Report No. 129

epaResearch
Climate - Water - Sustainability
Identifying pressures • Informing policy • Developing solutions

Are we willing to pay for good river water quality?

Willingness to pay for achieving good status across rivers in the Republic of Ireland

Comhshaol, Pobal agus Rialtas Áitiúil
Environment, Community and Local Government

www.epa.ie

Environmental Protection Agency

The Environmental Protection Agency (EPA) is a statutory body responsible for protecting the environment in Ireland. We regulate and police activities that might otherwise cause pollution. We ensure there is solid information on environmental trends so that necessary actions are taken. Our priorities are protecting the Irish environment and ensuring that development is sustainable.

The EPA is an independent public body established in July 1993 under the Environmental Protection Agency Act, 1992. Its sponsor in Government is the Department of the Environment, Community and Local Government.

OUR RESPONSIBILITIES

LICENSING

We license the following to ensure that their emissions do not endanger human health or harm the environment:

- waste facilities (e.g., landfills, incinerators, waste transfer stations);
- large scale industrial activities (e.g., pharmaceutical manufacturing, cement manufacturing, power plants);
- intensive agriculture;
- the contained use and controlled release of Genetically Modified Organisms (GMOs);
- large petrol storage facilities;
- waste water discharges;
- dumping at sea.

NATIONAL ENVIRONMENTAL ENFORCEMENT

- Conducting over 1200 audits and inspections of EPA licensed facilities every year.
- Overseeing local authorities' environmental protection responsibilities in the areas of - air, noise, waste, waste-water and water quality.
- Working with local authorities and the Gardaí to stamp out illegal waste activity by co-ordinating a national enforcement network, targeting offenders, conducting investigations and overseeing remediation.
- Prosecuting those who flout environmental law and damage the environment as a result of their actions.

MONITORING, ANALYSING AND REPORTING ON THE ENVIRONMENT

- Monitoring air quality and the quality of rivers, lakes, tidal waters and ground waters; measuring water levels and river flows.
- Independent reporting to inform decision making by national and local government.

REGULATING IRELAND'S GREENHOUSE GAS EMISSIONS

- Quantifying Ireland's emissions of greenhouse gases in the context of our Kyoto commitments
- Implementing the Emissions Trading Directive, involving over 100 companies who are major generators of carbon dioxide in Ireland.

ENVIRONMENTAL RESEARCH AND DEVELOPMENT

- Co-ordinating research on environmental issues (including air and water quality, climate change, biodiversity, environmental technologies).

STRATEGIC ENVIRONMENTAL ASSESSMENT

- Assessing the impact of plans and programmes on the Irish environment (such as waste management and development plans).

ENVIRONMENTAL PLANNING, EDUCATION AND GUIDANCE

- Providing guidance to the public and to industry on various environmental topics (including licence applications, waste prevention and environmental regulations).
- Generating greater environmental awareness (through environmental television programmes and primary and secondary schools' resource packs).

PROACTIVE WASTE MANAGEMENT

- Promoting waste prevention and minimisation projects through the co-ordination of the National Waste Prevention Programme, including input into the implementation of Producer Responsibility Initiatives.
- Enforcing Regulations such as Waste Electrical and Electronic Equipment (WEEE) and Restriction of Hazardous Substances (RoHS) and substances that deplete the ozone layer.
- Developing a National Hazardous Waste Management Plan to prevent and manage hazardous waste.

MANAGEMENT AND STRUCTURE OF THE EPA

The organisation is managed by a full time Board, consisting of a Director General and four Directors.

The work of the EPA is carried out across four offices:

- Office of Climate, Licensing and Resource Use
- Office of Environmental Enforcement
- Office of Environmental Assessment
- Office of Communications and Corporate Services

The EPA is assisted by an Advisory Committee of twelve members who meet several times a year to discuss issues of concern and offer advice to the Board.

EPA Research Programme 2014–2020

Willingness to Pay for Achieving Good Status Across Rivers in the Republic of Ireland

(2011-W-DS-7)

EPA Research Report

Prepared for the Environmental Protection Agency

by

Teagasc

Authors:

Cathal Buckley, Peter Howley, Cathal O'Donoghue, Paul Kilgarriff, John Lennon, Bridin McIntyre and Danny Campbell

ENVIRONMENTAL PROTECTION AGENCY

An Ghníomhaireacht um Chaomhnú Comhshaoil
PO Box 3000, Johnstown Castle, Co. Wexford, Ireland

Telephone: +353 53 916 0600 Fax: +353 53 916 0699
Email: info@epa.ie Website: www.epa.ie

ACKNOWLEDGEMENTS

This report is published as part of the EPA Research Programme. The Research Programme is administered on behalf of the Department of the Environment, Community and Local Government by the Environmental Protection Agency which has the statutory function of co-ordinating and promoting Irish environmental research.

DISCLAIMER

The EPA Research Programme addresses the need for research in Ireland to inform policymakers and other stakeholders on a range of questions in relation to environmental protection. These reports are intended as contributions to the necessary debate on the protection of the environment.

EPA Research Programme 2014–2020

Published by the Environmental Protection Agency, Ireland

ISBN: 978-1-84095-548-4

Price: Free **Online version**

Details of Project Partners

Cathal Buckley
Agricultural Catchments Programme
Teagasc
Athenry
Co. Galway
Ireland
Tel.: +353 91 845293
Email: cathal.buckley@teagasc.ie

Peter Howley
Environment Department
University of York
Heslington
York YO10 5DD
United Kingdom
Tel.: +44 1904 324058
Email: peter.howley@york.ac.uk

Cathal O'Donoghue
Rural Economy & Development Programme
Teagasc
Athenry
Co. Galway
Ireland
Tel.: +353 91 845263
Email: cathal.odonoghue@teagasc.ie

Paul Kilgarriff
Rural Economy & Development Programme
Teagasc
Athenry
Co. Galway
Ireland

John Lennon
Rural Economy & Development Programme
Teagasc
Athenry
Co. Galway
Ireland
Tel.: +353 91 845292
Email: john.lennon@teagasc.ie

Bridin McIntyre
Rural Economy & Development Programme
Teagasc
Ashtown
Dublin 15
Ireland
Tel.: +353 1 8059505
Email: bridin.mcintyre@teagasc.ie

Danny Campbell
Stirling Management School
University of Stirling
Stirling FK9 4LA
United Kingdom
Tel.: +44 17 86467277
Email: danny.campbell@stir.ac.uk

Table of Contents

Acknowledgements ii

Disclaimer ii

Details of Project Partners iii

Executive Summary vii

1 Introduction 1

1.1 Objectives 1

2 Background 2

3 Theoretical Framework 4

4 Review of Literature 6

4.1 Attitudes to Water Quality 6

4.2 WTP Studies 6

5 Methodology 8

5.1 Selecting the Target Population and Data Collection 8

5.2 Design of CVM Scenario 9

5.3 CVM Scenario 10

5.4 Environmental Values 11

5.5 Distance from a Watercourse 12

6 Results 14

6.1 Public Ranking of Water Quality Related Issues 14

6.2 Recreational Use of Rivers 14

6.3 WTP for Good Status 17

6.4 Modelling WTP Responses 18

6.5 Preferences for Achieving Good Status 22

6.6 Distance to Watercourse 22

7 Conclusions 23

8 Recommendations for Future Research 25

References 26

Acronyms and Annotations 29

Executive Summary

One of the main objectives of this research was to examine public attitudes towards water quality related issues and the importance that the general public places on these compared with other potential environment issues. Understanding more about how individuals in different areas relate to the environment and water quality, in particular, could be beneficial in formulating natural resource use decisions that are in keeping with individuals' needs and desires.

This research sought to explore the general public's attitudes towards water quality issues and estimate willingness to pay (WTP) values for achieving good status across rivers in the Republic of Ireland as set down under the European Union Water Framework Directive (WFD). The WFD mandates Member States to achieve good status across all surface waters by 2015. Derogations from this target have to be proven based on infeasibility or disproportionate cost. Hence, quantification of benefits is an important element in the assessment of the proportionality of costs in the implementation of the WFD. Assessing whether the achievement of good status is disproportionately expensive requires a comparison of the costs of putting measures in place to achieve good status versus the benefits that might come about as a result of the waterbody achieving good status. Very few studies have looked at the benefit side of this equation in the Republic of Ireland and this study aimed to address this research gap by undertaking a survey of the general population using a non-market contingent valuation methodology to explore the WTP of the general population to achieve good status across all rivers in the Republic of Ireland.

Findings from this study indicate that the general population places a high rating on water quality related environmental issues. Of the nine environmental issues explored, tackling poor drinking water quality and pollution of rivers and lakes were the top ranked priority issues across the sample. Damage from flooding was ranked joint third with damage to countryside and air pollution, and water pollution at beaches was ranked seventh (destruction of wildlife was ranked sixth, climate change eighth and growth of genetically modified crops ninth). Results from 614 respondents weighted to be representative of the population based on age, gender and social class indicated that 41% are using rivers for recreational purposes. Walking was by far the most popular activity, with 36% of the total sample undertaking this activity along rivers. Between 3% and 4% of the total sample engaged in either nature or bird watching, swimming, fishing or water sports relating to boats. Respondents were presented with a contingent valuation scenario where they were asked their WTP in increased annual taxation for a situation where 100% of river channels in the Republic of Ireland would achieve good status from the current situation of 68.9%. A statistical model (generalised tobit) was used to model respondents WTP using maximum likelihood estimation. Excluding protest responses, results show that over 50% of the sample indicated a €0 WTP for achieving 100% good status across Irish rivers from the current position.

Results from this model indicate that socio-demographic factors, such as actual income and subjective perceptions relating to household financial status as well as education, were found to have a positive impact on the general public's WTP. Recreational use values were also found to have an effect in that average number of trips taken to the river for recreational purposes and average distance travelled for access were both positively and significantly associated with WTP. In addition, environmental values were found to be significantly associated with overall WTP. Finally, WTP values were found to be higher among respondents living in river basin districts where rivers were generally of lower surface water status. Mean WTP for achieving full good status across rivers in the Republic of Ireland was estimated at €19 per respondent per annum. Aggregating this up across the general population indicates a total WTP for achieving good status across rivers in the Republic of Ireland of €65.35 million per annum. Results from this study can provide policy makers with an indicative guide of WTP values for achieving good status of rivers and can assist resource allocation decisions.

1 Introduction

The Water Framework Directive (WFD) (European Parliament and Council, 2000) is a framework established by the European Union (EU) for the protection of inland surface waters, groundwater, transitional waters and coastal waters (Europa, 2012). The WFD has a number of aims and objectives such as "*preventing and reducing pollution, promoting sustainable water usage, environmental protection, improving aquatic ecosystems and mitigating the effects of floods and droughts*" (Europa, 2012). One of the primary aims of the WFD in relation to surface waters (Article 4) is to achieve good status by 2015 if not at this level already. If a waterbody is already at '*good status*' or '*high status*' then it should be maintained; there can, hence, be no deterioration in quality. The WFD mandates that this objective will be co-ordinated at the level of the River Basin District (RBD). As outlined by the OECD (2012), the WFD is demanding as it:

- Covers the total water system (both quality and quantity);
- Sets timelines for achieving relevant objectives;
- Requires compliance with the polluter pays principle;
- Stipulates that economic criteria are necessary to ensure that WFD goals are achieved at least cost;
- Has definitive targets for the chemical and ecological status of waterbodies;
- Requires full evaluation and monitoring of programmes; and
- Comprises stakeholder consultation and participation through the river basin management planning process.

