

Enhancing the design of ground-breaking market-based Payments for Ecosystem Services (PES) schemes

SWEEP-affiliated PhD student Ben Balmford's research was instrumental in improving the efficiency of the Forestry Commission's unique £50m carbon-reduction tree planting scheme, and Poole harbour nitrate-reduction auctions delivering cost savings to both business and the public purse, in addition to improved environmental outcomes. Ben continues to work with Exeter's Mechanism Design Team developing three world-first, double-sided catchment markets, designed to allow economic development to proceed without harming the planet.

swEEP

PhD Impact Summary



Supported
2,750 hectares
of new woodland
creation



275 tonnes
nitrogen prevented
from entering Poole
Harbour



Co-created **3**
world-first double-
sided catchment
markets



Why it mattered?

Payments for Ecosystem Services (PES) schemes encourage or incentivise the conservation of natural resources, or delivery of specific ecosystem services. For example, payments can be made to farmers or landowners, who agree to take certain actions to manage their land in ways which improve water quality or biodiversity or sequester carbon. Schemes aimed at reducing the levels of nutrients in freshwater habitats and estuaries, help to reduce algal growth which disrupts natural processes and impacts wildlife. Whilst those aimed at planting trees or creating new or enriched habitat can boost carbon sequestration and deliver improved biodiversity.

PES schemes can take a range of forms, from flat-rate payments to auctions to full blown trading platforms, or what might be termed a PES market. PES markets provide a place where buyers and sellers make mutually beneficial trades and are increasingly being used to deliver environmental improvements. As prices are set by the market, they can overcome problems with predetermined price setting used in other forms of PES schemes.

Ben's PhD research explored a **range of design issues** relating to **PES markets**, including issues of perceived efficiency, trustworthiness, and fairness.

What Ben did

Ben began his PhD by exploring the principles of using 'public funding' for the provision of 'public goods'. He then explored emerging 'PES market' issues by conducting a series of experiments at the FEELE Lab, located in the University

of Exeter Business School. Research topics included studying bidding behaviour in a range of 'reverse auction' formats (where the lowest bids win the contracts to provide services), and comparing different types of auction format, pricing rules, participant incentives and external influences. Through collaborative work with Prof Brett Day and Dr Luke Lindsay as part of the University of Exeter's Mechanism Design (EMD) Team, Ben applied his research to a range of PES markets and trials, including:

- One of the **UK's first catchment market schemes** for the rivers Dove and Wye in Derbyshire Severn Trent Water (2017-2019), in which landowners bid to undertake actions to improve water quality, with the market discovering prices, rather than predetermined fixed prices.
- The **Forestry Commission's** £50m Woodland Carbon Guarantee online auction scheme. Launched in 2019, the scheme was the UK's first auction for carbon and is helping to deliver on Net Zero 2030 ambitions by incentivising land-owners to plant particular types of trees which lock in carbon. To date, there have been 110 successful bids over 5 auctions running from Jan 2020 to May 2022, for tree-planting in an area of 2759 Ha¹.
- Wessex Water/EnTrade's **Poole Harbour Nitrate reduction** auction enabled farmers to bid to plant cover crops that reduce the amount of nitrogen run-off entering rivers. The Pay-as-Bid format was changed to one where everyone pays the same Uniform Price, making bidding more straightforward.

- Trials of **world-first catchment markets** (2020-ongoing), developed in collaboration with EnTrade/Wessex Water as national pilots. These trials are unique in their double-sided nature, with multiple buyers, multiple sellers and multiple environmental services being traded simultaneously. They also use an innovative settlement mechanism, designed by the EMD Team, ensuring fair payments for environmental credits.

The catchment markets provide a place where landowners and farmers can bid to deliver nature-based projects, primarily aimed at improving water quality, and housing developers and businesses can buy credits to meet their planning and 'Nutrient Neutrality' obligations for protected wildlife sites.

- **Solent Nutrient Market Pilot** – sponsored by Defra, the pilot involves Natural England, local planning authorities, the Department for Levelling Up, Housing and Communities, the Environment Agency and the Forestry Commission.
- **Somerset Catchment Market Pilot** – led by the Environment Agency, Wessex Water and Natural England, this pilot was created in response to a request from Defra and its agencies for innovative projects that could contribute to a Green Economic Recovery.
- **Bristol Avon Catchment Market** – developed with the Avon and Wiltshire Wildlife Trusts, the market is designed to enable businesses to meet their environmental obligations and commitments.

¹ <https://woodlandcarboncode.org.uk/woodland-carbon-guarantee>

Impacts & benefits delivered

Ben's PhD research and collaborative work with the Exeter Mechanism Design (EMD) Team delivered significant impacts.



