I N S I G H T S

Resilience for Integrated Water Systems (RIWS)

On 6th February 2025 we held a progress meeting for DAFNI's Centre of Excellence for Resilient Infrastructure Analysis (CoE) projects where grant holders brought us up to date with progress on their projects.

The Centre of Excellence was funded by a £4m grant from UKRI in 2023, allowing DAFNI to fund 8 projects researching resilience in the natural and built environment using DAFNI as the high performance platform. The work forms part of the UKRI programme 'Building a Secure and Resilient World'.

Resilience for Integrated Water Systems (RIWS)

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The team together with Barnaby Dobson has already published a paper, 'Towards adaptive resilience for the future of integrated water systems planning', in Cambridge Prism: Water, on the link between the two aspects of the project – resilience assessment and adaptive planning. They are also preparing a review paper on the topic of performance-based resilience assessment for integrated water systems, and have another paper in progress in collaboration with DAFNI-project USARIS led by Associate Professor Francesca Pianosi of the University of Bristol, on resilience planning under deep uncertainties.

RIWS carried out a literature review into performance-based resilience for integrated water systems and identified 8 key challenges, mainly focusing on deriving consistent results across subsystems and interpreting resilience results for actionable management. Ana presented the project's recommendations for how existing performance-based resilience assessment can work, from unified resilience assessment approaches across subsystems, to stakeholder engagements to validate and refine assessments.

In the second part they looked at how to use the resilience assessment for adaptive planning. Firstly they carried out a literature review on Decision Making under Deep Uncertainty (DMDU), then decided to focus on flood resilience and narrowed the DMDU focus down to use "real options" – with the unique angle being using historical conditions to examine the cost efficiency of planning decisions in what they call the "known future".

When looking at the results, they used the "refined real options" approach, to look at different climate scenarios in a portfolio as the future unfolds in 10-year periods. This allows planners and researchers to reevaluate performance every 10 years and update the scenarios to take a more adaptive approach on implementations than the classic "real options".

The implement and monitor option present an opportunity to pause, for a reality check.

They used a case study of fluvial flood resilience in a small catchment in Luton, North London. The key results show the planning decisions from 1980 until 2020 – with the known future being the optimal set, of implementations across the 10 year intervals, had everything had been known.

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They also showed the real options and the refined real options, with interesting results showing both in the sequence of the implementation and the scale of implementation.

Benchmarking was used to show the deviation from what is theoretically optimal. The results showed that the real options were much more undersized in the early stages of planning and the refined real options more risk averse, but both DMDU approaches oversized regenerative farming as an option.

When applied to resilience and cost variables, the real options were generally lower cost but the resilience of the system was below what would be an acceptable level. The refined real options were more aligned with the known future, although tended to oversize slightly and the cost was higher with a higher threshold of resilience is higher. The work illustrates well the trade-offs between the variables. The intensity of climate change was also captured in the projections.

In terms of technical implementation, the WSIMOD model was put onto DAFNI at the very beginning and the RIWS team have added three upgrades so far: a calibration/parameter override, customisation of behaviour of model components, and creating a new component such as a natura-based solution. So DAFNI-users can choose to use the core functionality or use the additional elements.

Model availability

The Water Systems Integration Modelling framework (WSIMOD) is now publicly available and free to use on the DAFNI platform. WSIMOD is a powerful integrated water systems modelling tool that simulates key processes across the entire terrestrial water cycle, including:

- Water supply & demand
- Drainage, wastewater & surface runoff
- Groundwater dynamics
- River flow & water quality

To help users get started, an example model of the Luton catchment is available, showcasing how WSIMOD can support resilience planning and decision-making under uncertainty.

This is a great opportunity for researchers to explore complex water system interactions and develop better-informed strategies.

Try it now on DAFNI: https://www.dafni.ac.uk/

What's next?

The team plans to resilience profiles in a regional system for integrated water resources management – to research impact perspective at catchment scale, and how to use this for benchmarking and resilience profiles for different parts of England and the UK.

They also plan to use a multi-objective DMDU in integrated water system.