Article 4 of the WFD states that Member States may aim for less stringent objectives if the conditions of surface waterbodies are affected so much by human activity or their national conditions are such that it would be infeasible or disproportionately expensive to achieve the main objectives of the Directive, i.e. good status by 2015. Consequently, quantification of benefits is an important element in the assessment of the 'proportionality' of costs in the implementation of the WFD. As discussed by Norton et al. (2012), proving that achievement of good status is disproportionately expensive requires a comparison of the costs of putting in place a water management plan to achieve good surface water status versus the benefits that might come about as a result of the waterbody achieving good surface water status. Very few studies have looked at the benefit side of this equation in the Republic of Ireland and, in this context, this research seeks to address this gap by undertaking a survey of the general population using non-market valuation to explore willingness to pay (WTP) to achieve good status across all rivers in the Republic of Ireland.

1.1 Objectives

The main objectives of this research project are as follows:

- Examine public attitudes towards water quality. This will include an examination of the priority that the general public places on water quality related objectives compared with other environmental objectives.
- Estimate the general public's WTP for achieving good status across all rivers in the Republic of Ireland.
- Examine the impact of socio-demographic characteristics and environmental values towards achieving good status across rivers in the Republic of Ireland.
- Examine the impact of use values and distance travelled to river bodies for recreational activities on WTP for improvements in river water quality.

2 Background

The status of a surface waterbody is determined based on the assessment of both the ecological and the chemical status (EPA, 2008). Ecological status of surface water is an expression of the quality of the structure and functioning of aquatic ecosystems (McGarrigle et al., 2010). It is measured using a cross-section of biological parameters, supporting physico-chemical parameters, in addition to hydrology and morphology conditions. The biological parameters include the abundance and composition of aquatic flora (diatoms, phytoplankton, macrophytes) and aquatic fauna (benthic invertebrates, fish), while the physico-chemical parameters include oxygen, nutrients, temperature, water clarity, acid status and salinity. The hydrology and morphology parameters include depth, flow, water level and bank-side conditions (McGarrigle et al., 2010). The WFD requires a single standard that will separate the two chemical status classes 'good' and 'failing to achieve good' set out in the Directive based on priority substances (Annex X) and certain other pollutants (Annex IX) (European Parliament and Council, 2000). Failure to achieve one of these standards will mean failure to achieve good chemical status (EPA, 2008). Figure 2.1 outlines the assessment criteria for good status of surface water.

As outlined by Clabby et al. (2008), national surveys of rivers in Ireland have taken place continuously since 1971, when initially 2,900 km of river channel were surveyed. This has grown to 13,240 km today. Monitoring is mainly undertaken by the Environmental Protection Agency (EPA) and the local authorities at

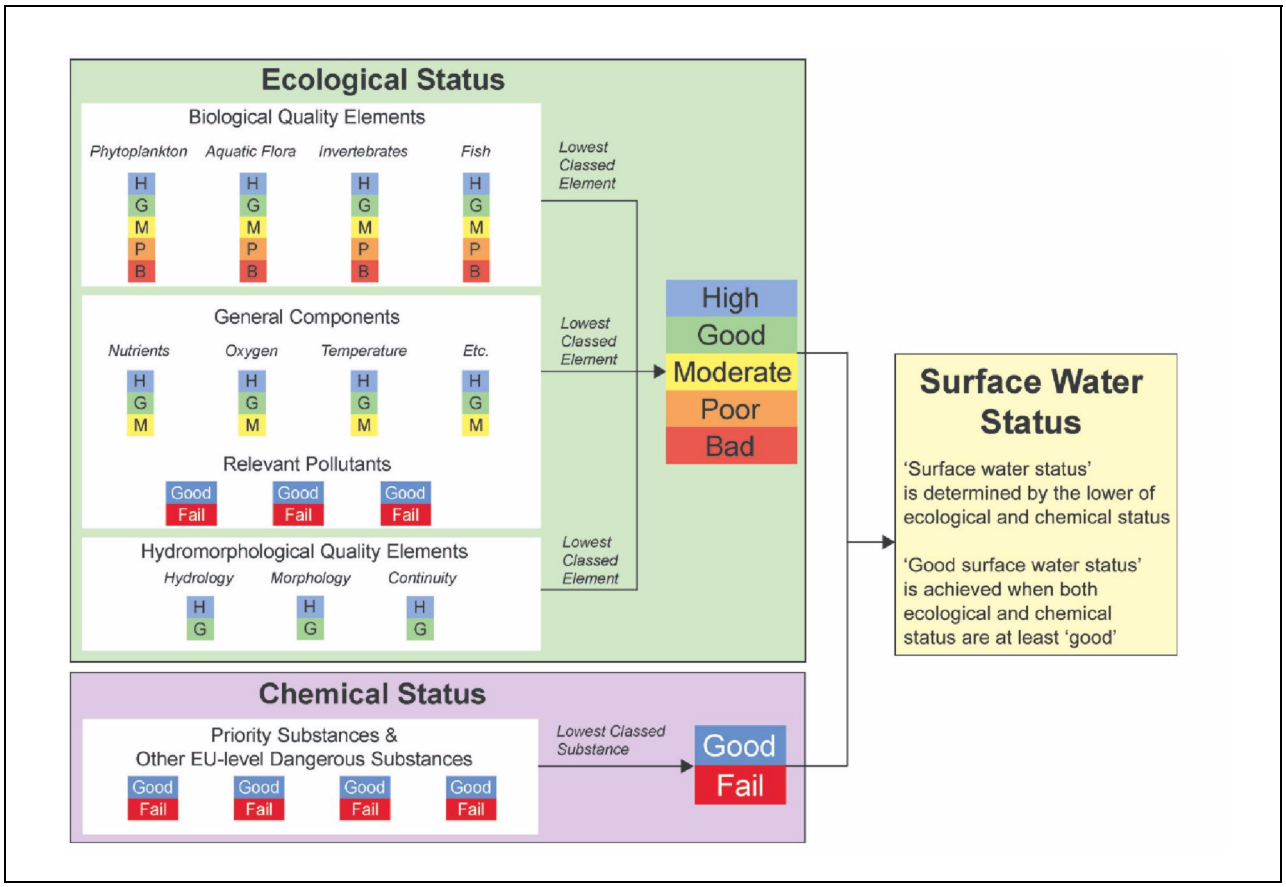

Figure 2.1. Surface water status classification system. Source: EPA (2008).

some 2,500 monitoring locations every 3 years. As outlined by McGarrigle et al. (2010), the most recent assessment shows that approximately 68.9% of river channel is classed as unpolluted (achieving at least good status). A total of 20.7% was classed as moderate status, a further 10% was found to be of poor status, while circa 0.5% was assessed as bad status.

The achievement of WFD objectives is to be co-ordinated at the RBD level. These were established based on the natural hydrologic units instead of administrative or political demarcations, and they correspond to large catchment basins incorporating smaller sub-basins or hydrometric areas. Ireland is divided into 40 hydrometric areas, each of which comprises a single large river catchment or a group of smaller catchments. There are four RBDs contained wholly within the Republic of Ireland, namely the Eastern, South Eastern, Western and South Western RBDs. Three others, the North Western, Shannon and Neagh–Bann are shared with Northern Ireland and, as such, are classified as International RBDs (IRBDs).

Table 2.1 outlines the percentage river channel of good or high status by RBD. The South Western RBD (92%) and the Western RBD (83%) have considerably higher levels of river channel at good status compared with the other RBDs.

Table 2.1. Percentage of rivers achieving good or high status by River Basin District (RBD).

RBD	% River channel of good or high status
South Western RBD	92
Western RBD	83
North Western RBD	66
South Eastern RBD	64
Shannon RBD	58
Neagh–Bann International RBD	55
Eastern RBD	46

(Source: McGarrigle et al., 2010)

3 Theoretical Framework

The benefits of an environmental public good, such as achieving good surface water status, are difficult to quantify because they are not reflected in cash flow. Bateman et al. (2006a) stipulate that "*the economic benefits (of implementing the WFD) are likely to be many although only a minority are likely to be easily amendable to quantification, for example, reduced water treatment costs. One important motivation for the WFD appears to be the creation of non-market environmental benefits, such as open-access recreation*". In situations where no market exists for the good or service (such as an environmental public good), alternative non-valuation methods are required to estimate economic values.

The total economic value (TEV) of an environmental public good is a measure of the welfare gain across both use and non-use categories. Use values relate to those aspects of the water resource where individuals (or corporate entities) gain from direct interaction with aquatic resources. This tends to be for consumptive use, such as potable water, or recreational use. Indirect use of the resource can also lead to human benefits but may involve indirect interaction on the part of the individual, e.g. flood protection or waste assimilation. Additionally, potential future use values may be held by individuals who do not currently use the resource but value the option that they may use the resource in the future.

Non-use values are ascribed to individuals who place value on the very existence of the environmental public good (such as good surface water status) even though they may not be in a position to directly or indirectly utilise it. These values may be motivated by a desire to protect the resource for future generations of users (bequest), or for the value it provides to others (altruistic), and/or by a belief in the value of the resource irrespective of what human use, if any, is derived from its existence. The TEV of achieving good status under the WFD is the sum of each of these values. Non-market valuation methods that could be used to estimate the value of achieving good ecological status (GES) under the WFD can be separated into two typologies: revealed and stated preference methods (Bateman et al., 2006b; Hanley et al., 2006).

As outlined by Norton et al. (2012), revealed preference methods are based upon observations of the behaviour of individuals in real markets from which inferences may be drawn on the value of a related non-market good under investigation. The two most common methods applied are travel cost and hedonic pricing. The hedonic pricing method approach stipulates that goods can be described as a bundle of characteristics and therefore the price of the good is a function of these characteristics and of their levels (Lancaster, 1966). The hedonic pricing method is commonly applied to land or house prices to estimate the value of the surrounding environmental quality levels, such as air, distance to amenities or a clean waterbody (Hanley and Barbier, 2009).

The travel cost method is used to determine the value of sites that people travel to for recreational purposes. In a water quality context, this includes fishing or boating, for example. The travel cost method typically measures the price of recreational access based on the cost of travel to a site and the time involved in accessing it. Distances travelled and number of trips undertaken can be modelled to represent the WTP of individuals for the site (Hynes and Hanley, 2006). However, revealed preference methods can only estimate the use value of an environmental good or service. To estimate the TEV for an environmental good or service (use and non-use values) stated preference techniques are required. The difference between revealed and stated preference methods is the type of data used to estimate values. Revealed preference methods rely on data that record actual choices, whereas stated preference methods rely on data from carefully worded survey questions that ask people what choice they would make for alternative levels of an environmental or natural resource amenity (Boyle, 2003).

Key limitations of revealed preference methods are the inability to estimate non-use values and the inability to estimate values for new levels of a natural resource amenity that have not yet been experienced or provided such as achievement of good status under the WFD. Stated preference methods have two major classes of elicitation techniques associated with the provision of environmental public goods. The first type, contingent valuation methodology (CVM), measures the value of a change from the status quo to some other state. The second, the choice experiment (CE) technique, involves the respondent choosing the preferred option from a number of scenarios in which elements of the attribute bundle describing the good are varied.

