A systems approach to water management

Water management experts **Professor Dionysis Assimacopoulos** and **Michiel Blind** explain their collaborative work towards improving systemic eco-efficient water use

Could you sum up the EcoWater project? How has your group's research path led to its development?

EcoWater assesses how innovative technologies can improve the environmental and economic performance of water systems. Through a systemic approach, we examine the entire value chain, together with the water-use processes involved in the production of agricultural and industrial goods or the provision of potable water services. EcoWater is a new project in a long line of EU-funded research into technologies for managing water scarcity, which we set out on several years ago.

Most of the project partners work in the water domain, though with quite different and complementary skills. Some of us are more involved in technologies to improve the use of water and mitigate the adverse effects of this use; others are more concerned with assessment tools or economy. Over successive research projects, all partners have worked in collaboration with other groups from the Mediterranean region and all over Europe, developing interdisciplinary methodologies that can help to mitigate and alleviate water stress problems.

Can you elaborate on the term 'meso-level eco-efficiency metrics? What is their primary function?

During the last two decades, the concept of eco-efficiency has been recognised as a suitable measure of progress towards a greener and more sustainable economy. The prefix 'eco' refers to both economic and ecological performance, and eco-efficiency improvement refers to achieving increased added value while reducing the environmental burden. Therefore, it becomes critical to develop eco-efficiency metrics for measuring both the environmental and economic performance of a system. The meso-level dimension incorporates both the physical structure of the system and the rules governing the operation, performance and interactions of its components; providing a concrete, comprehensive and accurate assessment of the economic and environmental performance of each actor separately, as well as the system as a whole. The key advantage of the meso-level dimension is that, for each stage in the value chain, the economic added value and the environmental burden become clear.

EcoWater aims to develop eco-efficiency indicators for technology assessment. How will this benefit both the environment and the economy?

This can be illustrated through an example. Implementing a water-saving irrigation scheme, such that the crop yield remains the same, reduces the environmental pressure – in this case the water depletion. Some of the saved water may be used for previously unused farmland, adding economic value. In a real world we need to account for much more; does the new irrigation system use a lot of energy, reducing the economic benefit and increasing the environmental pressure related to energy use?

What are the key features of your analytical framework?

Our analytical framework consists of four distinct steps to aid informed decision making. A structuring first step leads to a clear, transparent view of the system at hand. The second step provides the means to assess its eco-efficiency. The first essential novelty is the distribution of economic costs/benefits and environmental pressures over different stages and stakeholders in the value chain. A second novelty is the strong link with life cycle analysis, including the impacts from the background systems. The third step includes assessing the impacts of technologies, which are combined in the last step with mid-term scenarios to determine the feasibility of implementing technologies. Our framework is tested through eight case studies, with varying water-use processes.

How does the use of case studies contribute to achieving the project's objectives? Can you explain, highlighting some examples, how their results will be utilised?

The improved environmental and economic performance of businesses and the offer of new, competitive and environmentally friendly products is a driving force of the European economy. However, the way to bring about such innovations systemically has rarely been explored. In EcoWater, we try to investigate exactly this question for the water sector. Through representative case study modelling, and a strong science-industry-policy interface, we want to understand what the true needs of the industry are and how these can be factored into policies that provide the appropriate incentives for water innovations. During the local workshops, several stakeholders – mainly managing the water-use processes – have shown interest in the preliminary results and are willing to implement the proposed technologies, provided they are convinced about their feasibility and the eco-efficiency improvement.

Eco-innovation in water use

A consortium of 10 universities and research institutes across Europe has been formed in order to find innovative methods to make use of water; the result is **EcoWater**, a project that aims to improve the overall eco-efficiency of water-use systems

THERE ARE FEW ingredients as important to the chemical existence of life as water, and throughout human history this seemingly ubiquitous substance has taken on diverse social, economic and political significance. Today, as communities and nations across the world struggle to curb their pollution of natural resources while simultaneously trying to keep their businesses efficient and profitable, the way people make use of water has never been more important. Accordingly, recent years have seen the development of advanced regulatory systems, policies and technologies, related to the management of water in Europe, designed both to protect the environment and provide advantages to the economy.

The problem with these measures is that they occur on two scales: micro and macro. On the micro scale, businesses, utilities and private users have become very aware of their behaviour when it comes to water use, leading to individual initiatives that benefit specific actors. On the macro scale, governments are measuring nationwide water use, environmental impact and economic efficiency – leading to more effective general legislation and management. The fact that optimum water use is being recognised as a priority in Europe is undoubtedly positive, but there is something missing from the current approach.

THE MIDDLEMAN

The blind spot of present water efficiency initiatives is in the middle or meso level, which bridges the gap between national and individual use. This is an area that is seldom tackled, perhaps because it is so much more complex than examining usage on either a small and manageable scale or in conveniently general terms. Looking at one particular water system and gauging its efficiency through multiple actors is no easy task, demanding the specificity of a micro approach combined with a scale more comparable to a macro system.

