), Vrije Universiteit, De Boelelaan 1087, 1081 HV, Amsterdam http://www.lne.be/themas/beleid/milieueconomie/downloadbare-bestanden/ME13_Economic%20valuation%20of%20the%20nonmarket%20benefits%20of%20the%20WFD_%20Contingent%20valuation.pdf

EEA (2010), Bathing water results 2009 – The Netherlands. European Environment Agency, Copenhagen. http://ec.europa.eu/environment/water/water-bathing/report2010/Netherlands.pdf

Gulati, R. & van Donk, E. (2002), Lakes in the Netherlands, their origin, eutrophication and restoration: state-of-the-art review. Hydrobiologia 478: 73–106. http://www.jlakes.org/web/lake-in-Netherlands-H2002.pdf

Hein, L. (2006), Cost-efficient eutrophication control in a shallow lake ecosystem subject to two steady states. Ecological Economics, 59/4, 429-439 .

Howarth, A., Pearce, D.W., Ozdemiroglu, E., Seccombe-Hett, T.,Wieringa, K., Streefkerk,CM & Hollander, AEM de (2001), Valuing the benefits of environmental policy: the Netherlands. National Institute of Public Health & Environment. http://www.rivm.nl/bibliotheek/rapporten/481505024.pdf

Joosten, L., Buije, S. & Jansen, D. (1998), Nitrate in sources of drinking water? Dutch drinking water companies aim at prevention, Environmental Pollution, 102/ Issue 1, Supplement 1, 487-492

Kiwa N.V. (2001), Door drinkwaterbedrijven gemaakte kosten als gevolg van bestrijdingsmiddelengebruik. Inventarisatie over de periode 1991-2000, Project number 30.4603.013. (with English summary) http://www.vewin.nl/SiteCollectionDocuments/Publicaties/Overige%20Vewin-uitgaven/2001/Kosten%20bestrijdingsmiddelen%20waterbedrijven%201991-2000.pdf

Ligtvoet, W., & Beugelink, G.. (2006), Flexibility in the European Water Framework Directive. Netherlands Environmental Assessment Agency (PBL), Bilthoven. http://www.rivm.nl/bibliotheek/rapporten/500072001S.pdf

Ligtvoet, W., Beugelink, G. & Franken, R. (2008), Evaluation of the Water Framework Directive in the Netherlands; costs and benefits. Netherlands Environmental Assessment Agency (PBL), Bilthoven. http://www.pbl.nl/images/Evaluation%20of%20costs%20and%20benefits%20v2_tcm61-41253.pdf

Netherlands Environmental Assessment Agency (2009), Nature Balance 2009. Summary. Netherlands Environmental Assessment Agency (PBL), Bilthoven. http://www.rivm.nl/bibliotheek/rapporten/500402018.pdf

Schenau, S., Delahaye, R., Graveland, C. & van Rossum, M. (2009), The Dutch environmental accounts: present status and future developments. Statistics Netherlands, The Hague. http://mdgs.un.org/unsd/statcom/statcom_09/seminars/environment/Present%20state%20and%20future%20developments%20of%20the%20Dutch%20environmental%20accounts.pdf

New Zealand

Baskaran, R., Cullen, R. & Colombo, S. (2009a), Estimating values of environmental impacts of dairy farming in New Zealand. *New Zealand Journal of Agricultural Research,* 52/4, 377 – 389.

Baskaran, R., Cullen, R. & Takatsuka, Y. (2009b), Estimating the Value of Agricultural Ecosystem Services: A Case Study of New Zealand Pastoral Farming. *Australasian Journal of Environmental Management,* 16/2, 103-12.

Cullen, R., Hughey, K. & Kerr, G. (2006), New Zealand freshwater management and agricultural impacts. *Australian Journal of Agricultural and Resource Economics,* 50/3, 327–346.

Hamill, K. & McBride, G. (2003), River water quality trends and increased dairying in Southland, New Zealand. *New Zealand Journal of Marine and Freshwater Research* 37/2, 323–332.

Jackson, S. (2006), Compartmentalising Culture: the articulation and consideration of Indigenous values in water resource management. *Australian Geographer*, 37/1, 19 – 31.

Kouzminov, A., Ruck, J. & Wood, S. (2007), New Zealand risk management approach for toxic cyanobacteria in drinking water. *Australian and New Zealand Journal of Public Health,* 31/3, 275–281.

Land & Water Forum (2010), *Report of the Land and Water Forum: A Fresh Start for Fresh Water*. http://www.landandwater.org.nz/land_and_water_forum_report.pdf

OECD (2003), *The New Zealand experience with environmental accounting frameworks in measuring inter-relationships between the economy, society and the environment*. OECD, Paris. www.oecd.org/dataoecd/18/54/2713861.doc

Larned, S., Scarsbrook, M., Snelder, T., Norton, N. & Biggs, B. (2004), Water quality in low-elevation streams and rivers of New Zealand: Recent state and trends in contrasting land-cover classes.*New Zealand Journal of Marine and Freshwater Research*, 38/2, 347 – 366.