CVM is the original technique used to elicit preferences for environmental change. The CVM approach relies on asking respondents in a hypothetical market how much they are either willing to pay for the provision of a public good or service that implies an improvement in their well-being or their willingness to accept (WTA) compensation for the loss of this good and the subsequent decrease in well-being. A CE usually asks a respondent to perform a sequence of choices. Each alternative is described by a number of attributes or characteristics. A monetary value is included as one of the attributes, along with other attributes of importance, when describing the profile of the alternative presented. Thus, when individuals make their choice, they implicitly make trade-offs between the levels of the attributes in the different alternatives presented in a choice set.

CEs tend to deal more explicitly with how society values relate to individual attributes and combinations of attributes that make up the environmental good or policy under investigation, whereas the CVM takes a more holistic approach by focusing on the value of (inter alia) moving from the status quo to an alternative status of the good or service (Hynes et al., 2011). Hanley et al. (1998) use both contingent valuation and CE methodologies and compare the valuations of conservation benefits of Environmentally Sensitive Areas in Scotland. They conclude that CVM seems best suited in valuing the overall policy package and CE in valuing the individual characteristics that make up this policy. As this study is predicated on the policy of achieving good status across all rivers in the Republic of Ireland, the CVM approach was adopted.

4 Review of Literature

4.1 Attitudes to Water Quality

Outside of Ireland there have been a variety of international studies concerned with examining public attitudes towards water quality (see Dalrymple (2006) for a useful review). For example, in a Scottish survey-based study, 30% of respondents indicated that they were very worried about pollution of rivers, lochs and seas. In addition, 49% of all respondents stated that they were very worried about raw sewage discharged into the sea, while 27% were very concerned about the quality of drinking water (Scottish Executive, 2005). This study also compared how important water quality issues were relative to other environmental concerns such as waste disposal (25% were very worried about this), global warming by greenhouse gases (25%), genetically modified crops (24%), forestry (11%) and using up non-renewable resources (21%). Raw sewage discharged into the sea came top of a list of 23 current environmental concerns. Barr et al. (2005) examined public perceptions of water conservation in a sample of 1,265 households from Devon. Attitudes were found to vary according to demographic characteristics and overall environmental values. DEFRA (2001) carried out a survey of public attitudes to quality of life and the environment, including public perceptions of water quality. Over half of all respondents (54%) were very worried about pollution in rivers, bathing waters and beaches, with water pollution being the environmental issue about which respondents had most concern. Eggert and Olsson (2003) found significant heterogeneity in relation to the general public's attitudes towards water quality, with the water environment providing different values to different groups in society. At a general level, water quality values were found to be substantial and avoiding potential losses an important task for policy makers.

Few exclusively Irish studies exist that analyse public perceptions and attitudes towards water quality. One such study by Kelly et al. (2003) found that attitudes towards water quality differed according to socio-demographic characteristics. Those with high educational obtainment, greater incomes and identified as middle or upper class were more likely to be concerned about the environment and to recognise water pollution. The Irish Heritage Council (2004) undertook a public consultation on views on water quality, examining attitudes towards the public state of Ireland's waters. From 147 written responses to the consultation, the dominant concern for the majority of respondents was in relation to water quality, with respondents perceiving a need for a much greater level of public awareness. The European Commission found that 43% of Irish respondents indicated water pollution as one of the top issues that they have concerns about (European Commission, 2011). Additionally, the European Commission (2012) carried out a survey looking at the European public's understanding of water related issues. In relation to the Republic of Ireland, the results of the survey showed that 40% of those surveyed felt that they were well informed about problems facing groundwater, rivers and lakes. In terms of people's perceptions of water quality, 67% of respondents felt that water quality issues were a serious problem in Ireland and 42% felt that water quality in Ireland had actually deteriorated over the last 10 years.

4.2 WTP Studies

Although not exhaustive, this section provides a summary of previous international and national-level research that has explored public perceptions and WTP for changes in water quality in the context of the WFD at a more national scale.

Lago and Glenk (2008) used a CE across the general population to estimate non-market benefits that may arise from water quality improvements under the WFD in Scotland. Results show that respondents have a WTP of £2.18 per year per household in increased water charges for a 1% increase in the total area of rivers that are of GES by 2015. This compares with the WTP of £1.60 for lochs.

Glenk et al. (2011) used the CE method to estimate both use and non-use values of implementing WFD targets in rivers and lochs in Scotland. Respondents in three areas were surveyed: the Scotland RBD, the Solway–Tweed RBD, and Scotland as a whole. The study found an annual marginal WTP per household of £0.23–1.81 for water quality improvements to rivers in 7 years' time. For lochs, it ranged from £0.52 to £1.20.

Brouwer et al. (2006) looked at the Scheldt IRBD, which contains four sub-basins in three countries (France, Belgium and the Netherlands). Using CVM, they asked respondents in the four sub-basins whether they would be willing to pay (through general taxation) for the implementation of the WFD, i.e. achieving good status by 2015. Over 50% of all respondents were willing to pay in principle and they found a median WTP of €29.4 per annum in additional taxes.

Brouwer (2008) used CVM to ask respondents about their WTP (through increased general taxation) to improve water quality to good status in accordance with the WFD in the Netherlands. Brouwer found a mean WTP of €90 per household per year, with a 95% confidence interval, between €80 and €100. However, households in the Netherlands in 2003 were already paying €470 on average in water charges so this WTP amount represents an extra amount on top of what they are currently paying.

Valuation studies specifically focusing on waterbody improvements in the Republic of Ireland are limited (Goodbody Economic Consultants, 2008; Norton et al., 2012). The focus has been predominantly on valuing water-based leisure activities. Hynes and Hanley (2006) estimated, through travel cost methodology (TCM), the mean WTP of the average kayaker using the Roughty River, Co. Kerry, in order to shed light on the conflict between commercial interests and recreational pursuits on Irish rivers. Curtis (2002) also applied the TCM to estimate the demand and economic value of salmon angling in Co. Donegal. Doherty et al. (2012) estimated the economic values associated with providing walks along rivers in the Irish countryside. They found that these types of walks were amongst the most highly valued by Irish citizens. Finally, in the work by Campbell et al. (2009) on valuing rural environmental landscape improvements in Ireland, one of the landscape attributes used in the CE survey was 'Rivers and Lakes' as they were highly regarded by the public for their contribution towards landscape aesthetic quality.

Stithou et al. (2012) calculated the value of achieving GES using a CE in the Boyne River Catchment based on 252 face-to-face interviews in 2010. The four attributes chosen for the CE were river ecology, recreational opportunities, aesthetic appearance of the water, and the condition of the river banks. The average WTP to move from the baseline (no change in ecological status of the catchment, 19% was of good status or better at the time) to different medium/high impact management scenarios with various levels of improvement across the aforementioned attributes ranges from €23.32 to €75.56 per household per annum.

5 Methodology

This research used a CVM approach to estimate WTP for achieving good status across all rivers in the Republic of Ireland. This chapter outlines CVM design issues and the steps taken in implementing the CVM.

Carson (2000) notes that a quality CVM analysis has to take cognisance of a number of issues. The good and the scenario under which it would be provided should be described clearly and accurately, and the trade-off that the respondent is asked to make should be a plausible one. The respondent should be given enough information to make an informed decision but not be overwhelmed with it. Most good contingent valuation surveys contain the following elements:

- An introductory section that helps set the general context for the decision to be made;
- A detailed description of the good to be offered to the respondent;
- The institutional setting in which the good will be provided;
- The manner in which the good will be paid for;
- A method by which the survey elicits the respondent's preferences with respect to the good;
- Debriefing questions about why respondents answered certain questions the way that they did; and
- A set of questions regarding respondent characteristics, including attitudes and demographic information.

5.1 Selecting the Target Population and Data Collection

Once the policy change is specified (achieving good status across all rivers in the Republic of Ireland in this instance), the next step is to identify the target population. CVM studies result in point estimates of values on a per household or a per capita basis. Some studies elicit WTP values at the level of the individual, while others ask the WTP of the household. It is important when framing the contingent valuation question that it is clear whether the values sought are for the individual or the household as this will form the basis of aggregation of WTP estimates for the relevant population.

When selecting sample respondents, ideally each individual in the sample should have a known probability of selection from a specified population. The population sampled should be the appropriate one for evaluating the benefits and/or costs of the proposed project. The size of the population over which benefits and costs accrue can be one of the major factors in determining the economic value of a good. For a pure public good, its economic value is the sum of the WTP of all agents in the relevant population, since enjoyment of the good by one agent does not diminish any other agent's enjoyment of it, unless crowding occurs (Just et al., 1982). A sample size in the order of several hundred to a couple of thousand observations is generally required to achieve reasonable reliability from a sampling perspective. All members of the relevant population should have a positive and known probability of being included in the sample. Champ (2003) notes that sampling error to sample size decreases as the population increases in size and that whether the population is 10,000 or 100,000,000 a sample size of approximately 380 is generally required (±5% sampling error) for reliability. Mitchell and Carson (1989) state that a minimum sample size in the order of 600 usable responses is appropriate for a CVM study when estimating benefits for policy purposes and seeking to generalise to a population.

A contingent valuation study requires the collection of primary data. No one survey administration mode is unambiguously superior. Both Mitchell and Carson (1989) and the National Oceanic and Atmospheric Administration (NOAA) panel (Arrow et al., 1993) strongly advocate the use of personal interviews, mainly due to advantages in information provision with this method. Provision of information on the good being valued is a fundamental component of a

contingent valuation survey. Personal interviews have the advantage on this front as visual information can be provided, with the interviewer on hand to explain and answer queries. The cost of conducting face-to-face interviews is the principal constraint.

Following a competitive tendering process the market research company Red C was engaged to undertake a survey of the general population in the Republic of Ireland. A questionnaire instrument was designed to examine public preferences regarding water quality objectives and WTP for measures aimed at achieving good status across all rivers in the Republic of Ireland. A total of 650 face-to-face interviews (35 were conducted in the pilot phase and were not included in the final analysis) were conducted over 11 weeks. The target group for the surveys was the general public, i.e. adults aged 18 years or over. Stratified quota sampling was used to ensure a nationally representative sample of the population based on:

- 77 Electoral Division (ED) based sampling points (for sample size 650) were randomly selected around the country;
- Gender, age and social class quotas were calculated based on census of population data; and
- Quotas were broken down on sampling points and interviewers, i.e. each interviewer had to find a specific selection of different people within his/her sampling point.

This sampling methodology ensures that the sample will be nationally representative on gender, age, social class and region. Prior to the launch of the main survey, a pilot phase was undertaken where the questionnaire instrument was tested on 35 respondents to ensure that the questionnaire was understood and the WTP scenario was clear to respondents. Some minor alterations were made to the questionnaire following the pilot phase.

Table 5.1 illustrates the profile of the sample selected versus the population profile as per the last census of population in 2011 (CSO, 2012).

5.2 Design of CVM Scenario

This section outlines the approach taken in designing the CVM scenario, including information provided, method of administration and prices presented. Additionally, environmental values held by respondents were assessed and latent variables were derived to reflect these values (for inclusion in subsequent regression analysis).

5.2.1 Information component

The information component of a CVM study typically describes the change in quantity or quality of the good under investigation. As noted by Boyle (2003), respondents to a contingent valuation survey need to be presented with information that clearly explains the policy change in a context that is specific to them. Various studies have shown that failure to do so can lead to biased welfare estimates (Carmines and Zeller, 1979; Samples et al., 1986). The specific information included typically outlines the change being proposed and the effects of that change on the individual respondents or their household. This is strongly recommended by the NOAA panel (Arrow et al., 1993). There is no accepted one-size-fits-all template for framing accurate and specific scenarios, hence pre-testing a scenario in a focus group or pilot phase is standard practice to aid design. Refinement of the

Table 5.1. Summary statistics of the sample compared with the Irish Census 2011.

