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A solutions-focussed operational model to connect catchment water research to environmental resilience

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A transferable and operational model involving cross-sector collaborations, transdisciplinary project co-design and translation of cutting-edge research, has unlocked integrated investment in river catchment solutions in northern England.

Tensions between competing land and water uses, and short-term political thinking, have resulted in a water management crisis and intensified catchment degradation. In most regions of the world, there is a lack of co-ordination of the relevant parties who have responsibility for, reliance on, or influence over river catchment management. In some cases, catchment planning is based on top-down approaches, where important local voices are absent from the discussion, resulting in a lack of engagement, trust, compliance and investment. Even in regions where broad engagement in catchment management decision-making is mandated, such as within the European Union[1], there are major weaknesses due to the water sector being highly fragmented while the resilience of communities and other sectors to water challenges is limited by short-term political or financial framings[2]. Usually, translation of catchment-related research findings into real world solutions, including water and landscape interventions or policy, is very slow. Catchment degradation and water challenges are therefore outpacing the implementation of solutions.

The inception of an innovative approach

In the Yorkshire region of northern England, up until 2017, there was no focal point to bring relevant parties together around a collaborative and integrated platform to build shared understanding and co-designed solutions for catchment problems. The region's geography is remarkably well-aligned to the boundaries of a ~11000 km^2 river basin (Fig. 1). Tributary rivers flow from carbon-rich upland peatlands in the west and north, onwards through steep-sided formerly glaciated valleys into towns and major cities with heritage from the Industrial Revolution. Eventually rivers flow through extensive lowland arable agriculture, before flowing into the Humber estuary on the North Sea coast. The region suffers from recurrent flooding, drought, water quality and soil health issues.

In 2016, water@leeds, an interdisciplinary water research centre at the University of Leeds, convened meetings with a wide range of non-academic stakeholders to discuss catchment management perspectives across Yorkshire. The result was the framework for a co-designed programme of activity, which subsequently received funding from the UK's Natural Environment Research Council. Remarkably, but with outstanding foresight, the programme - the Yorkshire Integrated Catchment Solutions Programme (iCASP) - was funded without proposing a pre-defined set of projects or specific impacts that should be achieved. Rather, the support was fully given to the model of working, which was seen as a winning formula that would lead to environmental, social and economic impacts.

Operational since 2017, iCASP provided a regional forum for organisations to come together to co-create and co-produce projects to address catchment challenges. In the initial phase, the focus was on taking existing cutting-edge water-related research from the academic institutions involved (Universities of Leeds, York and Sheffield), and working with stakeholders to co-design projects based on such research. To be impactful, the projects specifically targeted user needs. All proposals were designed with the supervision of a central office to make sure that each project would be involve the contribution of various organisations working together and to guarantee a clear alignment with impact indicators developed under four broad areas, namely value creation, science-user engagement, policy formation & implementation, practical benefits. NGOs, community groups, businesses (large and small), government agencies, municipal authorities, and academics worked together to understand each other's perspectives. The proposals were presented to an independent Board comprising 16 representative non-academic organisations such as the National Farmers Union, companies, government agencies, municipalities, the UK Met Office, and community river groups. Rather than act like a traditional grant panel that decides which projects to approve or reject, the goal of the Board was to make recommendations for improvement, welcoming revised proposals coming back to the Board for a second or third time before approval and funding. This iterative process was extremely rewarding ensuring that bottom-up projects were focussed on outcomes, were strategic, and were placed within the wider catchment context. The process provided a focus on the delivery of non-academic impacts, with an Impact Evaluation Group that also provided feedback for encouragement and improvement. It also meant that the workshops and activities that led to project co-design were not wasted, thus enhancing trust and engagement with iCASP as a model of working.

Delivering impact

Tracking impact from the programme was an essential aspect of iCASP to: i) demonstrate to the funding body that water science research could be used to effectively deliver societal, economic and environmental benefits; ii) provide the regional stakeholders with the confidence to remain involved over the long term. A total of 274 partner organisations have engaged with iCASP so far. The social network evolved rapidly from reliance on a few key agencies to a much broader, more strongly connected catchment management community[3]. Other examples of impact include [4]: influencing how previously allocated municipal resources could be modified for enhanced water benefits (e.g. the £500M Our Spaces urban redesign in the City of Leeds); changing the mandatory water efficiency standards for new buildings in the region; shaping new business cases for sustainable catchment interventions worth £334M, such as a £25M investment delivering sustainable blue-green infrastructure to reduce flood risk in an urban subcatchment; inclusion of new monetary valuation techniques for peatland restoration projects; and employment of new staff within partner organisations armed with the latest modelling techniques for determination of optimal locations for natural flood management interventions such as leaky dams, soil enhancement techniques and hedge and tree planting across rural subcatchments[5].

The focus was on the Yorkshire region, but arising impacts have had a greater geographical reach. A surface water flood prediction tool - FOREWARNS[6] - was developed for use by national weather forecasting agencies, allowing high-resolution predictions to fine tune preparedness and warning with 1-4 days lead-in. Further enhancements enable FOREWARNS to run with greater precision at nowcasting timescales (0-6 hrs). Engagement with Government Ministers, including the UK Prime Minister, was vital to ensure national-level advocacy for catchment solutions. National policy has been influenced on training provision to reduce freshwater invasive species, and iCASP's recommendations for changes to the UK Government-approved investment process has unlocked further funding for 'green and blue' infrastructure as an alternative to hard engineering solutions. Many other tools and techniques developed by iCASP projects are now used at regional and national level by non-academic partners, including health agencies, emergency services, water companies, conservation bodies, land managers and municipalities, with outputs downloaded more than 75,000 times. iCASP partners have also reported on changes to mindsets and other less tangible changes to the way they approach problem framing and identification of solutions.