Policy & Legislation

Woodland Carbon Guarantee scheme:

Ben's research findings and advice was **"instrumental"** in shaping the design of the Forestry Commission's Woodland Carbon Guarantee scheme, according to Pat Snowdon of Scottish Forestry. To date, the scheme has delivered 2,750 hectares of new woodland and encouraged a diversification in woodland type and tree species². The research findings and advice allowed the FC to support woodland planting, which would not have otherwise happened, by incentivising future CO₂ removals at a significantly higher carbon price, helping to move the market price in the direction of the government's current estimated values per tonne of carbon required to meet climate change targets³. Based on current government values, the expected net reduction in carbon of 0.6m tonnes, directly resulting from this advice, offered a cost saving to the public purse for carbon bought of £6.2m.

Strategy and policy contributions: The strategic and policy decisions of a wide range of organisations were influenced, including: Defra, Environment Agency, Natural England, Wildlife Trusts, water companies, a number of Local Planning Authorities, EnTrade and NatureBid.



Organisational Function

Poole Harbour Nitrate reduction auction:

The change in auction design, directly informed by Ben's research findings, resulted in a **cost saving of 30%** compared to under the previous auction rules. Moreover, removing that quantity of nitrogen through a built infrastructure/traditional approach **would have cost £11.45m**. An estimated **275 tonnes of nitrogen was prevented** from entering Poole Harbour as a result of the re-designed auction schemes informed by Ben's research findings⁴.



Knowledge/Capacity

Catchment Market schemes: The catchment markets in **Poole Harbour** and the **rivers Dove and Wye** substantially reduced nutrient pollution entering rivers, and the improved water quality increased the recreation value people derived from using waterways. Farmers also benefited from payments that increased their income. Cost savings for water companies avoided the need for large infrastructure investments to reduce nutrient pollution and benefited customers where passed onto them. It is anticipated that the **national pilot and trial catchment markets** for the **Solent, Somerset Levels**, and the **Avon** will benefit farmers and rural communities by increasing and diversifying income streams in return for delivering nature-based projects. Housebuilders will benefit from being able to purchase verified nutrient credits and Biodiversity Net Gain (BNG) offsets. Nutrient offsetting will help protect fragile eco-systems, like saltmarshes and mudflats in

the Solent and the lowland wetlands in Somerset. The BNG offsets will establish new habitats and these ecosystems will also provide opportunities for leisure activities, like birdwatching, that contribute to wellbeing.



Economic

Boosting business: A range of businesses have benefited from Ben's and the EMD Team's research and advice, particularly EnTrade, with whom they have a unique and close co-creative relationship, and also consultants Arup, Wheatley Young & Partners and Vivid Economics.



Ben provided invaluable insights into the design and application of reverse auctions for a new policy initiative, the Woodland Carbon Guarantee. This advice was instrumental in giving us the confidence to carry out the auction. We subsequently ran five auctions under the Guarantee, helping drive woodland creation in England, which would not have otherwise happened, by incentivising future CO₂ removals at a significantly higher carbon price than previously. The Forestry Commission considered this to be a very successful outcome and one that had also impressed H.M. Treasury."

Pat Snowdon, Head of Economics, Scottish Forestry



The work that the Exeter team are doing to help design and operate catchment markets for nature-based solutions is world leading. Their innovation is creating the incentives for farmers and landowners to integrate nature with agriculture through a unique, high integrity mechanism (the Lindsay mechanism), that can enable private capital to be efficiently deployed to address climate change and nature recovery at a global scale."

David Young, Senior Fellow at the Broadway Initiative



The Exeter team has the rare ability to apply world-leading academic expertise to the practical requirements of environmental market design. Their work is informing the development of well-designed high integrity markets that can fairly reward farmers and landowners for delivering environmental outcomes and integrate environmental measures with food production and other land uses in farmed landscapes."

Guy Thompson, Managing Director, EnTrade

2 <https://woodlandcarboncode.org.uk/woodland-carbon-guarantee>

3 <https://www.gov.uk/government/publications/valuing-greenhouse-gas-emissions-in-policy-appraisal/valuation-of-greenhouse-gas-emissions-for-policy-appraisal-and-evaluation#annex-1-carbon-values-in-2020-prices-per-tonne-of-co2>

4 Balmford et al (2022): Pricing Rules for Pes Auctions: Evidence from a Field Experiment. Available at SSRN: <https://dx.doi.org/10.2139/ssrn.4280685>

Looking to the future

Awarded his PhD in 2022, Ben is now a Postdoctoral Research Fellow at the University of Exeter LEEP Institute. He works alongside Prof. Ben Groom, who holds the Dragon Capital Chair in Biodiversity Economics, on a specially-created 5 year programme examining: (1) the relationship between biodiversity and human well-being; (2) how much the economy depends on biodiversity and nature; and (3) how the well-being of future generations can be reflected in decisions today.