Variable	Survey mean	Irish Census mean 2011
Age (years)	44.8	44.8
Secondary education (%)	60	53
Third-level education (%)	36	31
Married (%)	55	51
Male (%)	49	49
Urban (%)	57	62

appropriate information to present and the delivery method occurs in focus groups, one-on-one interviews and/or in a small-scale pilot pre-test phase.

5.2.2 Elicitation format

One of the crucial elements for the validity of CVM studies is the payment vehicle, i.e. how the proposed scenario is going to be paid for. Respondents might reject the valuation exercise even if they value the change if they think the payment vehicle is not credible. As water charges have not as yet come into operation in the Republic of Ireland, the only credible payment vehicle in this instance was an increase in income taxation. The three primary elicitation formats in the CVM literature are open-ended, payment cards and dichotomous choice. An open-ended question asks respondents how much they would pay for good provision. The payment card presents a series of bids and asked the respondents to pick the appropriate one relevant to them. The dichotomous choice asks respondents if they would pay a given price, which is varied across the sample. The dichotomous choice format has various hybrids, including double bounded and multiple bounded, where respondents are asked a second or series of prices after the first one is presented.

While dichotomous choice questions are most commonly used, each of the three main formats has strengths and weaknesses (Boyle, 2003). The payment card method was employed in this study; hence, WTP responses cannot be interpreted as an exact statement of WTP but rather as an indication that the WTP lies somewhere in the interval between the chosen value and the next larger value above it on the payment card. This method was first developed by Mitchell and Carson (1989) and does not require large samples and avoids the anchoring effects of dichotomous choice since respondents select their own WTP amount. The range of payments used in the payment card was guided by previous research and from responses in the pilot phase.

5.2.3 Protest responses

Respondents may object to some element of the scenario presented and consequently indicate a €0 WTP value for the non-market good in question even though they may hold a value greater than this. This is known as a protest response. Debriefing questions post the WTP question are recommended to establish why respondents chose the option they chose; this may help to identify potential protest responses. Hence, in this case, respondents who indicated a €0 WTP were asked a series of debriefing questions to explore this preference.

5.3 CVM Scenario

In the questionnaire, respondents were presented with the following scenario:

> Under the EU WFD, introduced by the European Commission, all rivers in the EU must reach what is described as good status by 2015. If Ireland fails to comply with this standard it is facing reoccurring fines from EU enforcement institutions. At present 31.5% of river channels in the Republic of Ireland are failing to achieve good status. Of this total, 21% of river channels are classified as of moderate status, 10% of poor status and 0.5% of bad status.
>
> Good status in a river means that fish, insects and plants exist in abundance and with wide variety and also that the river is suitable for a variety of recreational activities. The following show card illustrates some of the common problems associated with rivers that are of moderate, poor or bad status. (*Respondents were given the show card and allowed time to digest*.) In order to get all Irish rivers to a point where they can be classified as having good status, it is likely that households will have to pay additional taxes to help finance it. With this in mind, this study is interested in determining what ***you*** might be willing to pay to improve the quality of our rivers and streams.

A show card (Fig. 5.1) was developed to take account of the various attributes associated with good status. This was presented to respondents before the WTP question was administered.

Once respondents had time to examine and consider the show card, they were asked the following question: *Bearing in mind the information presented earlier what is the maximum increase in your annual income tax that you would be willing to pay to get all rivers in Ireland to a point where they are classified as being of*

	High/Good status	Moderate status	Poor status	Bad status
Current % rivers	68	21	10	0.5
Quality	Pristine and unpolluted	Slightly polluted	Moderately polluted	Seriously polluted
Water clarity & composition	Good water clarity No or trace algae No smell	Slightly murky or discoloured water Some algae present No noticeable smell	Moderately murky or discoloured water Excessive algae present Some smell may be noticeable	Murky or discoloured water. Smell noticeable Absence of algae Some smell may be noticeable
Insects	High diversity of insects	Less diversity but more density of certain type	Low diversity	Minimal diversity
Plant life	Diverse range of aquatic plants	Reduced diversity of aquatic plants	Excessive growth of aquatic plants	Aquatic plants are few to absent
Fish	Game (salmon, trout) and coarse (bream, roach) fisheries	Game fish are at risk	Coarse fisheries only	Fish absent
Bank condition	Banks in their natural condition Good cover of native vegetation	Evidence of bank alterations/erosion Majority of bank covered by native vegetation	Clear evidence of bank alteration/erosion Only parts of the banks are covered by native vegetation	Extensive interference/erosion Only small traces of vegetation on the banks

Figure 5.1. Show card presented to respondents.

a good status or in other words being pristine and unpolluted?

Respondents were then presented with the payment card shown in Fig. 5.2 and asked to select one price only.

A series of questions were included in the questionnaire to capture relevant socio-demographic characteristics of the respondents, such as age, education, income and recreational use of rivers. Additionally, a series of statements were constructed to establish respondents' environmental values. In the questionnaire, respondents were presented with these statements and were asked to indicate their level of agreement on a scale of 1 (completely agree) to 7 (completely disagree). The following section outlines how environmental values of survey respondents were derived and included in the regression analysis.

5.4 Environmental Values

Environmental values refer to a psychological tendency in which individuals evaluate the natural

Nothing/€0	€40	€225
€1	€50	€250
€3	€70	€300
€5	€100	€350
€10	€125	More than €350
€15	€150	
€20	€175	
€30	€200	

Figure 5.2. Payment card presented to respondents.

environment with some degree of favour or disfavour (Hawcroft and Milfont, 2010). The most widely used measure of environmental values has been the New Environmental Paradigm (NEP) scale initially developed by Dunlap and van Liere (1978), which was designed to measure general beliefs about the relationship of human beings to the environment. Originally the existence of environmental values as measured by the NEP scale was supposed to be a one-dimensional phenomenon ranging from unconcerned about the environment at the low end to concerned at the high end (Dunlap and Van Liere, 1978; Dunlap et al., 2000). Since the derivation of the NEP scale much research has, however, found a multidimensional structure of environmental values and used different dimensions to better understand individuals' environmental attitudes and behaviour (Thompson and Barton, 1994; Bogner and Wilhelm 1996; Kaltenborn and Bjerke, 2002; Kaltenborn et al., 2008; Larson, 2010; Howley, 2011). In this study, variables were derived – one reflective of an ecocentric attitude whereby individuals see the intrinsic value of nature and another reflective of a more apathetic environmental attitude whereby individuals don't like to see environmental protection getting in the way of economic growth and development.

In order to derive these environmental values, respondents in the questionnaire were presented with a list of statements and were asked to indicate their level of agreement on a scale of 1 (completely agree) to 7 (completely disagree) (see Table 5.2 for the list of statements). Principal component analysis (PCA) was employed to extract underlying latent constructs. Factor analysis involves data reduction and operates by examining the pattern of correlations (or covariances) among a number of variables. PCA transforms a set of correlated variables into a smaller number of uncorrelated factors or variables (Kline and Wichelns, 1998). Factor loading coefficients were used to derive standardised-values-based factors for the sample population. Each factor having a mean of zero and a standard deviation of one, a respondent's factor value score is relative to the sample mean. Factor scores are advantageous as they can be employed in regression analysis in place of the original attitudinal statements, with the knowledge that the meaningful variation in the original data has not been lost but that the derived variables are uncorrelated thus preventing any potential multicollinearity problems. Following a PCA in this instance, a total of two value constructs emerged.

The first component had high factor loadings on statements that placed human needs ahead of the environment, such as "*We worry too much about the future of the environment and not enough about prices and jobs today*" and "*People worry too much about economic progress harming the environment*" and was hence labelled as environmental apathy. The second attitude component had high factor loading on statements that favoured environmental protection, such as "*It is wrong to destroy natural environments*" and "*Polluting the environment is not fair on future generations*", and as such was labelled ecocentric.

The explained proportion of the total variation of the original variables was 65%. A Kaiser–Meyer–Olkin measure of factor suitability was 0.83, indicating the use of factor analysis on this data set to be appropriate. A reliability test using Cronbach's alpha was applied to test the internal consistency and reliability of the derived factor variables. Values above 0.5 are considered acceptable as evidence of a relationship (Nunnally, 1967), whereas values above 0.7 are more definitive (Peterson, 1994). There is a high degree of consistency in responses to questions relating to the environmental apathy and ecocentric value constructs, with Cronbach's alpha of 0.82 and 0.78, respectively. The factor loadings in Table 5.2 represent correlations between all respondents' answers to each attitudinal statement with the derived component scores.

5.5 Distance from a Watercourse

To explore the effect of distance from a river on WTP for good status, a geographic information systems (GIS) analysis was undertaken. As outlined in Section 5.1, there were 77 sampling points across the full survey. These sampling points were at the ED level. These EDs were identified spatially using GIS analysis and distance from the centre of the ED to the nearest river/tributary was identified (some EDs had several rivers located therein and in this instance the largest river or river with the longest flow through the ED was taken as the nearest river). This distance was used as a measure of distance to the nearest river.

Table 5.2. Attitude factors and component statements.

	Environmental apathy	Ecocentric
We worry too much about the future of the environment and not enough about prices and jobs today	0.774	–0.091
People worry too much about economic progress harming the environment	0.750	–0.148
I believe society places too much emphasis on environmental issues	0.740	–0.259
I find it hard to get too concerned about environmental issues	0.675	–0.211
Humans have the right to modify the natural environment to suit their needs	0.672	–0.153
It is wrong to prevent people from developing their own land just because it can cause damage to the environment	0.620	0.061
The most important thing about public lands is to provide jobs and income for local people	0.605	0.316
It is wrong to destroy natural environments	–0.078	0.817
I care about the environment	–0.155	0.798
Polluting the environment is not fair on future generations	–0.127	0.772
Natural resources must be preserved even if people must do without some products	–0.007	0.678

6 Results

6.1 Public Ranking of Water Quality Related Issues

Respondents were asked to consider some potential environmental problems that 'exist in Ireland today' and to indicate on a scale of 1 to 5 (1 = very unimportant, 5 = very important) how important these issues are to them personally. Table 6.1 outlines the relative ranking of the nine environment related issues examined. The two highest ranked issues related to water quality, namely poor drinking water quality and pollution of rivers and lakes. Poor drinking water quality received the highest importance score of all the environment related issues presented, with an average score of 4.44. Pollution of rivers and lakes was the next highest ranked issue with an average score of 4.32. Damage from floods was jointly ranked third with damage to the countryside and air pollution, with an average score of 4.24. Water pollution at beaches received a slightly lower score of 4.20 and was ranked seventh in the environment related issues and was lowest ranked of the water related issues as outlined in Table 6.1.

6.2 Recreational Use of Rivers

Rivers provide a range of ecosystem services. Humans can derive benefit from their consumptive and non-consumptive use. These range from the provision of drinking water to various forms of direct recreational use, such as water sports or fishing, to indirect use, such as walking or jogging along a river bank. This can influence the value individuals place on good water quality across rivers. The Republic of Ireland has an extensive network of rivers and results here reflect this as the majority of the sample respondents are within close proximity to a river system. Table 6.2 indicates that nearly 80% of the sample respondents are within

Table 6.1. Importance scores for potential environmental issues in Republic of Ireland.