Monaghan, R., Wilcock, R., Smith, L., Tikkisetty, B., Thorrold B. & Costall, D. (2007), Linkages between land management activities and water quality in an intensively farmed catchment in southern New Zealand *Agriculture, Ecosystems & Environment,* 118/1-4, 211-222.

Statistics New Zealand (2005), *Environmental Protection Expenditure Account for the Public Sector. Years ended June 2001 to June 2003*. Statistics New Zealand, Wellington. http://search.stats.govt.nz/search?p=Q&srid=S2%2d4&lbc=statsnz&ts=custom&w=water%20account&uid=888436659&method=and&isort=score&srt=10

Takatsuka, Y., Cullen, R., Wilson, M. & Wratten, S. (2009), Using stated preference techniques to value four Key Ecosystem Services on New Zealand Arable Land, *International Journal of Agricultural Sustainability* 7(3),1–13.

Trait, P., Cullen, R. & Bicknell, K. (2008), *Valuing agricultural externalities in Canterbury rivers & streams,* Lincoln. http://www.nzares.org.nz/pdf/Valuing%20Agricultural%20Externalities.pdf

Van Bunnik *et al.* (2007), *Environment New Zealand 2007*. Ministry of Environment, Wellington. http://www.mfe.govt.nz/publications/ser/enz07-dec07/

Norway

Alfsen, K. & Greaker, M. (2006), *From natural resources and environmental accounting to construction of indicators for sustainable development.* http://www.ssb.no/publikasjoner/DP/pdf/dp478.pdf

Anon (undated), *Physical and Hybrid Environmental Accounts*. Eurostat, http://epp.eurostat.ec.europa.eu/portal/page/portal/environmental_accounts/publications/physical_and_hybrid_environmental_accounts

Aquamoney (2009), *Morsa Case Study Fact Sheet AquaMoney Policy Brief No. 4-9*. http://www.aquamoney.org/sites/download/Morsa_Basin_Fact_Sheet.pdf

Barton D.N. , Saloranta T., Moe S.J., Eggestad H.O., Kuikka S. (2008), Bayesian belief networks as a meta-modelling tool in integrated river basin management – pros and cons in evaluating nutrient abatement decisions under uncertainty in a Norwegian river basin, *Ecological Economics,* 66/1, 91-104.

Kolshus *et al.* (2009), *Environmental Accounts Environmental Goods and Services Industry and Environmental Expenditures statistics.* Statistics Norway, Oslo. http://epp.eurostat.ec.europa.eu/portal/page/portal/environmental_accounts/documents/NO%20470%20EGSS_0.pdf

Larssen T., Cosby B.J., Lund E., & Wright R.F. (2010), Modeling future acidification and fish populations in Norwegian surface waters. *Environ Sci Technol*. 44(14):5345-51

Lundekvam, H., Romstad, E. & Øygarden, L. (2003), Agricultural policies in Norway and effects on soil erosion. *Environmental Science and Policy,* 6/1, 57-67.

Navrud, S. (2001), Economic valuation of inland recreational fisheries: empirical studies and their policy use in Norway, *Fisheries Management and Ecology*, 8/4-5, 369–382,

Øgaard, A., & Bechmann, M. (2008), Integrated Project In The Region Of Lake Vansjø, Norway, For Reduced Phosphorus Runoff From Vegetable Fields *Acta Hort. (ISHS)* 852:153-156. http://www.actahort.org/books/852/852_17.htm

Rubæk, G. (Ed, 2008), *Phosphorus management in Nordic-Baltic agriculture – reconciling productivity and environmental protection.* Uppsala, Sweden - 22-23 September 2008 NJF Report Volume 4, No 4. http://www.njf.nu/filebank/files/20081124$090257$fil$zOVHaH474860Yr2l1u6u.pdf

Statistics Norway (2009), *Natural Resources and the Environment 2008*. Statistics Norway, Oslo. http://www.ssb.no/english/subjects/01/sa_nrm/

Sørensen, K. (2000), *Environmental Accounts in Norway*. Statistics Norway, Oslo. http://www.iariw.org/papers/2000/sorensen.pdf

Poland

Blaszczyk, P. (undated), *The Challenge of Implementing The Water Framework Directive in Poland.* http://www.unece.org/env/water/documents/poland.pdf

Czajkowski, M. & Ščasný, M. (2010), Study on benefit transfer in an international setting. How to improve welfare estimates in the case of the countries' income heterogeneity *Ecological Economics,* 69/12, 2409-2416

Dzikiewicz, M. (2000), Anthropogenic changes in water quality in the Swarzędzkie Lake (West Poland). *Ecological Engineering,* 14/4, 429-434.