Ben also continues his work with the Exeter Mechanism Design Team and EnTrade to inform and advise the ground-breaking PES markets and trials currently underway in the UK, and offer similar advice to developing schemes in Wales.

For more information contact leep@exeter.ac.uk



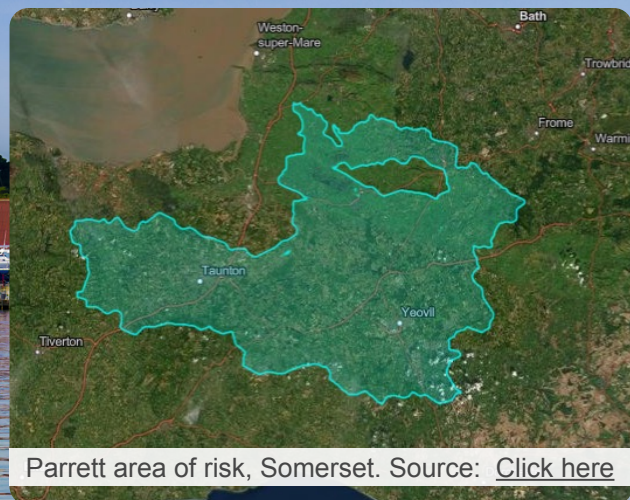
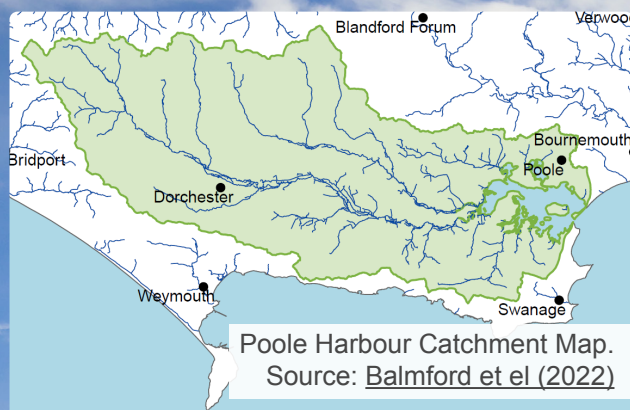
The Bristol Avon Catchment Market is a genuine step change for the delivery of nature-based solutions at a landscape scale."

Amy Coulthard, Director for Nature's Recovery, Avon Wildlife Trust



New housing schemes.... now having to demonstrate nutrient neutrality before building can commence or resume - an estimated 120,000 new homes are now delayed."

National Federation of Housebuilders



Organisations Ben worked with

EnTrade
Arup
Wheatley Young & Partners
Vivid Economics



Somerset
Catchment Market



PhD related publications

- B. Balmford, R.E. Green, M. Onial, B. Phalan, A. Balmford (2019) How imperfect can land sparing be before land sharing is more favourable for wild species? Journal of Applied Ecology, 56, 1, 73-84.
- Bateman, I. J. and Balmford, B. (2018) Public Funding for public goods: A post-Brexit perspective on principles for agricultural policy. Land Use Policy, 79, 293-300.
- Co-author of 7 Recommendation Reports written for the Forestry Commission (2018-2020)
- Balmford, B., Collins, J., Day, B., Lindsay, L. and J. Peacock. At what price? The effects of a pricing rule change on outcomes in a PES auction. 2022. Working Paper.
- Balmford, B. & L. Lindsay. Bidding in auctions with divided attention. (2022). Working Paper.
- Balmford, B. & L. Lindsay. Behaviour in sealed-bid and clock multi-unit reverse auctions. (2022). Working Paper.
- Balmford, B., Bateman, I., Day, B. & G. Smith. Incentivising efficient effort with minimal monitoring costs. (2022). Working Paper.
- NERC Business Engagement blog 'How to price environmental goods?' published May 2021.
- Balmford, Ben and Day, Brett and Lindsay, Dr Luke and Collins, Dr Joseph and Peacock, James. Pricing Rules for Pes Auctions: Evidence from a Field Experiment. <http://dx.doi.org/10.2139/ssrn.4280685>

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About SWEEP

The South West Partnership for Environmental & Economical Prosperity (SWEEP) is a partnership between the University of Exeter, the University of Plymouth, and Plymouth Marine Laboratory. Funded by the Natural Environment Research Council and stakeholders together to solve key challenges faced by those working with our natural resources. www.sweep.ac.uk



Natural
Environment
Research Council