Poor drinking water quality	4.44
Pollution of rivers and lakes	4.32
Damage from floods	4.24
Damage to countryside	4.24
Air Pollution	4.24
Destruction of wildlife	4.21
Water pollution at beaches	4.20
Climate change	4.12
Growth of genetically modified crops	3.71

Table 6.2. Travel time to nearest river by respondent.

Distance time to nearest river	No. of respondents	% of sample
1- to 15-min drive	488	79.5
16- to 30-min drive	83	13.5
>30-min drive	37	6.0
Don't know	6	1.0
Total	**614**	**100.0**

a 15-min drive to the nearest river, while a further 13.5% are within 30 min.

Respondents were asked to indicate their level of use of rivers for recreational purposes. Results indicate that 41% of the total sample indicated using a river for recreational purposes in the previous year (Table 6.3).

Table 6.3. Visits to river in the last 12 months for recreational purposes.

	Number	% of sample
Yes	251	41
No	363	59
Total	**614**	**100**

Respondents were asked to indicate what recreational activities they engaged in on these visits. It should be noted that some individuals undertook more than one activity on the same trip. A total of 69 individuals or 27% of those visiting rivers for recreation undertook one to five trips per annum, while 22% of this cohort undertook six to 10. Seven per cent of the river visiting cohort undertook between 51 and 100 trips per annum, while 3%, 1% and 2% of river visiting respondents undertook between 101 and 200, 201 and 300 and 301 and 400 trips, respectively, as outlined in Table 6.4.

Table 6.5 reports trips by recreational activity undertaken. Walking was by far the most popular activity, with 218 individuals or 36% of the total sample undertaking this activity along rivers. Between 19 and 25 individuals across the sample (3–4% of the total sample) engaged in either nature or bird watching, swimming, fishing or water sports relating to boats, while four respondents visited rivers for wind, kite or board surfing.

Table 6.6 reports the average distance travelled to rivers by respondents to engage in the various recreational activities. Results indicate that average distances travelled varied by activity as would be expected a priori as rivers generally tend to lend themselves to walking more readily than other recreational activities, such as fishing and boating, which may depend on specific attributes of the river. Average distance travelled to rivers for walking was 13.9 km, followed by nature or bird watching at 17.1 km. Average distance travelled for fishing was 30.6 km, 51.8–54.7 km for boating and swimming related activities, and 76 km for wind, kite or board surfing as illustrated by Table 6.6.

As outlined in Table 6.7, respondents did not generally travel on recreational trips to rivers alone (only 4% of the cohort). The most common number of people travelling with the respondent was two adults (this was

Table 6.4. Number of visits to rivers in the last 12 months for recreation.

Visits by respondents	Number of respondents making visits	% of total sample[1]	% of those making trips
0	363	59	
1–5	69	11	27
6–10	54	9	22
11–20	51	8	20
21–30	21	3	8
31–50	26	4	10
51–100	17	3	7
101–200	7	1	3
201–300	2	0	1
301–400	4	1	2
Total	**614**	**100**	**100**

[1]**Due to rounding, values may not sum to 100%.**

Table 6.5. Number of river visits in the last 12 months by recreational purpose.

Trips	Walking, jogging, running	Nature or bird watching	Swimming	Fishing	Rowing, boating, canoeing or cruising	Wind, kite or board surfing
1–5	64	10	12	7	7	0
6–10	43	4	4	6	6	3
11–20	47	2	6	4	4	0
21–30	17	2	1	1	0	1
31–50	18	2	0	0	0	0
51–100	14	2	0	2	2	0
101–200	10	2	0	0	0	0
201–300	1	0	0	0	0	0
301–400	4	1	0	0	0	0
Total	**218**	**25**	**23**	**20**	**19**	**4**

Table 6.6. Average distance (kilometres) travelled to river by recreational activity.

	Walking, jogging or running	Nature or bird watching	Fishing	Rowing, boating, canoeing or cruising	Swimming	Wind, kite or board surfing
Average distances (km)	13.9	17.1	30.6	51.8	54.7	76

Table 6.7. Number of people accompanying respondents on trip to rivers for recreational pursuits.

People accompanying respondent on trip	No of Adults (over 16 years)	%[1]	Children (under 16 years)	%
0	10	4	140	55.8
1	85	33.9	41	16.3
2	117	46.6	46	18.3
3	14	5.6	12	4.8
4	18	7.2	8	3.2
5	2	0.8	1	0.4
6	3	1.2	1	0.4
8	1	0.4	0	0
10	1	0.4	0	0
14	0	0	1	0.4
20	0	0	1	0.4
Total	**251**	**100**	**251**	**100**

[1]**Due to rounding, values may not sum to 100%.**

the case in 46.6% of times for those travelling to rivers), while 33.9% travelled with one other adult. Of respondents accompanied by children, 16.3% travelled with one child, while 18.3% went with two children.

6.3 WTP for Good Status

Table 6.8 presents results indicating respondents' WTP for achieving good status across all rivers in the Republic of Ireland. Results indicate that a large percentage (61.4%) of the sample indicated that it was not willing to pay anything for the scenario presented. After this, the most frequent prices chosen by respondents were €10, €20 and €50, representing 6.5%, 6.4% and 6.2% of the sample, respectively. As would be expected, a priori as the price increased the percentage of the sample willing to pay declined.

Individuals who indicated a €0 WTP were asked debriefing questions and Table 6.9 presents the results. Respondents who indicated an objection to paying taxes, believed that the Government/Council should pay, and/or didn't believe the improvements would actually take place were deemed to be giving protest responses and were excluded from the analysis (Statements 2, 4 and 5).

Table 6.10 outlines the WTP of the sample after excluding protest responses. Just over 50% of the

Table 6.8. Willingness to pay for achieving good status across rivers in Republic of Ireland.

	No. of respondents	% of sample[1]
Nothing/€0	377	61.4
€1	8	1.3
€3	5	0.8
€5	31	5.0
€10	40	6.5
€15	2	0.3
€20	39	6.4
€30	25	4.1
€40	10	1.6
€50	38	6.2
€70	6	1.0
€100	22	3.6
€125	1	0.2
€150	1	0.2
€200	5	0.8
€250	2	0.3
€300	1	0.2
€350	1	0.2
>€350	0	0
Total	**614**	**100.0**

[1]Due to rounding, values may not sum to 100%.

Table 6.9. Reasons given for non-willingness to pay (WTP).

	No. of respondents	% of non-WTP respondents[1]
1. I cannot afford to pay	166	44%
2. I object to paying taxes	17	5%
3. The improvements are not important to me	1	0%
4. The Government/Council other body should pay	79	21%
5. I don't believe the improvements will actually take place	19	5%
6. I don't use the waterbodies	4	1%
7. I pay enough tax already	70	19%
8. Other	21	6%
Total	**377**	**100%**

[1]Due to rounding, values may not sum to 100%.

Table 6.10. Willingness to pay (WTP) distribution excluding protest responses.

	WTP profile (€)
Mean WTP (based on bid selected from payment card)	19.00
Standard deviation	40.06
Range (max.–min.)	0–350
50th percentile	0
Median	0
75th percentile	20
90th percentile	50
95th percentile	100
99th percentile	200
Total sample	**499**

sample stated a €0 WTP for the proposed scenario and the mean WTP across the sample was €19 per person.

6.4 Modelling WTP Responses

6.4.1 Modelling framework

A generalised tobit model was used to model respondents WTP using maximum likelihood estimation procedures (Daniels and Rospabé, 2005; Hynes and Hanley, 2009; Buckley et al., 2012). This generalised tobit interval model employs a log-likelihood function adjusted to allow for point, left-censored, right-censored (top WTP category with only a lower bound) and interval data. For respondents $j \in C$, WTP_j can be observed – these are point data where respondents are willing to pay €0. For individuals who selected the top WTP bid, respondents are right censored $j \in R$, hence it is only known that the unobserved WTP_j is greater than or equal to WTP_{Rj} – the largest value offered in the show card (>€350).

$$\ln L = -\frac{1}{2}\sum_{j\in C}\left\{\left(\frac{WTP_j - x\beta}{\sigma}\right) + \log 2\pi\sigma^2\right\} + \sum_{j\in L}\log\phi\left\{\left(\frac{WTP_{Lj} - x\beta}{\sigma}\right)\right\}$$

$$+ \sum_{j\in R}\log\left\{1-\Phi\left(\frac{WTP_{Rj} - x\beta}{\sigma}\right)\right\} + \sum_{j\in I}\log\left\{\phi\left(\frac{WTP_{2j} - x\beta}{\sigma}\right) - \phi\left(\frac{WTP_{1j} - x\beta}{\sigma}\right)\right\}$$

Finally, there are intervals where respondents selected a bid above €0 and below €350. Hence, it is known that the unobserved WTP_j falls in the interval $[WTP_{1j}, WTP_{2j}]$. The log likelihood is hence given by:

where $\Phi()$ is the standard normal cumulative distribution function and $\phi()$ is the probability distribution function. The WTP bid selected is hence specified as: $WTP_j = \mu_j + \varepsilon_j$, where μ_j is the deterministic component and ε_j is the error term. It is assumed that $\varepsilon \sim N(0, \sigma^2 I)$.

6.4.2 Explanatory variables

The following explanatory variables were included in the model:

- *Income* – The questionnaire collected income of the respondent under 11 different categories as outlined in Table 6.11. Common to surveys such as this, a large number of respondents did not answer the income question (35%). As income is a theoretically important variable in this type of analysis it was decided not to delete these observations. Different methodologies have been proposed for dealing with such missing variables, including substitution of the mean/mode of the observed income responses, dummy variable control or conditional mean substitution. This income non-response was tested across education, age, gender and social class and no statistical pattern was found as to the nature of this non-response. Hence, it was decided to use the mean of the observed data in cases where respondents refused to provide data on income.

- *Income perception* – The variable is a measure of respondents' own perception of the financial status of their household. Some respondents, even with high incomes, may be under significant financial pressure given the economic recession in the Republic of Ireland since 2008. This variable is based on responses to the question "*How would you rate the financial situation of your household*". In this analysis, respondents who reported their financial status to be either very good, good or neither good nor bad were compared with respondents who reported their financial status as either bad or very bad.

- *Trips to river* – This variable reflects the use of the river for recreational activities and represents the number of trips taken in the previous 12 months.

- *Distance travelled to access river* – This variable reflects the average distance the respondent travelled to access a river for recreational purposes.

- *Age* – This variable reflects the actual stated age of the respondent.

- *Gender* – This variable represents the gender of the respondent and takes a value of 0 if the respondent is male and 1 if female.

- *Environmental apathy* – This variable reflects the environmental apathy value construct derived as outlined in Table 5.2.

- *Ecocentric value* – This variable reflects the ecocentric value construct derived as outlined in Table 5.2.

- *College education* – This variable takes a value of 1 if the respondent has a college education and a value of 0 otherwise. It would be expected a priori that those of higher education would be more willing to pay.

- *River Basin District* – This variable is included to reflect the general river water quality in the RBD in which the respondent is located. As outlined in Table 2.1, the percentages of rivers of good or high status in the South Western RBD (92%) and the Western RBD (83%) were significantly higher than those in the other RBDs. Hence, these two RBDs were set as the base category and the remaining four RBDs (46–66%) were included (no observations were recorded from the Neagh–Bann IRBD as the vast majority is in Northern Ireland) as dummy variables. These variables were included in the regression analysis to examine if there was any spatial heterogeneity in

Table 6.11. Explanatory variables that were included in the willingness to pay model.