More than the sum of its parts

Within the iCASP central office, there is a team providing a neutral and trusted co-ordination role, without a particular sectoral or political agenda. This has strongly supported buy-in and enabled the co-design and co-production process, and supports the communication around iCASP projects more widely[7]. Without this central team, wider stakeholder engagement, agility to respond to emerging issues and opportunities, and integrated impact from joined-up approaches would be lacking. The team enables iCASP to be more than a set of projects. Also critical to the iCASP model was the development of a cohort of 'impact translation fellows' – highly skilled water professionals with a research background (post-doctoral level) able to work at the interface of the academic and user communities. Initially, it was envisaged that these staff would be employed to work on projects that had been approved by the Board, and they could also support knowledge exchange through secondments into partner organisations. However, over time, these staff were able to grow their skills to lead and facilitate the project co-design process and ultimately become the principal leader of some projects.

Ongoing sustainability of the model

Over time, the funder requirement that only 'existing' research could be utilised became restrictive, as it was clear that the co-design process, which matched available science to user needs, often highlighted key research gaps that, once filled, could unlock new solutions. However, new research funding bids were strengthened through leveraging a clear end-user need, and showcasing how new research could be rapidly taken up by users through the existing iCASP network. In some cases, iCASP's partner organisations decided to fund the new water research themselves, demonstrating commitment and trust in the iCASP model.

The initial research council funding lasted for six years, but iCASP is now in its ninth year and still operating. Its financial sustainability is built on the notion that iCASP is not a research project or a product, rather it is a storyboard of continued coordination, and collaborative learning and working across the water management sector in the region. Funding comes from multiple sources including an agreement with some municipalities that a proportion of funds

from each new flood innovation project iCASP helps them to secure can be used to fund the ongoing co-ordination role. More importantly, the process has allowed these organisations to jointly work on projects, share knowledge and best practice, and more efficiently operate, rather than compete for the same funding.

The unique model of operation that addresses complex water-related socio-economic-ecological problems, combined with its ability for self-funding, capacity building and ongoing engagement, can be exported to other regions. The Yorkshire iCASP can become an 'Anywhere iCASP' but would be best operated at a regional level to ensure traction with stakeholders at the right level. This operational model should be of broad interest, including its potential use to drive regional hubs that will form part of the upcoming >€750M investment promised for a Europe-wide 'Water Knowledge and Innovation Community' [8] which seeks to defragment the water sector, grow skills and enhance innovation.

References

1. European Commission. *Seventh Implementation Report from the Commission to the Council and the European Parliament on the implementation of the Water Framework Directive (2000/60/EC) and the Floods Directive (2007/60/EC) (Third river basin management plans Second flood risk management plans)*. European Commission, Brussels (2025).

2. Mdee, A., Ofori D. A., Lopez-Gonzalez, G., Stringer, L., Martin Ortega, J., Ahrari, S., Dougill A., Evans, B., Holden, J., Kay, P., Kongo, V., Obani, P., Tillotson, M. & Camargo-Valero, M.A. The top 100 global water questions: results of a scoping exercise. *One Earth* **5**, 563-573 (2022).

3. Ferre, M., Martin-Ortega, J., Di Gregorio, M., Dallimer, M**.** How do information flows affect impact from environmental research? - An analysis of a science-policy network. *Journal of Environmental Management* **321**, 115828 (2022).

4. iCASP. iCASP Impact Report. Available at https://icasp.org.uk/wp-content/uploads/sites/13/dlm_uploads/2024/07/20240618_iCASP-Impact-report-san-Annex.pdf (2024).

5. Zhu, Q., Klaar, M., Willis, T. & Holden, J. Use of Spatially Distributed TOPMODEL to assess the effectiveness of diverse natural flood management techniques in a UK catchment. *Hydrological Processes* **39**, e70122 (2025).

6. Maybee, B., Birch, C.E., Böing, S. J., Willis, T., Speight, L., Porson, A. N., Pilling, C., Shelton, K. L. & Trigg, M. A. FOREWARNS: development and multifaceted verification of enhanced regional-scale surface water flood forecasts, Nat. Hazards Earth Syst. Sci. **24**, 1415–1436 (2024).

7. Yorkshire iCASP YouTube channel. https://www.youtube.com/channel/UCuArvTSP3qwBZLunMi_hziQ/videos [accessed 17 July 2025]

8. European Institute of Innovation and Technology. EIT Water. Available at https://www.eit.europa.eu/our-activities/call-for-eit-communities/eit-water [accessed 17 July 2025]

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Competing interests

The authors declare the following competing interests: all authors are members of the iCASP directorate team and have received research and research translation funding from some of the stakeholder partners involved in iCASP.

Figure caption

Figure 1. iCASP collaboration area focussed on the River Ouse drainage basin in Yorkshire, England, with example images of the area and applied water management practices following project co-design between academics and non-academic organisations.