EEA (2010), Bathing water results 2009 – Poland. European Environment Agency, Copenhagan. http://ec.europa.eu/environment/water/water-bathing/report2010/Poland.pdf

Fotyma, M. & Duer, I. (2006), Implementation of Nitrate Directive to Poland. *Acta agriculturae Slovenica, 87* – 1 http://aas.bf.uni-lj.si/april2006/05fotyma.pdf

Howarth, A., Pearce, D.W., Ozdemiroglu, E., Seccombe-Hett, T.,Wieringa, K., Streefkerk,CM & Hollander, AEM de (2001), *Valuing the benefits of environmental policy: the Netherlands.* National Institute of Public Health & Environment. http://www.rivm.nl/bibliotheek/rapporten/481505024.pdf

Kindler J., Roman M., Nalberczynski A., Tyszewski S., Puslowska D., Kloss-Trebaczkiewicz H., Osuch-Pajdzinska E.. & Gromiec M. (1998), Balancing costs and water quality in meeting EU directives (the Upper/Middle Odra case study in Poland) *Water Policy,* 1/3, 283-303.

Peszko, G. & Lenain, P. (2001), *Encouraging Environmentally Sustainable Growth in Poland*. OECD, Paris. http://www.oecd.org/dataoecd/31/49/1892043.pdf

Kowalkowski, T., & Buszewski, B. (2006), Emission of Nitrogen and Phosphorus in Polish Rivers: Past, Present, and Future Trends in the Vistula River Catchment *Environmental Engineering Science,* 23(4): 615-622.

Sapek, A. (2002), The impact of agriculture on ground and surface water quality in Poland: state of affairs and policy in Steenvoorden, J., Claessen, F. & Willems, J. (Eds, 2002) *Agricultural Effects on Ground and Surface Waters*. International Association of Hydrological Sciences, Wallingford.

Szoege, H. & Sobolewska, A. (2004), Cost Effectiveness of some Environmental Projects in Agriculture in Poland. *Electronic Journal of Polish Agricultural Universities* 7/1.

WHO (2009), *Environment and health performance review: Poland.* World Health Organisation, Copenhagen. http://www.euro.who.int/__data/assets/pdf_file/0005/95333/E92584.pdf

Portugal

Cerqueira, M., Vieira, F., Ferreira, R. & Silva, J. (2005), The Water Quality of the CÉrtima River Basin (Central Portugal). *Environmental Monitoring and Assessment* 111/1-3, 297-306.

Diogo, P., Cohello, P. & Almedia, M. (undated), *Phosphorus Sources and Reservoir Eutrophication in Portugal* http://disciplinas.dcea.fct.unl.pt/hidraulica/grhid/invdes/publicacoes/2007-11-IWAPolDifConf.pdf

EEA (2008), *Bathing water results 2008 – Portugal.* European Environment Agency, Copenhagen. http://ec.europa.eu/environment/water/water-bathing/report2009/PT_BWD%202008%20season.pdf

Ferreira, R., Cerqueira, M., de Melo, M., de Figueiredo, D. & Keizer, J. (2010), Spatial patterns of surface water quality in the Cértima River basin, central Portugal. *Journal of Environmental Monitoring* 12(1) 189-199.

Marques, J., Søren., N., Nielsen, N., Miguel, N., Pardala, A. & Jørgensen, S. (2003), Impact of eutrophication and river management within a framework of ecosystem theories. *Ecological Modelling* 166/1-2147-168.

Machado, F.S. & Mourato, S. (2002), Evaluating the Multiple Benefits of Marine Water Quality Improvements: How Important are Health Risk Reductions? *Journal of Environmental Management* 65/3, 239-250

Pérez, J.R., Loureiro, S., Menezes, S., Palma, P., Fernandes, R., Barbosa, I. & Soares, A. (2009), Assessment of water quality in the Alqueva Reservoir (Portugal) using bioassays. *Environmental Science and Pollution Research,*17/3, 688-702.

Sistem Nacional de Informaao de Recursos Hidricos (2010), *Water quality statistics*. http://www.snirh.pt/

Statistics Portugal (2008), *Environment Statistics and Accounts. Pilot Study On Water Flow Accounts*. Report by Statistics Portugal to Eurostat. http://epp.eurostat.ec.europa.eu/portal/page/portal/environmental_accounts/documents/PT%20479%20Water.pdf

Stigter T., Ribeiro, L. & Carvalho, D. (2006), Application of a groundwater quality index as an assessment and communication tool in agro-environmental policies - two Portuguese case studies. *Journal of Hydrology* 327:578-591.

