

# Optimising Water Use in Scotland: Valuation, Tradability and Portfolio Theory

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## INTRODUCTION

Water has a variety of uses (as shown in Fig. 1), some are mediated by water quality, some are mutually exclusive. Each use has different economic value.

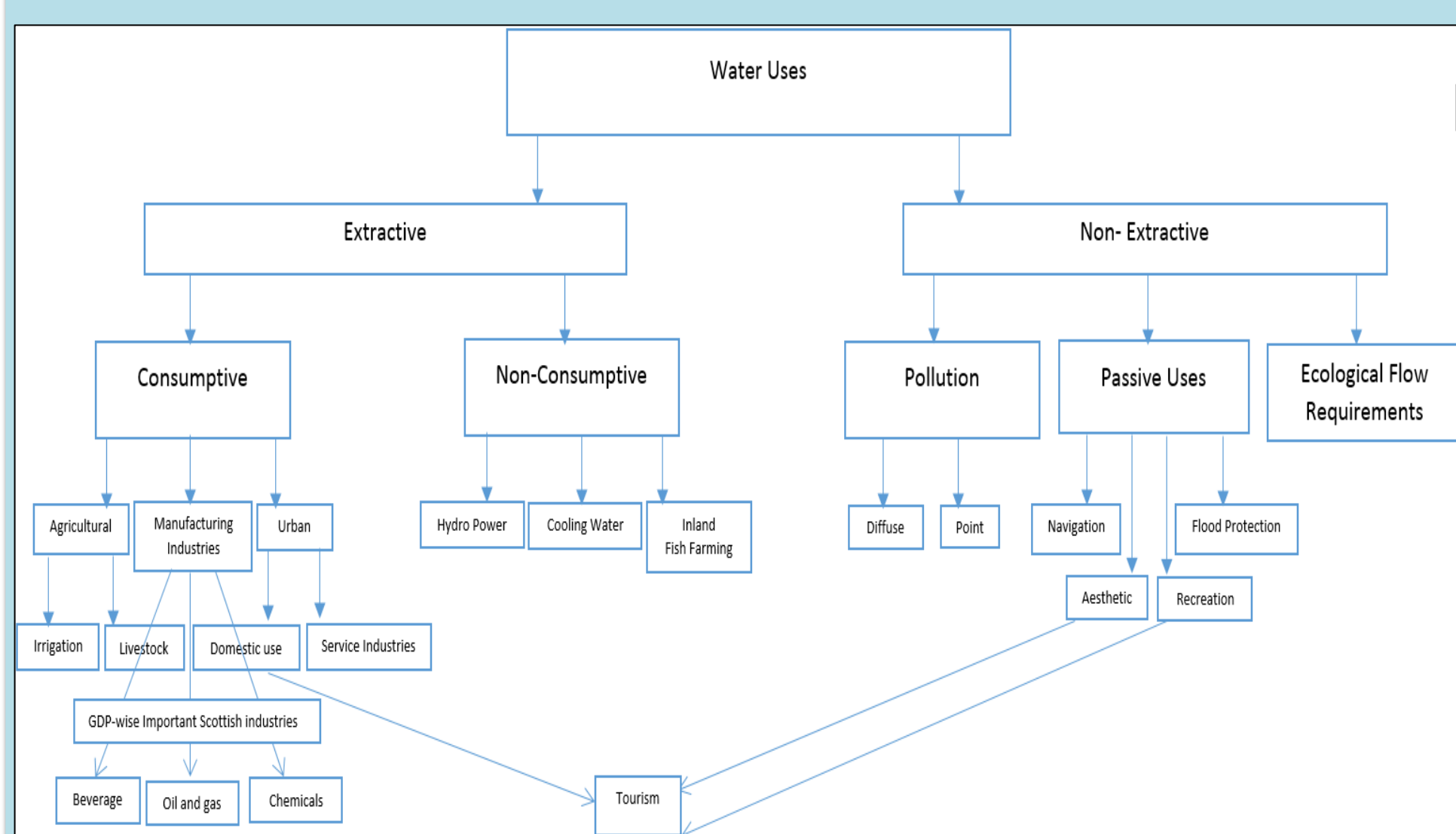


Fig. 1 Water resource uses

This PhD project aims to look into the current availability, uses and non uses of water in Scotland in relation to their contribution to Scottish economy. Thus a better allocation among its sectorial uses can be identified. In the identification of this water management challenge, the central questions are:

- What is the value of water available in Scotland?
- How can this current value be optimised?



Scotland's centre of expertise for waters

### Acknowledgements

We acknowledge the Hydro Nation Scholars Programme of the Scottish Government.