Variable	Variable description	Mean	Min.	Max.
Income (per annum)	1 = €4,000–9,999 2 = €10,000–19,999 3 = €20,000–29,999 4 = €30,000–39,999 5 = €40,000–49,999 6 = €50,000–59,999 7 = €60,000–69,999 8 = €70,000–79,999 9 = €80,000–89,999 10 = €90,000–99,999 11 = €100,000+	3.2	1	11
Income perception	0 = Financial situation of household is very bad or fairly bad 1 = Financial situation of household is neither bad/good, fairly good or very good.	0.81	0	1
Trips to river	Average number of recreational trips to river	12.9	0	365
Distance travelled to access river	Average number of kilometres travelled to access river	1.2	0	74
Age	Age of respondent	44	18	88
Gender	0 = Male 1 = Female	1.5	1	2
Environmental apathy value	Derived factor score (Table 5.2)	1	–2.5	2.2
Ecocentric value	Derived factor score (Table 5.2)	1	–5.1	2.2
College education	1 = College degree 0 = No college degree	0.38	0	1
North Western River Basin District	1 = Respondent living in North Western RBD 0 = Respondent not living in North Western RBD	0.07	0	1
Shannon River Basin District	1 = Respondent living in Shannon RBD 0 = Respondent not living in Shannon RBD	0.16	0	1
South Eastern River Basin District	1 = Respondent living in South Eastern RBD 0 = Respondent not living in South Eastern RBD	0.12	0	1
Eastern River Basin District	1 = Respondent living in Eastern RBD 0 = Respondent not living in Eastern RBD	0.40	0	1

WTP for water quality objectives. Specifically, if respondents living in RBDs with a relatively low proportion of rivers meeting water quality criteria were willing to pay more for measures aimed at improving river water quality.

6.4.3 Model results (Table 6.12)

Respondents in higher income categories were willing to pay more for achieving GES across rivers in the Republic of Ireland. This variable was significant at the 5% level. This would be expected a priori and is in line with economic theory. In addition to income having a significant effect on WTP, it was found that subjective evaluations of a household's economic situation are also highly significant (10% level). The importance of perceptions of financial status may arise if perceptions are a more accurate measure of purchasing power (accounting for differences in cost of living across regions and debt levels). Subjective evaluations of financial status can in turn be shaped by individual

Table 6.12. Results of the willingness to pay model.

Variable	Co-efficient (z-value)
Income	2.51
	(2.44)**
Income perception	7.61
	(1.81)*
Trips to river	0.121
	(2.88)***
Distance travelled to access river	0.932
	(3.19)***
Age	0.07
	(0.48)
Gender	–2.84
	(–0.90)
Environmental apathy value	–8.68
	(–5.06)***
Ecocentric value	4.45
	(2.79)***
College education	10.08
	(2.84)***
North Western RBD	18.18
	(2.70)***
Shannon RBD	8.74
	(1.65)*
South Eastern RBD	11.16
	(1.92)*
Eastern RBD	7.87
	(1.92)*
Constant	–8.19
	(–0.98)
Observations	478
Chi-squared	107.35
Log-likelihood	–2082.68

*Significant at 10%; **significant at 5%; ***significant at 1%.

circumstances and past experiences. In other words, income levels can be relatively low but individuals can perceive themselves as being relatively well off and vice versa.

Another socio-demographic variable found to have a positive effect (1% level) on WTP was education, with those who have at least a college degree being willing to pay more than those with less than third-level education. It could be hypothesised that as individuals become more educated then their awareness of environmental issues increases, translating into a stronger preference regarding the importance of water quality. Age and gender were not found to have a significant effect on WTP.

Trips taken to the river for recreational purposes were found to have a positive and significant effect on WTP (1% level). Again this would be in line with economic theory and reflects stronger use values in that those who use rivers more for recreational purposes are willing to pay more for measures aimed at improving water quality. Average distance travelled to access the rivers for recreational purposes was also found to have a positive and significant affect (1% level) on WTP. It could be hypothesised that respondents who travel greater distances for recreational access have higher use values and hence place a higher value on achieving GES.

Environmental values were also found to have a significant effect on WTP. As expected respondents with more of what was termed an ecocentric value orientation had a higher WTP. Conversely, environmental apathy values held by respondents had a significant (1%) negative affect on WTP.

Finally, respondents located in the South Western and Western RBDs currently experience higher levels of good status in rivers than respondents in the other four Republic of Ireland RBDs. The authors hypothesised that respondents in these other RBDs would be willing to pay more for improvements in river water quality as they have more to gain in relative terms given that a greater proportion of their river channel is currently not achieving good status. Results suggest this to be the case, as respondents in these four RBDs indicated a higher WTP than those in the base categories (Western and South Western RBDs) at various significance levels: North Western RBD (1% level); South Eastern, Eastern and Shannon RBDs (10% level).

A Wald test was performed to test whether the parameters of the model were all equal to zero. The Wald χ^2 statistic shows that, taken jointly, the coefficients for this model specification are significantly different from zero at the 1% level. The mean WTP, as estimated by the model, was €19, and this is the same as that calculated based on the actual bid selected from the payment card (excluding protest responses) as outlined in Table 6.10. According to the last census of population in 2011 (CSO, 2012), the total population of the Republic of Ireland aged 18 and over was 3,439,565. Applying this population number to the average WTP value of €19 returns a total WTP for the population for achieving good status across Irish rivers of €65.35 million per annum.

6.5 Preferences for Achieving Good Status

All respondents (n = 614) were asked which option they thought was most important: improving the 0.5% of rivers that are severely polluted, the 10% of rivers that are moderately polluted or the 21% of rivers that are slightly polluted. Nearly 41% of the entire sample indicated that they believed that the priority should be improving the 0.5% of rivers that were severely polluted. Similar proportions of the sample, 28 and 29%, indicated that the priority should be improving moderately and slightly polluted waters, respectively, while 2.3% of the sample had no opinion or refused to answer as shown in Table 6.13.

6.6 Distance to Watercourse

Distance to the nearest river was found to have no statistically significant effect on WTP for good status. It is hypothesised that this is because the study focuses on all river bodies and the Republic of Ireland has a vast network of rivers. This is illustrated by results that indicate that the majority of respondents (80%) are within a 15-min drive of a river.

Table 6.13. Priority category for good ecological status improvements

Issue of most importance	Number of respondents	% of sample
Improving the 0.5% of rivers that are severely polluted	250	40.7
Improving the 10% of rivers that are moderately polluted	172	28.0
Improving the 21% of rivers that are slightly polluted	178	29.0
No opinion/Refused	14	2.3
Total	**614**	**100.0**

7 Conclusions

One of the main objectives of this research was to examine public attitudes towards water quality related issues and the importance that the general public places on these compared with other potential environmental issues. Of the nine issues presented to respondents, poor drinking water quality and pollution of rivers and lakes were top ranked across the sample. This is in line with the other research in this area as, in an EU citizen survey, 43% of Irish respondents indicated water pollution as being one of the top environmental issues that they have concerns about (European Commission, 2011). This is a clear indication of the importance placed by the general public on these issues and could be informative for policy makers in terms of resource allocation for tackling environmental problems.

Very few studies have looked at the value that the general public places on achieving good status across waterbodies in the Republic of Ireland. In this context, one of the objectives of this study was to investigate the general public's WTP for achieving good status across all rivers in the Republic of Ireland. Using non-market CVM, results indicate that 61.4% of the sample was not willing to pay any additional income tax to achieve good status across rivers in the Republic of Ireland. However, this declined to just over 50% when protest responses were eliminated. Mean WTP for achieving full good status across rivers in the Republic of Ireland was estimated at €19 per respondent per annum. This finding is generally in line with the results of some international studies that examined WTP for achieving WFD objectives at a more national scale (Brouwer et al., 2006; Lago and Glenk, 2008). While not directly comparable based on scale (national versus Boyne River Catchment), unit of evaluation (individual versus household) or valuation methodology (CVM versus CEs), results from this research are at the lower end of WTP estimates found in Stithou et al. (2012) for the Boyne River. Additional research is required to explore WTP values across different scales in the Republic of Ireland.

An additional objective was to examine factors that influenced WTP values. Results from this study show that both income and subjective perceptions relating to financial status are positively and significantly associated with WTP. Higher levels of income have consistently been found to influence WTP values in environmental valuation. Subjective perception relating to financial status was explored in this study as, since 2008, the Republic of Ireland has experienced a significant economic contraction. According to statistics from the CSO's Survey on Income and Living Conditions (SILC), incomes peaked in 2008 and have since declined by 9%, on average, reflecting decreases in earnings, reduced welfare payments and increases in income taxation levels (NERI, 2012). Associated with this reduction in income has been a significant increase in the levels of personal debt. Ireland currently has one of the highest levels of personal debt in the eurozone area (National Competitiveness Council, 2012). In this context, it is perhaps not surprising that subjective perception relating to financial status, as well as actual income levels, is influential in explaining variability in WTP.

Recreational use values were also found to have an effect in that average number of trips taken to rivers for recreational purposes and average distance travelled for access were both positively and significantly associated with WTP. Findings indicate that 41% of the sample used rivers for recreational pursuits in the previous 12 months. This suggests that rivers are a significant recreational resource for the general public across the Republic of Ireland. Indeed, while nearly 80% of the sample is within a 15-min drive of a river, some respondents were travelling over 76 km to engage in recreational pursuits on Irish rivers. Results hence suggest that recreational use values strongly influence WTP for achieving higher levels of good status.

Findings from this study suggest that underlying environmental values are strongly related to WTP. There is now an established link between environmental value orientations and individuals'

preferences towards a variety of environmental issues (Thompson and Barton, 1994; Kaltenborn et al., 2008; Howley, 2011). This study found a positive association between an ecocentric value orientation and WTP for improvements in good status. Conversely, a value orientation more reflective of environmental apathy was found to have a negative effect on WTP. The analysis suggests that underlying environmental values are as important a predictor of WTP as socio-demographic information. Previous work has established that there can be significant variability in environmental values across nations (Kellert, 1993; Aoyagi-Usui et al., 2003) and understanding more about how individuals in different areas relate to the environment could be beneficial in formulating natural resource use decisions that are in keeping with individuals' needs and desires.

At a national level, 69% of river channel is of good or high status. However, there is significant variation across RBDs in the percentage of river channel that is of good status. The percentage of river channel achieving good status is much lower across the Eastern, South Eastern, Shannon and North Western RBDs (46–66%) compared with the South Western (92%) and Western (83%) RBDs. The results indicate WTP values to be significantly higher among respondents living in RBDs where rivers were generally of lower status. This suggests that spatial heterogeneity influences WTP values. This heterogeneity could be explored further with additional research that examines WTP at different spatial levels, such as RBD, hydrometric area or water management unit, and could be beneficial to policy makers in resource allocation decisions.

Overall, results from this study can assist policy makers to improve their decision making in resource allocation for water management. This research was conducted at a national scale but the results could potentially provide policy makers with useful information to assist in resource allocation decisions at a more localised sub-national level. However, additional research at sub-national level across different regions would complement this study and would be more robust for the relevant sub-national level.

8 Recommendations for Future Research

It is interesting to note that 41% of all respondents, when asked, indicated that they believed that the priority focus should be on addressing the 0.5% of river channel that is severely polluted. This is equivalent to bad status. Future research in this area would be useful to see how priorities and preferences manifest themselves when the costs of addressing bad, poor and moderate status are introduced.