Torrent, J. & Barberis, E. (2007), Agriculture as a source of phosphorus for eutrophication in southern Europe. *Soil Use & Management,* 23, 25–35

Slovak Republic

Csathó, P.*et al.* (2007), Agriculture as a source of phosphorus causing eutrophication in Central and Eastern Europe, *Soil Use & Management*, 23, 36-56.

EEA (2009), *Bathing water results 2009 – Slovakia*. European Environment Agency, Copenhagen. http://ec.europa.eu/environment/water/water-bathing/report2010/Slovakia.pdf

Nixon, S. (2000), *Sustainable use of Europe's water? State, prospects and issues.* European Environment Agency, Copehagen. http://www.dwaf.gov.za/projects/eutrophication/Website%20Survey/European%20Union/water_assmnt07_en.pdf

ICPDR (2007), *Slovakia Facts and Figures*. International Commission for the Protection of the Danube River http://www.icpdr.org/icpdr-pages/slovakia.htm

Kriš, J. & Škultétyová, I. (2009), *Slovak Water Resources–Present Conditions.* International Symposium on Water Management and Hydraulic Engineering. http://wmhe.gf.ukim.edu.mk/Downloads/PapersTopic2/A63-Kris-Skultetyova.pdf

OECD (2008), *Slovak Republic Country Section.* Environmental Performance of Agriculture in OECD countries since 1990. OECD, Paris. Parishttp://www.oecd.org/dataoecd/33/47/40806684.pdf

Pekárová, P. & Pekár, J. (1996), The impact of land use on stream water quality in Slovakia. *Journal of Hydrology,* 180/1-4, 333-350.

Pekarova, P., Miklanek, P., Roncak, P., Adamkova, J., Chriastel, R., Metelkova, M. & Pekar, J. (2004), Identification and assessment of long-term trends of surface water quality determinands in Slovakia for implementation of the EU WFD *Journal of Hydrology and Hydromechanics*, 52/4, 317-328

Sebíň, M., Pekárová, P. & Miklánek, P. (2007), Evaluation and indirect estimation of nitrate losses from the agricultural microbasin Rybárik. *Biologia,* 62/5, 569-572.

Slovenia

Ærtebjerg, G. *et al.* (2007), *Eutrophication in Europe's coastal waters.* European Envrionment Agency, Copenhagen. http://www.eutro.org/documents/EEA%20Topic_Report_7_2001.pdf

Anon (2007), *Policy Brief: Technical assistance for the preparation of the Krka river basin management plan*. ftp://212.18.43.13/public/KrkaWEB/102_Deliverable_6.3_final.pdf

Csathó, P.*et al.* (2007), Agriculture as a source of phosphorus causing eutrophication in Central and Eastern Europe, *Soil Use & Management*, 23, 36-56.

Drolc, A., Kondan, J. & Cotman, M. (2001), Evaluation of total nitrogen pollution reduction strategies in a river basin: a case study. *Water Sci. Technology*, 44/6, 55-62.

Drolc, A. & Koncan, J. (2002), Estimation of sources of total phosphorus in a river basin and assessment of alternatives for river pollution reduction. *Environment International*, 28/5, 393-400.

Drolc, A., Koncan, J.& Tisler, T. (2007), Evaluation of Point and Diffuse Sources of Nutrients in a River Basin on Base of Monitoring Data. *Environmental Monitoring & Assessment*, 129/1-3,461-470.

Dworak, T. *et al.* (2008), *Case study on calculating cost-effective measures to tackle nutrient pollution from the agricultural, municipal and industrial sectors in the Black Sea.* Institute for International and European Environmental Policy. http://ecologic.eu/download/projekte/900-949/914/914-case-study.pdf

ICPDR (2010), *Slovenia Facts and Figures*. International Commission for the Protection of the Danube River http://www.icpdr.org/icpdr-pages/slovenia.htm

Jamnik, B., Zeleznik, B. & Urban, J. (2003), *Diffuse Pollution of Water Protection Zones in Ljubljana, Slovenia.* Diffuse Pollution Conference Dublin 2003. http://www.ucd.ie/dipcon/docs/theme07/theme07_01.PDF

Maticic, B. (1999), The impact of agriculture on ground water quality in Slovenia: standards and strategy. *Agricultural Water Management*, 40/203, 235-247.