<sup>1</sup> Renzetti, S. (2002). The Economics of Water Demands. Kluwer Academic Publishers, Dordrecht.  
<sup>2</sup> Hoekstra, A. Y, Chapagain, A. K., Aldaya, M., M. and Mekonnen, M., M. (2011). The Water Footprint Assessment Manual: Setting the Global Standard, Earth scan, London, UK.  
<sup>3</sup> Scottish Office (1998). Scottish Environment Statistics, Stationery Office, Edinburgh  
<sup>4</sup> Ostojki, S. M., Niedbala, J., Orlinska, P., Wilk, P., Wrobel, J., Kidd, R. A., (2012). Water Availability in Reference to Water Needs in Poland. Available: www.earthzine.org/2012/01/09/water-availability-in-reference-to-water-needs-in-poland-the-importance-of-correct-estimation-of-water-resources/ Accessed:20/10/14

## METHODS

### • Valuation

When valuing water, it is important to distinguish between values for quantity and quality (Fig. 2).

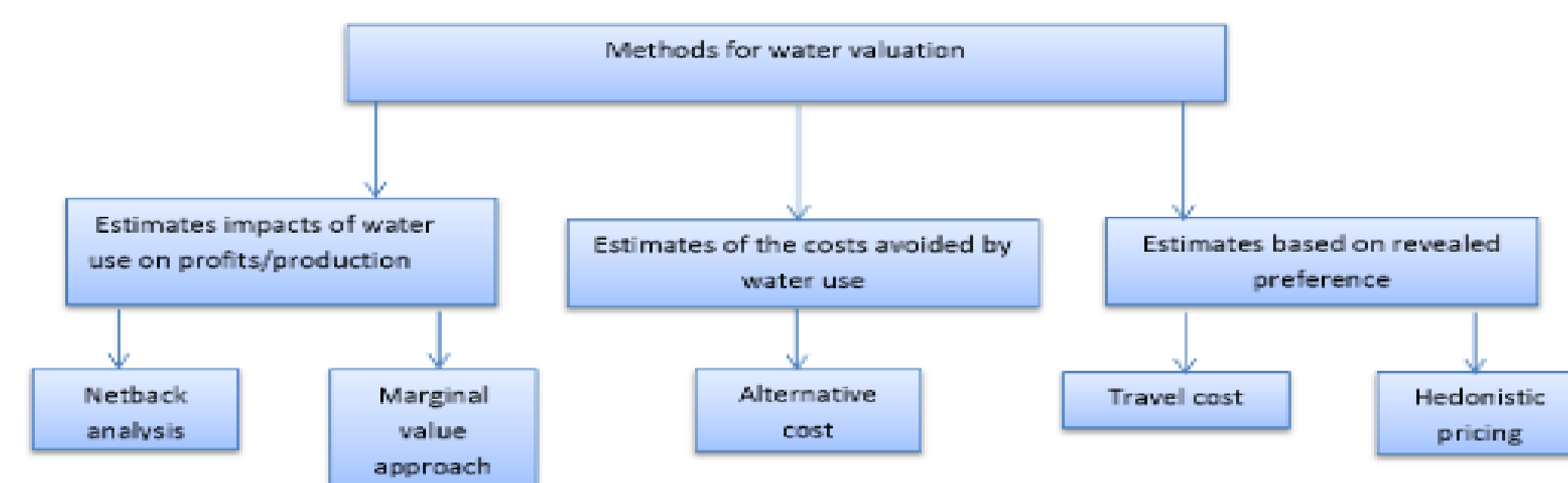


Fig. 2 Methods for economic valuation of water<sup>1</sup>  
– direct use of demand curve is not shown.

Valuation is necessary but not a sufficient condition to realise full economic value. This is where the tradability concept comes in to realise full value.

### • Water Footprinting

The methodology set in the Water Footprint Assessment Manual<sup>2</sup> will be used to identify the amount of water moving across Scotland's borders through its imports and exports that has the highest influence on its GDP.

### • Modern Portfolio Theory (MPT)

Reallocating use to high value uses recuperates the lost opportunity cost of investing water in low value uses. A portfolio of current water uses with their estimated values will be designed to seek the optimal allocation of water.

### • Optimisation Modelling

The different scenarios of water use portfolios will be analysed. Trading possibilities among different water uses under different scenarios in a specific catchment will be identified to optimise the current allocation.

## CASE STUDY

There is 16000 m<sup>3</sup> exploitable water resources per annum per capita in Scotland<sup>3</sup> which is high average compared to the rest of Europe (Fig. 3).