Additionally this research focused on achieving good status across rivers. However, the WFD sets down that Member States shall prevent the deterioration of the status of all surface waterbodies. Hence, high status where it exists must be maintained. The number of such high status waters has declined significantly in recent decades (EPA, 2012). Additionally, research would be useful to inform policy makers of preferences and WTP (if any) of the general public for maintaining and/or restoring high status sites.

The results indicate WTP values to be significantly higher among respondents living in RBDs where rivers were generally of lower status. This suggests that spatial heterogeneity influences WTP values. This heterogeneity and potential scale effects could be explored further with additional research that examines WTP at different spatial levels, such as RBD, hydrometric area or water management unit, and could be beneficial to policy makers in resource allocation decisions at a local level.

The WFD mandates Member States to achieve good status across all surface waters by 2015. Derogations from this target have to be proven based on infeasibility or disproportionate cost. Hence, quantification of benefits is an important element in the assessment of the proportionality of costs in the implementation of the WFD. Assessing whether the achievement of good status is disproportionately expensive requires a comparison of the costs of putting measures in place to achieve good status versus the benefits that might come about as a result of the waterbody achieving good status. This research focused on achieving good status across rivers. Additional research is required to explore WTP values for achieving good status across other surface and groundwater bodies.

References

Aoyagi-Usui, M., Vinken, H. and Kuribayashi. A., 2003. Pro-environmental attitudes and behaviors: an international comparison. *Research in Human Ecology* **10:** 23–31.

Arrow, K., Solow, R., Portney, P.R. Leamer, E.E., Radner, R. and Schuman, H., 1993. *Report of the NOAA Panel on Contingent Valuation*. In Federal Register 58.

Barr, S., Gilg, A. and Ford, N., 2005. Defining the multi-dimensional aspects of household waste management: A study of reported behaviour in Devon. *Resources, Conservation and Recycling* **45:** 172–192.

Bateman, I.J., Brouwer, R., Davies, H., Day, B.H., Deflandre, A., Di Falco, S., Georgiou, S., Hadley, D., Hutchins, M., Jones, A.P. Kay, D., Leeks, G., Lewis, M., Lovett, A.A., Neal, C., Posen, P., Rigby, D. and Turner, R.K., 2006a. Analysing the agricultural costs and non-market benefits of implementing the Water Framework Directive. *Journal of Agricultural Economics* **57:** 221–237.

Bateman, I.J., Day, B.H., Georgiou, S. and Lake, I., 2006b. The aggregation of environmental benefit values: welfare measures, distance decay and total WTP. *Ecological Economics* **60:** 450–460.

Bogner, F.X. and Wilhelm, M.G., 1996. Environmental perspectives of pupils: the development of an attitude and behaviour scale. *The Environmentalist* **16:** 95–110.

Boyle, K., 2003. Contingent valuation in practice. *In*: Champ, P., Boyle, K. and Brown, T. (Eds) *A Primer on Nonmarket Valuation*. Kluwer Academic Publishers.

Brouwer, R., 2008. The potential role of stated preference methods in the Water Framework Directive to assess disproportionate costs. *Journal of Environmental Planning and Management* **51:** 597–614.

Brouwer, R., Beckers, A., Courtecuisse, A., van den Driessche, L. and Dutrieux, S., 2006. *Economic Valuation of the Non-Market Benefits of the European Water Framework Directive: An International River Basin Application of the Contingent Valuation Method*. (Ed.) Natuur en Energie van de Vlaamse overheid Departement Leefmilieu, Belgium.

Buckley, C., Hynes, S. and Mechan, S., 2012. Supply of an ecosystem service – farmers' willingness to adopt riparian buffer zones in agricultural catchments. *Environmental Science and Policy* **24:** 101–109.

Campbell, D., Hutchinson, W.G. and Scarpa, R., 2009. Using choice experiments to explore the spatial distribution of willingness to pay for rural landscape improvements. *Environment and Planning A* **41:** 97–111.

Carmines, E.G. and Zeller, R.A., 1979. *Reliability and Validity Assessment*. Sage, Beverly Hills, CA, USA.

Carson, R., 2000. Contingent valuation: a user's guide. *Environmental Science and Technology* **34:** 1413–1418.

Champ, P.A., 2003. Collecting Survey Data for Nonmarket Valuation. *In*: Champ, P., Boyle, K. and Brown, T. (Eds) *A Primer on Nonmarket Valuation*. Kluwer Academic Publishers.

Clabby, K.J., Bradley, C., Craig, M., Daly, D., Lucey, J., McGarrigle, M., O'Boyle, S., Tierney, D. and Bowman, J., 2008. *Water Quality in Ireland 2004–2006*. Environmental Protection Agency, Johnstown Castle Estate, Wexford, Ireland.

CSO (Central Statistics Office), 2012. *Census of Population 2011*. Central Statistics Office, Cork, Ireland.

Curtis, J., 2002. Estimating the demand for salmon angling in Ireland. *Economic and Social Review* **33:** 319–332.

Dalrymple, G., 2006. *Valuing the Water Environment: A Review of International Literature*. Environment and Rural Affairs Department, Scottish Executive, Scotland.

Daniels, R. and Rospabé, S., 2005. *Estimating an Earnings Function from Coarsened Data by an Interval Censored Regression Procedure*. Development Policy Research Unit Working Paper 05/91.

DEFRA (Department of Environmental, Food and Rural Affairs), 2001. *Survey of Public Attitudes to Quality of Life and to the Environment: 2001*. Available at: http://archive.defra.gov.uk/evidence/statistics/environment/pubatt/download/survey2001.pdf.

Doherty, E., Campbell, D. and Hynes, S., 2012. Models of site-choice for walks in rural Ireland: exploring cost heterogeneity. *Journal of Agricultural Economics* **64:** 446–466.

Dunlap, R.E. and Van Liere, K.D., 1978. The 'new environmental paradigm': a proposed measuring instrument and preliminary results. *Journal of Environmental Education* **9:** 10–19.

Dunlap, R.E., Van Liere, K.D., Mertig, A.G. and Jones, R.E., 2000. Measuring endorsement of the new ecological paradigm: a revised NEP scale. *Journal of Social Issues* **56:** 425–442.

Eggert, H. and Olsson, B., 2003. *Valuation of Water Quality in the Coastal Zone: A Stated Choice Application to the Swedish West Coast*. EAFE 2003 Proceedings of the Fifteenth Annual Conference of European Association of Fisheries, Ifremer, Brest, France.

EPA (Environmental Protection Agency), 2008. *2008 – State of the Environment Report*. Environmental Protection Agency, Johnstown Castle Estate, Wexford, Ireland. Available at: https://www.epa.ie/pubs/reports/indicators/irlenv/.

EPA (Environmental Protection Agency), 2012. *Ireland's Environment*. Available at: http://www.epa.ie/pubs/reports/indicators/00061_EPA_SoE_2012.pdf.

Europa, 2012. *Water Protection and Management (Water Framework Directive)*. Available at: http://europa.eu/legislation_summaries/agriculture/environment/l28002b_en.htm.

European Commission, 2011. *Attitudes of European Citizens to the Environment*. Available at: http://ec.europa.eu/environment/pdf/ebs_365_en.pdf.

European Commission, 2012. *Introduction to the New EU Water Framework Directive*. Available at: http://ec.europa.eu/environment/water/water-framework/info/intro_en.htm.

European Parliament and Council, 2000. Water Framework Directive 2000/60/EC establishing a framework for community action in the field of water policy. *Official Journal of the European Communities* **L331:** 1–73.

Glenk, K., Manuel, L. and Moran, D., 2011. Public preferences for water quality improvements: implications for the implementation of the EC Water Framework Directive in Scotland. *Water Policy* **13:** 645–662.

Goodbody Economic Consultants, 2008. *Review of Water Resource Benefit Values*. Available at: http://www.wfdireland.ie/docs/35_Economics/Review%20of%20Water%20Resource%20Benefit%20Values%20-%20Draft%20Reportv5.pdf.

Hanley, N., MacMillan, D., Wright, R.E., Bullock, C., Simpson, I., Parsisson, D. and Crabtree, B., 1998. Contingent valuation versus choice experiments: Estimating the benefits of environmentally sensitive areas in Scotland. *Journal of Agricultural Economics* **49:** 1–15.

Hanley, N.R., Wright, R. and 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.

Hanley, N. and Barbier, E., 2009. *Pricing Nature: Cost–Benefit Analysis and Environmental Policy*. Edward Elgar Publishing, UK.

Hawcroft, L.J. and Milfont, T.L., 2010. The use (and abuse) of the new environmental paradigm scale over the last 30 years: A meta-analysis. *Journal of Environmental Psychology* **30:** 143–158.

Howley, P., 2011. Landscape aesthetics: Assessing the general public's preferences towards rural landscapes. *Ecological Economics* **72:** 161–169.

Hynes, S. and Hanley, N., 2006. Preservation versus development on Irish rivers: whitewater kayaking and hydro-power in Ireland. *Land Use Policy* **23:** 170–180.

Hynes, S. and Hanley, N., 2009. The "*Crex crex*" lament: Estimating landowners willingness to pay for corncrake conservation on Irish farmland. *Biological Conservation* **142:** 180–188.

Hynes, S., Campbell, D. and Howley, P., 2011. A holistic vs. an attribute-based approach to agri-environmental policy valuation: do welfare estimates differ? *Journal of Agricultural Economics* **62:** 305–329.

Irish Heritage Council, 2004. *Seeking your Views on Water Quality*. Report on feedback. The Heritage Council, Dublin, Ireland.

Just, R., Hueth, D. and Schmidt, A., 1982. *Applied Welfare Economics*. Prentice-Hall, New York, USA.

Kaltenborn, B.P. and Bjerke, T., 2002. Association between environmental value orientations and landscape preferences. *Landscape Urban Plan* **59:** 1–11.

Kaltenborn, B.P., Andersen, O., Nellemann, C., Bjerke, T. and Thrane, C., 2008. Resident attitudes towards mountain second-home tourism development in Norway: the effects of environmental attitudes. *Journal of Sustainable Tourism* **16:** 664–680.

Kellert, S.R., 1993. Attitudes, knowledge, and behaviour towards wildlife among the industrial superpowers: United States, Japan, and Germany. *Journal of Social Issues* **49:** 53–69.

Kelly, M., Kennedy, F., Faughnan, P. and Tovey, H., 2003. *Cultural Sources of Support on which Environmental Attitudes and Behaviours Draw*. Second Report from the Research Programme on Environmental Attitudes, Values and Behaviour in Ireland. Environmental Protection Agency, Johnstown Castle Estate, Wexford, Ireland.

Kline, J. and Wichelns, D., 1998. Measuring heterogeneous preferences for preserving farmland and open space. *Ecological Economics* **26:** 211–224.

Lago, M. and Glenk, K., 2008. *Delivering Good Status in Scotland: Using Choice Experiments for the Estimation of Non-Market Benefits of the EC Water Framework Directive*. Macaulay Institute, Aberdeen, Scotland.

Lancaster, K.J., 1966. A new approach to consumer theory. *Journal of Political Economy* **74:** 132–157.

Larson, K.L., 2010. An integrated theoretical approach to understanding the sociocultural basis of multidimensional environmental attitudes. *Society and Natural Resources* **23:** 898–907.

McGarrigle, M., Lucey, J. and Ó Cinnéide, M., 2010. *Water Quality in Ireland 2007–2009*. Environmental Protection Agency, Johnstown Castle Estate, Wexford, Ireland.