Petresin, E. (2000), *Slovenian Water Management and EU - Challenge and Opportunity.* European water Management Online. http://www.ewaonline.de/journal/2003_05.pdf

Pintar, M. *et al.* (2005), *The Impact of Land Use on Nitrogen Concentration in Surface Waters in Slovenia.* ICID 21st European Regional Conference 2005 - 15-19 May 2005. http://www.zalf.de/icid/ICID_ERC2005/HTML/ERC2005PDF/Topic_1/Pintar.pdf

UN (2004), *Freshwater Country Profile: Slovenia*. United Nations, Division for Sustainable Development http://www.un.org/esa/agenda21/natlinfo/countr/slovenia/Sloveniawater04f.pdf

Spain

Albiac, J., Playn, E.,& Martnez, J. (2007), Instruments for Water Quantity and Quality Management in the Agriculture of Aragon. *International Journal of Water Resources Development*, 23/1, 147 – 16.

Anon (undated), *Methodology: Satellite water accounts in Spain.* http://www.ine.es/en/daco/daco42/ambiente/aguasatelite/notaaguasat_9799_en.pdf

Candela, L., Domingo, F., Berbel, J. & Alarcon, J. (2008), *An overview of the main water conflicts in Spain: proposals for problem-solving.* Water Culture & Conflicts in the Mediterranean Area. http://ressources.ciheam.org/om/pdf/a83/00800935.pdf

Cardoch, L. & Day, J. (2002), Biophysical energy analyses of non-market values of the Ebro Delta *Journal of Coastal Conservation*, 8/1, 87-96.

Hernandez-Sancho, F., Molinos-Senante, M. & Sala-Garrido, R. (2010), Economic valuation of environmental benefits from wastewater treatment processes: An empirical approach for Spain, *Science of the total environment*, 408(4):953-7.

INE (2010), *Environmental Accounts*. Instituto National de Estadistica. http://www.ine.es/jaxi/menu.do?L=1&type=pcaxis&path=%2Ft26%2Fp067&file=inebase

Lomas, P., Alvarez, S., Rodríguez, M. & Montes, C. (2007), Environmental accounting as a management tool in the Mediterranean context: the Spanish economy during the last 20 years. *J. Environ Manage.* 88(2):326-47.

Martinez, Y., Calvo, E. & Albiac, J. (2007), A dynamic analysis of nonpoint pollution control instruments in agriculture. *International Journal of Agricultural Resources, Governance and Ecology*, 6/1, 60 - 78.

Martínez Y. & Albiac, J. (2004), Agricultural pollution control under Spanish and European environmental policies. *Water Resources Research* 40, W10501, 12 PP., 2004 doi:10.1029/2004WR003102

Morillaa, C., Díaz-Salazarb, G. & Cardenete, M.A. (2007), Economic and environmental efficiency using a social accounting matrix. *Ecological Economics*, 60/4,774-786.

OECD (2008), *Environmental Performance of Agriculture in OECD Countries Since 1990: Spain Country Section.* OECD, Paris. http://www.oecd.org/dataoecd/33/51/40806906.pdf

Pac, R.D. & Sánchez-Chóliz, J. (1999), Regional productive structure and water pollution in the Ebro Valley (Spain) *Environmental Management and Health*, 10/3, 143 – 154

Sánchez-Chóliz, J. & Duarte, R. (2005), Water pollution in the Spanish economy: analysis of sensitivity to production and environmental constraints. *Ecological Economics*, 53/3, 325-338.

Sweden

Ahlroth, S. (2007), *Calculating damage values for ecosystem effects in Sweden.* A paper arising from the EU-funded ExternE project. http://www20.vv.se/fud-resultat/Publikationer_000201_000300/Publikation_000237/slutrapport%20V%c3%a4rdering%20av%20ekosystemeffekter.pdf

Boesch, D., Carstensen, J., Paerl, H.W., Skjoldal, H.R. & Voss, M. (2008), *Eutrophication of the Seas along Sweden's West Coast* Report to the Swedish Environmental Protection Agency, (Naturvårdsverket) REPORT 5898 http://www.naturvardsverket.se/Documents/publikationer/978-91-620-5898-2.pdf

Elofsson, K. (2010), The Costs of Meeting the Environmental Objectives for the Baltic Sea: A Review of the Literature *AMBIO: A Journal of the Human Environment* 39(1):49-58.

Gren, I-M. (2008), *Costs and benefits from nutrient reductions to the Baltic Sea*. Report 5877. Swedish Environmental Protection Agency, Stockholm. http://www.naturvardsverket.se/Documents/publikationer/978-91-620-5877-7.pdf

Huhtala, A., Ahtiainen, H., Ekholm, P., Fleming-Lehtinen, V., Heikkilä, J., Heiskanen, A-S., Helin, J., Helle, I., Hyytiäinen, K., Hällfors, H., Iho, A., Koikkalainen, K., Kuikka, S., Lehtiniemi, M., Mannio, J., Mehtonen, J., Miettinen, A., Mäntyniemi, S., Peltonen, H., Pouta, E., Pylkkö, M., Salmiovirta, M., Verta, M., Vesterinen, J., Viitasalo, M., Viitasalo-Frösen, S. & Väisänen, S. (2009), *The economics of the state of the Baltic Sea : pre-study assessing the feasibility of a cost-benefit analysis of protecting the Baltic Sea* ecosystem http://www.minedu.fi/export/sites/default/OPM/Tiede/setu/liitteet/Setu_2-2009.pdf

Laukkanen, M., & Huhtala, A. (2007), Optimal management of a eutrophied coastal ecosystem: Balancing agricultural and municipal abatement measures. *Journal of Environmental and Resource Economics* 39(2): 139–159.