Even in a resource abundant country like Scotland, there are issues such as non-uniform average per capita water consumption across the country and competition for uses and these competing demands may be exacerbated by climate.

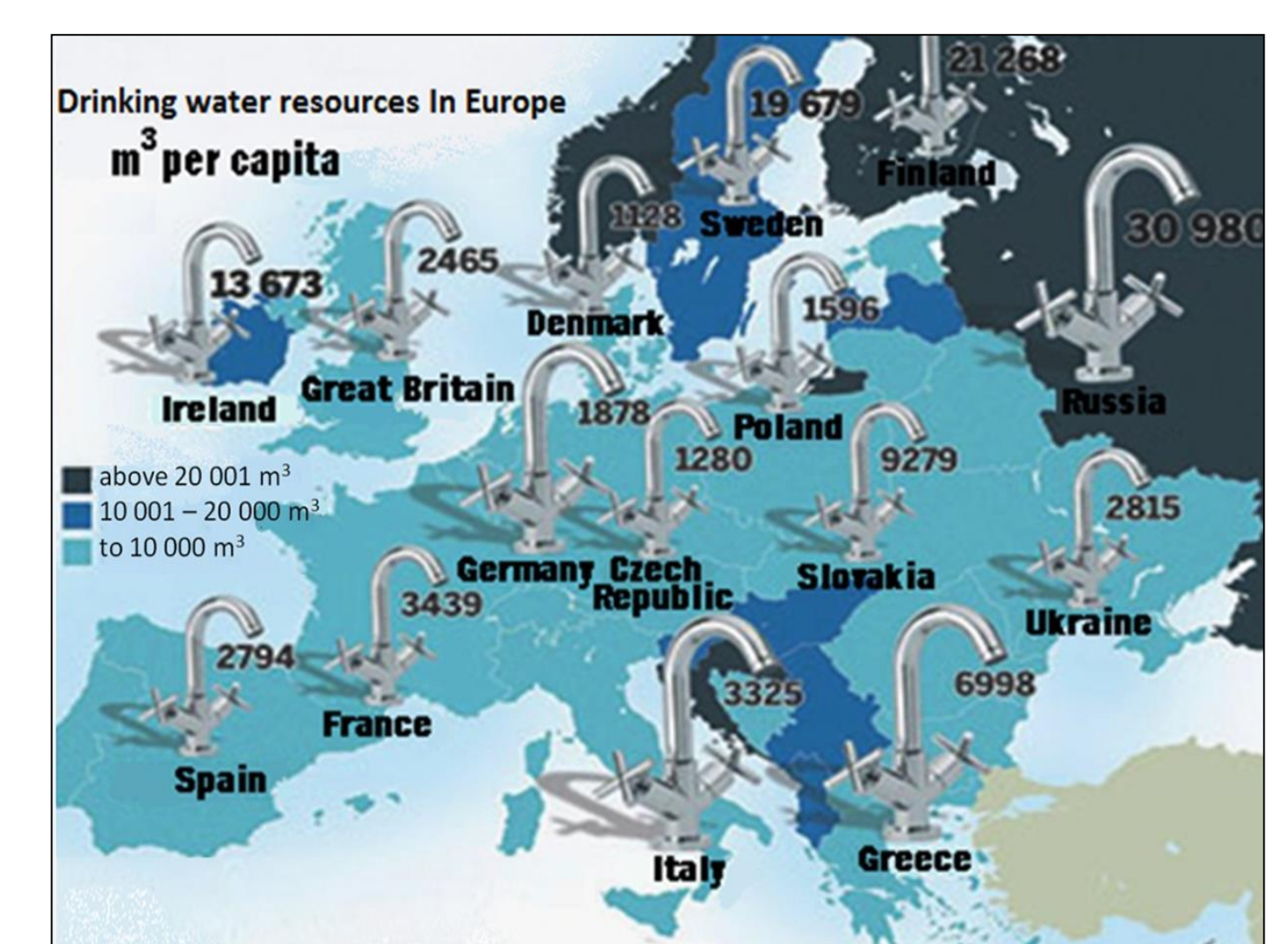


Fig.3 Drinking water resources per capita in Europe in 2011<sup>4</sup>.

## EXPECTED RESULTS

This particular PhD thesis aims to inform the Hydro Nation Agenda and to initiate a high-profile policy debate on Scottish and international water issues. It will contribute to the following areas:

- value of water to the economy, society and the environment
- economic regulation of water
- climate change adaptation
- multiple benefits of water resource management
- international best practice and their possible implications for the Hydro Nation Policy

This PhD further aims to inform the current academic literature in the application of Modern Portfolio Theory to water allocation and water footprinting methodology in the case of Scotland.