Mitchell, R. and Carson, R., 1989. *Using Surveys to Value Public Goods: the Contingent Valuation Method*. Resources for the Future, Washington, DC, USA.

National Competitiveness Council, 2012. Ireland's *Competitiveness Scorecard 2012*. Available at: http://www.competitiveness.ie/publication/nccSearch.jsp?ft=/publications/2012/title,9502,en.php

NERI (Nevin Economic Research Institute), 2012. *Quarterly Economic Facts – Autumn 2012*. Available at: http://www.nerinstitute.net/research/quarterly-economic-facts-autumn-2012.

Norton, D., Hynes, S., Doherty, E., Buckley, C., Campbell, D. and Stithou, M., 2012. *Using Benefit Transfer Techniques to Estimate the Value of achieving 'Good Ecological' Status in Irish Water Bodies*. Environmental Protection Agency, Johnstown Castle Estate, Wexford, Ireland.

Nunnally, J.C., 1967. *Psychometric Theory*. McGraw-Hill, New York, USA.

OECD (Organisation for Economic Cooperation and Development), 2012. *Water Quality and Agriculture: Meeting the Policy Challenge, OECD Studies on Water*. OECD Publishing, Paris, France.

Peterson, R.A., 1994. A meta-analysis of Cronbach's coefficient alpha. *Journal of Consumer Research* **21:** 381–391.

Samples, K.C., Dixon, J.A. and Gowen, M.M., 1986. Information disclosure and endangered species valuation. *Land Economics* **62:** 306–312.

Scottish Executive, 2005. *Public Attitudes to the Environment in Scotland*. Environment Group, Scottish Executive, Scotland.

Stithou, M., Hynes, S., Hanley, N. and Campbell, D., 2012. Estimating the value of achieving "good ecological status" in the Boyne River Catchment in Ireland using choice experiments. *The Economic and Social Review* **43:** 397–422.

Thompson, S.C.G. and Barton, M., 1994. Ecocentric and anthropocentric attitudes towards the environment. *Journal of Environmental Psychology* **14:** 149–157.

Acronyms and Annotations

CE	Choice experiment
CVM	Contingent valuation methodology
DCCV	Dichotomous choice contingent valuation
ED	Electoral Division
EPA	Environmental Protection Agency
EU	European Union
GES	Good ecological status
GIS	Geographic information systems
IRBD	International River Basin District
NEP	New Environmental Paradigm
NOAA	National Oceanic and Atmospheric Administration
PCA	Principal component analysis
PCCV	Payment card contingent valuation
RBD	River Basin District
SILC	Survey on Income and Living Conditions
TCM	Travel cost methodology
TEV	Total economic value
WFD	Water Framework Directive
WTA	Willingness to accept
WTP	Willingness to pay

An Ghníomhaireacht um Chaomhnú Comhshaoil

Is í an Gníomhaireacht um Chaomhnú Comhshaoil (EPA) comhlachta reachtúil a chosnaíonn an comhshaol do mhuintir na tíre go léir. Rialaímid agus déanaimid maoirsiú ar ghníomhaíochtaí a d'fhéadfadh truailliú a chruthú murach sin. Cinntímid go bhfuil eolas cruinn ann ar threochtaí comhshaoil ionas go nglactar aon chéim is gá. Is iad na príomh-nithe a bhfuilimid gníomhach leo ná comhshaol na hÉireann a chosaint agus cinntiú go bhfuil forbairt inbhuanaithe.

Is comhlacht poiblí neamhspleách í an Ghníomhaireacht um Chaomhnú Comhshaoil (EPA) a bunaíodh i mí Iúil 1993 faoin Acht fán nGníomhaireacht um Chaomhnú Comhshaoil 1992. Ó thaobh an Rialtais, is í an Roinn Comhshaoil, Pobal agus Rialtais Áitiúil.

ÁR bhFREAGRACHTAÍ

CEADÚNÚ

Bíonn ceadúnais á n-eisiúint againn i gcomhair na nithe seo a leanas chun a chinntiú nach mbíonn astuithe uathu ag cur sláinte an phobail ná an comhshaol i mbaol:

- áiseanna dramhaíola (m.sh., líonadh talún, loisceoirí, stáisiúin aistrithe dramhaíola);
- gníomhaíochtaí tionsclaíocha ar scála mór (m.sh., déantúsaíocht cógaisíochta, déantúsaíocht stroighne, stáisiúin chumhachta);
- diantalmhaíocht;
- úsáid faoi shrian agus scaoileadh smachtaithe Orgánach Géinathraithe (GMO);
- mór-áiseanna stórais peitreail;
- scardadh dramhuisce;
- dumpáil mara.

FEIDHMIÚ COMHSHAOIL NÁISIÚNTA

- Stiúradh os cionn 2,000 iniúchadh agus cigireacht de áiseanna a fuair ceadúnas ón nGníomhaireacht gach bliain
- Maoirsiú freagrachtaí cosanta comhshaoil údarás áitiúla thar sé earnáil - aer, fuaim, dramhaíl, dramhuisce agus caighdeán uisce
- Obair le húdaráis áitiúla agus leis na Gardaí chun stop a chur le gníomhaíocht mhídhleathach dramhaíola trí comhordú a dhéanamh ar líonra forfheidhmithe náisiúnta, díriú isteach ar chiontóirí, stiúradh fiosrúcháin agus maoirsiú leigheas na bhfadhbanna.
- An dlí a chur orthu siúd a bhriseann dlí comhshaoil agus a dhéanann dochar don chomhshaol mar thoradh ar a ngníomhaíochtaí.

MONATÓIREACHT, ANAILÍS AGUS TUAIRISCIÚ AR AN GCOMHSHAOL

- Monatóireacht ar chaighdeán aeir agus caighdeáin aibhneacha, locha, uiscí taoide agus uiscí talaimh; leibhéil agus sruth aibhneacha a thomhas.
- Tuairisciú neamhspleách chun cabhrú le rialtais náisiúnta agus áitiúla cinntí a dhéanamh.

RIALÚ ASTUITHE GÁIS CEAPTHA TEASA NA HÉIREANN

- Cainníochtú astuithe gáis ceaptha teasa na hÉireann i gcomhthéacs ár dtiomantas Kyoto.
- Cur i bhfeidhm na Treorach um Thrádáil Astuithe, a bhfuil baint aige le hos cionn 100 cuideachta atá ina mór-ghineadóirí dé-ocsaíd charbóin in Éirinn.

TAIGHDE AGUS FORBAIRT COMHSHAOIL

- Taighde ar shaincheisteanna comhshaoil a chomhordú (cosúil le caighdéan aeir agus uisce, athrú aeráide, bithéagsúlacht, teicneolaíochtaí comhshaoil).

MEASÚNÚ STRAITÉISEACH COMHSHAOIL

- Ag déanamh measúnú ar thionchar phleananna agus chláracha ar chomhshaol na hÉireann (cosúil le pleananna bainistíochta dramhaíola agus forbartha).

PLEANÁIL, OIDEACHAS AGUS TREOIR CHOMHSHAOIL

- Treoir a thabhairt don phobal agus do thionscal ar cheisteanna comhshaoil éagsúla (m.sh., iarratais ar cheadúnais, seachaint dramhaíola agus rialacháin chomhshaoil).
- Eolas níos fearr ar an gcomhshaol a scaipeadh (trí cláracha teilifíse comhshaoil agus pacáistí acmhainne do bhunscoileanna agus do mheánscoileanna).

BAINISTÍOCHT DRAMHAÍOLA FHORGHNÍOMHACH

- Cur chun cinn seachaint agus laghdú dramhaíola trí chomhordú An Chláir Náisiúnta um Chosc Dramhaíola, lena n-áirítear cur i bhfeidhm na dTionscnamh Freagrachta Táirgeoirí.
- Cur i bhfeidhm Rialachán ar nós na treoracha maidir le Trealamh Leictreach agus Leictreonach Caite agus le Srianadh Substaintí Guaiseacha agus substaintí a dhéanann ídiú ar an gcrios ózóin.
- Plean Náisiúnta Bainistíochta um Dramhaíl Ghuaiseach a fhorbairt chun dramhaíl ghuaiseach a sheachaint agus a bhainistiú.

STRUCHTÚR NA GNÍOMHAIREACHTA

Bunaíodh an Ghníomhaireacht i 1993 chun comhshaol na hÉireann a chosaint. Tá an eagraíocht á bhainistiú ag Bord lánaimseartha, ar a bhfuil Príomhstiúrthóir agus ceithre Stiúrthóir.

Tá obair na Gníomhaireachta ar siúl trí ceithre Oifig:

- An Oifig Aeráide, Ceadúnaithe agus Úsáide Acmhainní
- An Oifig um Fhorfheidhmiúchán Comhshaoil
- An Oifig um Measúnacht Comhshaoil
- An Oifig Cumarsáide agus Seirbhísí Corparáide

Tá Coiste Comhairleach ag an nGníomhaireacht le cabhrú léi. Tá dáréag ball air agus tagann siad le chéile cúpla uair in aghaidh na bliana le plé a dhéanamh ar cheisteanna ar ábhar imní iad agus le comhairle a thabhairt don Bhord.

EPA Research Report 129

Are we willing to pay for good river water quality?

epaResearch
Climate - Water - Sustainability
Identifying pressures • Informing policy • Developing solutions

Willingness to pay for achieving good status across rivers in the Republic of Ireland

The Water Framework Directive (WFD) mandates member states to achieve good status across all surface waters by 2015. Derogations from this target have to be proven based on infeasibility or disproportionate cost. This research aimed to undertake a survey of the general population to explore willingness to pay (WTP) for policy measures aimed at achieving good status across all rivers in the Republic of Ireland.

Identifying Pressures

Assessing whether the achievement of good status is disproportionately expensive requires a comparison of the costs of putting measures in place to achieve good status versus the benefits that might come about as a result of the water body achieving good status. Very few studies have looked at the benefit side of this equation in the Republic of Ireland and this research aimed to address this.

Informing Policy

- Findings from this study indicate that the general population place a high rating on water quality related environmental issues. Of the nine environmental issues explored, tackling poor drinking water quality and pollution of rivers and lakes were the top ranked priority issues across the sample (n=614).
- Results from the WTP regression analysis indicate that environmental and recreational use values as well as socio-demographic factors including education, actual income and subjective perceptions relating to household financial status were found to have a positive impact on the general public's WTP for achieving good status across Irish rivers. WTP was also found to be higher among respondents living in river basin districts where rivers were generally of lower surface water quality status.
- Over 50% of the sample indicated a €0 willingness to pay for achieving 100% good status across Irish rivers.
- Mean WTP for achieving full good status across rivers in the Republic of Ireland was estimated at €19 per respondent per annum. Aggregating this up across the general population indicates a total WTP for achieving good status across rivers in the Republic of Ireland of €65.35 million per annum.

Developing Solutions

- This research used a contingent valuation methodology (CVM) approach to estimate WTP for achieving good status across all rivers in the Republic of Ireland.

Comhshaol, Pobal agus Rialtas Áitiúil
Environment, Community and Local Government

EPA Research: McCumiskey House, Richiew, Clonskeagh, Dublin 14.

Phone: 01 268 0100
Twitter: @EPAResearchNews
Email: research@epa.ie

Cover photo: John Doheny

www.epa.ie

EPA Research Webpages
www.epa.ie/researchandeducation/research/