THE ECOWATER TOOLBOX

Based on the project's investigations and strong links with industry and policy makers, the consortium has launched the EcoWater toolbox, a suite of online tools for assessing ecological efficiency system-wide. Equipped with a continuously updated inventory of currently available technological innovations, as well as the finalised list of eco-efficiency indicators, the toolbox supports a comprehensive four-step assessment.

STEP ONE The toolbox allows the user to frame the case study by defining system boundaries, describing the water supply chain and the water value chain, including all the direct and indirect actors

STEP TWO The toolbox helps users establish a baseline eco-efficiency assessment, using the SEAT and EVAT tools to model the water supply and water value chains respectively

STEP THREE The user is able to make use of the toolbox's integrated technology inventory to identify both sector-specific and system-wide technologies and practices to suit their situation

STEP FOUR The toolbox enables the user to assess innovative technology solutions by developing predictive technology scenarios and comparing these with baseline results

THE TOOLS

Two tools have been developed in order to assess eco-efficiency in extended supply chains:

Systemic Environmental Analysis Tool (SEAT) – Addresses the supply chain and its components, processes and interactions, to provide the flow of materials (water, resources, products, etc.) that can be used for estimating the environmental components of the eco-efficiency indicators

Economic Value Chain Analysis Tool (EVAT) – Addresses the value chain, its actors and their interactions to provide monetary flows that can be used for estimating the economic component of the eco-efficiency indicators

This is the goal of EcoWater, a collaborative project between 10 European organisations, coordinated by Professor Dionysis Assimacopoulos. The partner organisations have all contributed to the development of models and procedures for estimating systemic eco-efficiency. The EcoWater consortium is therefore capable of calculating the total economic value of a water-use chain – as well as its environmental or ecological impact – and computing the overall effect that new technologies are likely to have on the system. Such an insight could prove a boon for businesses, utilities and private users, as well as policy makers. It is hoped that this solution will benefit all stakeholders, as well as the environment.

> Using the EcoWater modelling tools, the actors will be able to determine quickly, easily and methodically which technological innovations will be most useful to them as a group

GIVE AND TAKE

The basic issue that EcoWater aims to tackle is that changes to one part of the water system have an effect on other users, both upstream as well as downstream. Consequently, what seems like an efficient measure to an individual actor, may not, however, be efficient for the system. A business that can operate more eco-efficiently by producing less waste water, for example, is not necessarily benefiting the system as a whole if the local waste water utility subsequently loses a large part of its income, or has to operate sub-optimally due to the low flow. Likewise, what seems like an efficient technology to implement on a national scale may not be applicable in every region. The EcoWater vision is that instead of making decisions individually, actors in the water chain will sit down together and calculate the overall benefits of measures before they are taken – a process that will be facilitated by the project's decision support system.

Using the EcoWater modelling tools, the actors will be able to determine quickly, easily and methodically which technological innovations will be most useful to them as a group, and what impact they might have on the water system under consideration, in terms of eco-efficiency, affecting both its economic and its ecological/environmental performance. This process will include mapping the water system and assessing not just site-specific innovations – such as high-efficiency irrigation systems or low-flow shower heads – but also innovations applied to the water supply chain.

A CASE FOR STUDY

In order to devise tools that are as versatile and reliable as possible, the consortium undertook eight case studies to gain a specific insight into water use in a wide range of environments. These investigated the textile industry in Italy, the demands of dairy farming in Denmark, and even water use for the generation of electricity in The Netherlands. In every instance, comprehensive interviews and workshops were conducted to establish the opinions of key actors. Two series of local events are planned in each case study region, with participation from local stakeholders. The first workshops, which have already been organised, aim at the accurate mapping of each water-use system, while the second will focus on the dissemination and discussion of results among consortium members and local actors.

SPREADING THE WORD

The EcoWater consortium has already disseminated its work in two large-scale events – the AquaConSoil Conference and the AquaTech Exhibition – and the researchers plan to expand on this success by addressing national and European policy makers at Green Week 2014 in Brussels. Now in its final year, most of what the consortium intended to accomplish has been achieved; like clean water, the fruits of their labour will be freely available going forward.

INTELLIGENCE

ECOWATER

MESO-LEVEL ECO-EFFICIENCY INDICATORS TO ASSESS TECHNOLOGIES AND THEIR UPTAKE IN WATER USE SECTORS

OBJECTIVES

- Selection of meso-level eco-efficiency indicators, suitable for assessing the systemic eco-efficiency improvements or deteriorations from innovative technologies
- Integration of methods and tools into a coherent modelling environment for the system-wide environmental and economic benchmark of innovations
- Elaboration of case studies in different water-use systems to assess innovative technologies in terms of their holistic contribution to eco-efficiency improvements

KEY PARTNERS

National Technical University of Athens, Greece • **Istituto Agronomico Mediterraneo di Bari**, Italy • **MITA SAS**, Italy • **Deltares**, The Netherlands • **University of Applied Sciences Northwestern Switzerland**, Switzerland • **University of Porto**, Portugal • **University of Architecture, Civil Engineering and Geodesy**, Bulgaria • **Open University**, UK • **DHI**, Denmark • **IVL Swedish Environmental Research Institute**, Sweden

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