Östberg, K., Hasselström, L. & Håkansson, C. (2010), *Non-market valuation of the coastal environment - uniting political aims, ecological and economic knowledge.* CERE Working Paper, 2010:10 http://www.cere.se/documents/wp/CERE_2010_10.pdf

Söderqvist, T., & Scharin, H. (2000), The regional willingness to pay for a reduced eutrophication in the Stockholm archipelago. Discussion Paper, no. 128, Beijer International Institute of Ecological Economics, The Royal Swedish Academy of Sciences. http://www.beijer.kva.se/PDF/22897416_artdisc128.pdf

Söderqvist, T. & Hasselström, L. (2008), *The economic value of ecosystem services provided by the Baltic Sea and Skagerrak. Existing information and gaps of knowledge*. Swedish Environmental Protection Agency, Stockholm. http://www.naturvardsverket.se/Documents/publikationer/978-91-620-5874-6.pdf

Statistics Sweden (2003), *Water Accounts 2000 – with disaggregation to sea basins.* Statistics Sweden, Stockholm. http://www.scb.se/Statistik/MI/MI1202/2003M00/MI71OP0302.pdf

Statistics Sweden (2008), *Environmental protection expenditure in industry 2008*. Statistics Sweden, Stockholm. http://www.scb.se/Statistik/MI/MI1302/2008A01/MI1302_2008A01_SM_MI23SM0901.pdf

Switzerland

FSO (2008), *Environmental Accounting*. Swiss Federal Statistical Office, Neuchâtel. http://www.bfs.admin.ch/bfs/portal/en/index/themen/04/22/lexi.Document.107039.pdf

FSO (2009), *Economic accounts for the primary sector: methods. An introduction to the theory and practice.* Federal Department of Home Affairs, Federal Statistical Office , Neuchâtel. http://www.bfs.admin.ch/bfs/portal/en/index/news/publikationen.Document.121163.pdf

FSO (2010), *Swiss Environmental Statistics A Brief Guide 2010*, Federal Office for the Environment; Federal Statistical Office, Neuchâtel. http://www.bfs.admin.ch/bfs/portal/en/index/themen/02/22/publ.html?publicationID=4019

Herzog, F., Prasuhn, V., Spiess, E. & Richner, W. (2008), Environmental cross-compliance mitigates nitrogen and phosphorus pollution from Swiss agriculture. *Environmental Science & Policy*,11/7, 655-668 .

Moser, D., Pfammatter, R., Ribi, F. & Zysset, A. (2009) *Überblick finanzielle Kenngrössen der Schweizer Wasserwirtschaft.* http://docs.google.com/viewer?a=v&q=cache:hxGJQ7qlPkIJ:www.bafu.admin.ch/wasser/01444/08820/index.html%3Flang%3Dde%26download%3DNHzLpZeg7t,lnp6I0NTU042l2Z6ln1acy4Zn4Z2qZpnO2Yuq2Z6gpJCGdIN9hGym162epYbg2c_JjKbNoKSn6A--

Pillet, G., Zingg, N. & Maradan, D. (2000), *Appraising Externalities of Swiss Agriculture — A Comprehensive View.* Ecosys Sa Applied Economics & Environmental Economics, Geneva. On Behalf of the Swiss Federal Office of Agriculture. http://www.ecosys.com/spec/ecosys/download/Mandats/summary_swiss%20agriculture.pdf

Vermont, S. (2004), *Switzerland National Report* Convention on Protection and Use of Transboundary Watercourses and International Lakes Seminar On The Role Of Ecosystems As Water Suppliers (Geneva, 13-14 December 2004). http://www.unece.org/env/water/meetings/ecosystem/Reports/Switzerland_en.pdf

Vermont, S. (2005), *National Report of Switzerland on Environmental Services and Financing for the Protection and Sustainable Use of Water-Related Ecosystems*. Convention on Protection and Use of Transboundary Watercourses and International Lakes. Seminar on Environmental Services and Financing for the Protection and Sustainable Use of Ecosystems. Geneva, 10-11 October 2005. http://www.unece.org/env/water/meetings/payment_ecosystems/Reports/Switzerland_e.pdf

Woolsey, S., Capelli, F., Hoehen, E. *et al.* (2007), A strategy to assess river restoration success. *Freshwater Biology*, 52/4, 752–769.

