

**Project number:** 6265  
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## Benefits and factors affecting water quality in Ireland.



### Key external stakeholders:

Department of Environment and Local Government  
Local Authorities  
Environmental Protection Agency  
Department of Transport, Tourism and Sport  
Department of Agriculture, Food and the Marine  
Farm Organisations  
Community Groups

### Practical implications for stakeholders:

Results from this study can assist policymakers in resource allocation and risk management in the area of water quality improvement.

### Main results:

- Using geographical information system (GIS) techniques this study examines water quality and provides a spatial illustration at the water management unit (WMU) level of various non-market benefits that the general public derive from river water bodies. These benefits include those derived from angling, swimming, canoeing, rowing, sailing and conservation. Significant regional variation was found when it came to the various non-market benefits enjoyed by the general public from the use of river waters and in some instances significant disparities between water quality ratings as measured by Q values (a biological water quality index based on abundance and composition of aquatic flora and fauna) and actual benefits derived by the general public for a particular river water body were observed.
- Results suggest that a variety of anthropogenic factors such as agricultural activity, forestry cover, landfills and septic tank density affect river water quality. While the agricultural sector continues to have a negative effect on river water quality, results from this study indicate that this effect has declined in recent times. A combination of geomorphological and climatic variables was also found to affect river water quality.

### Opportunity / Benefit:

This study derives benefit indicators to quantify and to map river water quality benefits at a spatial scale. This scale is commensurate with local water management decision making governance structures. Analysis at this level can contribute towards a more comprehensive assessment framework and assist policymakers in targeting resources to maximize benefits to the general public.

This study also illustrates how river water quality is affected by the combination of natural and anthropogenic factors, the relative influences of which changes over time. The analysis provided here will be an important tool in the management of risk and will allow for more appropriate land use planning aimed at restoring and maintaining water quality as required by the EU Water Framework Directive.

### Collaborating Institutions:

University of York  
National University of Ireland, Galway

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**External collaborators:** Peter Howley, University of York  
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### 1. Project background:

Originally water quality policy was concerned with public health protection. Latterly it has evolved to encompass wider aims with respect to protecting the environment. The Water Framework Directive (WFD) adopted by the European Commission in 2000 requires the integrated management of water resources throughout the EU. The aim of the WFD is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and ground waters. The Directive aims at a minimum to achieve 'good' and 'non-deteriorating status' for surface, underground and coastal waters and sets common approaches and goals for water management in the EU Member State countries. The Directive calls for a consideration of all the benefits as well as costs of improvements to good status in catchment management plans. Hence, the identification of benefits and linking these benefits with physical measures of water quality as well as a better understanding of the factors affecting river water quality will play an important role in the assessment of the proportionality of costs which is part of WFD implementation.

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### 2. Questions addressed by the project:

The main objectives of this research project were as follows:

- Develop and map using GIS techniques a variety of indicators reflecting the non-market benefits provided by river bodies.
  - Compare benefit indicators to water quality ratings (i.e. Q values).
  - Investigate the major land use and environmental drivers of river water quality.
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### 3. The experimental studies:

The study firstly uses GIS techniques to provide a spatial illustration at the WMU of various non-market benefits that the general public derives from river water bodies. These benefits include those derived from angling, swimming, canoeing, rowing, sailing and conservation. These benefits are compared to measured Q values to explore whether there was disparity between water quality ratings (as measured by Q values) and actual benefits derived by the general public.

Secondly this study undertakes an econometric analysis exploring the effects of land use, geomorphological and climatic variables on river water quality in the Republic of Ireland. This is achieved by combining a number of spatial datasets from a range of sources relating to agricultural, residential, forestry, geomorphological and climatic data with the biological measures of water quality (Q values) using an ordered probit panel data model. This modeling framework allows a spatial and temporal examination of the different drivers of river water quality at a national level.

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### 4. Main results:

This study finds that significant regional variation was observed when it came to the distribution of various non-market benefits. For example, participants in long distance swimming events are heavily concentrated in Dublin and Cork and to a lesser extent Galway. On the other hand, triathlon events are much more evenly distributed across the country. The Moy water management unit in the West of Ireland is by far the most important for recreational angling when it comes to salmon and sea trout, with 12,760 salmonoids harvested out of a national total of 40,146. For canoeing and kayaking activity, results indicate that there is a good spatial distribution across the country with a relatively larger number of service providers along the west coast. Cork, Dublin and Galway have the highest number of rowing clubs and events and Dublin City and west Cork are popular sailing centers. However, results highlight how quality ratings and non-market benefits provided by specific rivers may often only be weakly related as many of the river water bodies that provided significant recreational value had relatively lower Q values than those providing less recreational services and vice versa. Hence, when it comes to assessing river water bodies, policymakers should take into consideration not just quality ratings based on biological data or otherwise, but also the wider range of

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recreational benefits that river bodies provide to the general public. Water quality is likely to be only one of a suite of attributes that play a part in determining the range of benefits that can be enjoyed by the general public.

Findings from this research indicate that various agricultural activities such as livestock, cereal and pig production have a significant negative effect on river water quality. However, analysis indicates that this effect is significantly reduced over time. In Ireland, wastewater from a significant proportion of the population (generally in rural areas) is treated by small-scale on-site systems (septic tanks). Results indicate a statistically significant and negative association between septic tank density and river water quality. Findings from this analysis indicate that an active landfill site upstream of a monitoring station was associated with lower Q value outcomes. Conversely, greater forestry cover was found to be positively associated with better river water quality outcomes. The analysis also indicates that river water quality is affected by a combination of geomorphological (e.g. soil type, slope) and climatic (e.g. rainfall) variables.

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#### 5. Opportunity/Benefit:

This research can contribute towards a more comprehensive assessment framework and assist policymakers in targeting resources to maximize benefits for the general public as set down under the Water Framework Directive. Findings can assist policymakers in understanding how anthropogenic and natural factors affect water quality and how relationships change over time. This can aid water resource managers in targeting efforts aimed at improving river water quality.

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#### 6. Dissemination:

The main publication from this work to-date is an EPA Strive Report.

#### Main publications:

Howley, P., Buckley, C., Jordan, R., O' Donoghue, C., Hynes, S., Green, S., 2014. A spatial analysis of the distribution of river water quality benefits and the major forces affecting river water quality across the Republic of Ireland. EPA Strive Report, 2011-W-DS-8.

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#### 7. Compiled by: Dr. Cathal Buckley & Dr. Cathal O'Donoghue

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