Turkey

Atis, E. (2006), Economic impacts on cotton production due to land degradation in the Gediz Delta, Turkey. *Land Use Policy*, 23/2, 181-186.

Baba, A. & Ayyildiz, O. (2006), Urban Groundwater Pollution In Turkey. *Urban Groundwater Management and Sustainability* Nato Science Series: IV: Earth and Environmental Sciences, 2006, Volume 74, SECTION II, 93-110, DOI: 10.1007/1-4020-5175-1_7.

Baris, M.E. & Karadag, A.A. (2007), Water resources management issues in Turkey and recommendations. *Journal of Applied Sciences*, 7/24, 3900-3908. http://docsdrive.com/pdfs/ansinet/jas/2007/3900-3908.pdf

Dadaser-Celik, F., Coggins, J.S., Brezonik, P.L. & Stefan, H.G. (2009), The projected costs and benefits of water diversion from and to the Sultan Marshes (Turkey). *Ecological Economics*, 68/5, 1496-1506.

General Directorate of State Hydraulic Works (2009), *Turkey Water Report 2009.* General Directorate of State Hydraulic Works, Ankara. http://www.dsi.gov.tr/english/pdf_files/TurkeyWaterReport.pdf

OECD (2008), *Environmental Performance of Agriculture in OECD countries since 1990: Turkey Country Section*. OECD, Paris. http://www.oecd.org/dataoecd/34/19/40807967.pdf

Sakcalia, M. S., Yilmazb, R., Gucelc, S. , Yarcid, C. & Ozturk, M. (2009), Water pollution studies in the rivers of the Edirne Region-Turkey. *Aquatic Ecosystem Health & Management*, 12/3, 313 – 319.

UKDTI (2010), *Sector Report. Water Sector Turkey.* Sector Report by the DTI, London. http://ukdti.gov.uk/downlaod/112444_101940/Water%20Sector%20in%20Turkey.html

Ulger, S. (2001), *An analysis of the inter-relationship between environment and socio-economic structure with special reference to water pollution in the Turkish Black Sea Basin*. University of Tsukuba. http://www.tulips.tsukuba.ac.jp/limedio/dlam/B23/B2364427/1.pdf

Varola, M., Gökotb, B. & Bekleyen, A. (2009), Assessment of Water Pollution in the Tigris River in Diyarbakır, Turkey. Water Practice & Technology © IWA Publishing 2010 doi:10.2166/wpt.2010.021 http://archive.rec.org/REC/Programs/ExtensionToTurkey/TurkeysEnvironment.pdf

United Kingdom

Bateman, G. (2010), Delivering the Water Framework Directive in AMP5.*Utility Week*, May 2010. http://www.utilityweek.co.uk/features/uk/delivering-the-water-framework.php

Church, A., Gilchrist, P., Ravenscroft, N. & Taylor, B. (2008), *Valuation of recreational benefits of improvements in water quality – potential benefits and data requirements.* A report by University of Brighton under the Collaborative Research Programme on River Basin Management Planning Economics. Defra, London.

Dalton, H. & Brand-Hardy, R. (2003), Nitrogen: the essential public enemy. *Journal of Applied Ecology* 40, 771-781.

Eftec & IEEP (2004), Framework for Environmental Accounts for Agriculture. Eftec in association with IEEP, report to Defra, London. http://www.defra.gov.uk/evidence/economics/foodfarm/reports/envacc/eftec.htm

EA (2008), *Water resources in England and Wales - current state and future pressures*. Environment Agency, Bristol. http://publications.environment-agency.gov.uk/pdf/GEHO1208BPAS-e-e.pdf

Hanley, N., Wright, R.E. & Alvarez-Farizo, B. (2006), Estimating the economic value of improvements in river ecology using choice experiments: an application to the water framework directive. *Journal of Environmental Management* (78): 183-193.

Jacobs (2008), *Environmental Accounts for Agriculture*. A Jacobs report in association with SAC and Cranfield, to Defra, London. http://www.defra.gov.uk/evidence/economics/foodfarm/reports/envacc/jacob.htm

O'Neil, D. (2007), *The Total External Environmental Costs and Benefits of Agriculture in the UK.* Environment Agency, Bristol. http://www.environment-agency.gov.uk/static/documents/Research/costs_benefitapr07_1749472.pdf

Pretty, J.N., Mason, C.F., Newell, D.B. & Hine, R.E. (2002), *A preliminary Assessment of the Environmental Damage Costs of the Eutrophication of Fresh Waters in England and Wales*, report prepared for Environment Agency. http://www.essex.ac.uk/ces/occasionalpapers/EAEutrophReport.pdf

Pretty, J.N., Mason, C.F., Newell, D.B, Hine, R., Leaf, S. & Dils, R. (2003), Environmental Costs of Freshwater Eutrophication in England and Wales. *Environ. Sci. Technol*., 37 (2), 201-208.

Ravenscroft, N. & Church, A. (2010), The attitudes of recreational user representatives to pollution reduction and the implementation of the European Water Framework Directive. *Land Use Policy*, 28/1, 167-174.

SEPA (2006), *State of Scotland's Environment 2006*. Scottish Environmental Protection Agency. http://www.sepa.org.uk/science_and_research/data_and_reports/state_of_the_environment.aspx

Turner, K. (1977), The recreational response to changes in water quality: A survey and critique. *International Journal of Environmental Studies*, 11/2, 91-98.

United States

Anderson, D.M., Kaoru, Y. & White, A. (2000), *Estimated Annual Economic Impacts from Harmful Algal Blooms (HABs) in the United States*. Woods Hole Oceanographic Institution Technical Report. http://www.whoi.edu/fileserver.do?id=24159&pt=10&p=19132

Bockstael, N.E., McConnell, K. & Strand, I. (1988), *Benefits from Improvements in Chesapeake Bay Water Quality, Benefit Analysis Using Indirect or Imputed Market Methods*, Vol. 3, EPA Agreement No. 811043-01-0, U.S. Environmental Protection Agency, Washington, D.C., U.S.A. http://ageconsearch.umn.edu/bitstream/48498/2/8175807.pdf

Capel, P., Hamilton, P. & Erwin, M. (2004), *Studies by the U.S. Geological Survey on Sources, Transport, and Fate of Agricultural Chemicals.* US Geological Survey Fact Sheet 2004-3098. http://pubs.usgs.gov/fs/2004/3098/

Crutchfield, S., Feather, P. & Hellerstein, D. (1995), *The benefits of protecting rural water quality, an empirical analysis,* Agricultural Economic Report No 701, USDA. http://www.ers.usda.gov/publications/aer701/AER701.PDF

Dodds, W.K., W.W. Bouska, J.L. Eitzmann, T.J. Pilger, K.L. Pitts. A.J. Riley, J.T. Schloesser and D.J. Thornbrugh (2009), "Eutrophication of U.S. Freshwaters: Analysis of potential economic damages", *Environmental Science and Technology*, Vol. 43, No.1, pp. 12-19.

Fare, R., Grosskopf, S. & Weber, W. (2006), Shadow prices and pollution costs in U.S. agriculture. *Ecological Economics,* 56/1, 89-103.

Hamilton, P.A., Miller, T.L. & Myers, D.N. (2004), *Water quality in the Nation's Streams and Aquifers—Overview of Selected Findings, 1991-2001*. U. S. Geological Survey Circular 1265 http://water.usgs.gov/pubs/circ/2004/1265

Morgan, C. & Owens, N. (2001), Benefits of water quality policies: the Chesapeake Bay. *Ecological Economics*, 39/2, 271-284.

Morgan, K. & Larkin, S. (2006), *Economic impacts of red tide events on restaurant sales*. Paper prepared to SAEA meeting, Feb '06. http://ageconsearch.umn.edu/bitstream/35323/1/sp06mo07.pdf

NCEE (2005), *Pollution Abatement Costs and Expenditures: 2005 Survey.* National Center for Environmental Economics. http://yosemite.epa.gov/ee/epa/eed.nsf/webpages/pace2005.html

OECD (2008), *Environmental Performance of Agriculture in OECD Countries Since 1990: United States Country Section*. OECD, Paris. http://www.oecd.org/dataoecd/35/27/40808705.pdf

Pimentel, D. (2005), Environmental and Economic Costs of the Application of Pesticides Primarily in The United States. *Environment, Development and Sustainability* 7: 229-252.

Ribaudo, M. & Johansson, R. (2006), *Water quality – Impacts of Agriculture*. ERS, USDA. http://www.ers.usda.gov/publications/arei/eib16/Chapter2/2.2/

Scavia, D. & Bricker, S. (2006), Coastal eutrophication assessment in the United States. *Biogeochemistry,* 79/1-2, 187-208.

Tegtmeier, E.M. & Duffy, M.D. (2004), External costs of agricultural production in the United States. *International Journal of Agricultural Sustainability* 2, 155-175. http://www.leopold.iastate.edu/pubs/staff/files/externalcosts_IJAS2004.pdf

US Environmental Protection Agency (2002), *National Water Quality Inventory 2000 Report*, Office of Water, Washington DC, United States. http://water.epa.gov/lawsregs/guidance/cwa/305b/2002report_index.cfm