European Commission

LIFE's Blueprint for water resources

LIFE Environment

Environment

EUROPEAN COMMISSION
ENVIRONMENT DIRECTORATE-GENERAL

LIFE ("*The Financial Instrument for the Environment*") is a programme launched by the European Commission and coordinated by the Environment Directorate-General (LIFE Units - E.3. and E.4.).

Authors: Gabriella Camarsa (Environment expert), Justin Toland, Tim Hudson, Wendy Jones, Jon Eldridge, Ed Thorpe, Christophe Thévignot (AEIDL, Communications Team Coordinator). **Managing Editor**: Hervé Martin, European Commission, Environment DG, LIFE E.4 – BU-9, 02/1, 200 rue de la Loi, B-1049 Brussels. **LIFE Focus series coordination**: Simon Goss (LIFE Communications Coordinator), Valerie O'Brien (DG Environment Communications Coordinator). **Technical assistance**: Lynne Barratt, Roberto Ghezzi, Mariona Salvatella, Katerina Raftopoulou, Eva Roben, Mickaelle Rousseleau, Monica Marrucci (Astrale GEIE). **The following people also worked on this issue**: Federico Nogara, Santiago Urquijo-Zamora, Alexis Tsalas, Alban De Villepin, Sylvie Ludain (Environment DG, LIFE Environment and Eco-innovation Unit), Helen Jolly (Environment DG, Protection of Water Resources Unit), Nicola Notaro (Environment DG, Deputy Head of Protection of Water Resources Unit). **Production**: Monique Braem (AEIDL). **Graphic design**: Daniel Renders, Anita Cortés (AEIDL). **Photos database**: Sophie Brynart. **Acknowledgements**: Thanks to all LIFE project beneficiaries who contributed comments, photos and other useful material for this report. Photos: Unless otherwise specified; photos are from the respective projects. Cover photo: River Restoration Centre (UK)

Luxembourg: Publications Office of the European Union, 2012

ISBN 978-92-79-27206-6
ISSN 1725-5619
doi:10.2779/39850

Printed in Luxembourg
Printed on recycled paper that has been awarded the EU Ecolabel (http://ec.europa.eu/ecolabel/)

FSC www.fsc.org RECYCLED Paper made from recycled material FSC® C103749

carbon neutral natureOffice.com | LU-319-035986 print production

Foreword

Peter Gammeltoft
Head of Unit ENV D.1 - Protection of Water Resources
European Commission

The year 2012 was the 'Water Year' for the European Commission. In the last 12 months the Commission has published 'The Blueprint to Safeguard Europe's Water Resources' ("Water Blueprint"), together with the 3rd Implementation Report on the Water Framework Directive and a review of the Strategy on Water Scarcity and Droughts.

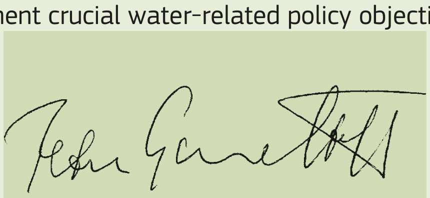
To achieve the Water Framework Directive objective of good water status by 2015, the Water Blueprint sets out a three-tier strategic approach: it will concentrate on better implementation of current water legislation; integration of water policy objectives into other policies; and, where necessary, on filling gaps with regards to water quantity and efficiency. The objective is to ensure that a sufficient quantity of good quality water is available for the needs of citizens, the economy and the environment throughout the EU. To this end, the Water Blueprint should be seen as a "toolbox" that Member States can use to improve water management at river basin level.

The time horizon of the Water Blueprint is closely related to the EU's 2020 Strategy and, in particular, to the 2011 Resource Efficiency Roadmap, of which the Blueprint is the water milestone. However, the analysis behind the Blueprint looks ahead to 2050 and is expected to drive EU water policy over the long term.

The project-based approach of the EU LIFE programme has proved a good fit with water policy, providing practical examples of sustainable and equitable ways of using water. This publication contains many such examples from LIFE Environment (and Nature) projects across Europe.

LIFE co-funding has been used to address crucial water-related issues, from the quantity and quality of ground and surface waters to the impact of water scarcity in the Mediterranean (and other) areas. LIFE Projects have contributed to the development of 'green infrastructure' by supporting natural water retention measures, have improved water efficiency and water re-use in agriculture and industry and provided examples of ways to improve water governance and pricing methods..

Such "lessons from LIFE" continue to inspire responses to the water challenges we face today and for the future. Therefore, this publication provides a "blueprint" of practical actions that implement crucial water-related policy objectives.



Peter Gammeltoft

Table of contents

INTRODUCTION

A Water Blueprint for Europe

EU policy has made a significant contribution to the protection of water resources across Europe. The newly-launched 'Water Blueprint' is designed to help overcome barriers to the implementation of existing EU water policy goals.

The Water Framework Directive (WFD) of 2000 addressed for the first time in a comprehensive manner all the challenges faced by EU waters. The directive established a legal basis to protect and restore clean water across Europe and ensure it is used sustainably, setting for Member States the objective of achieving 'good water status' by 2015.

However, a number of challenges remain. Notably, there are still conflicts between water policy and other policy objectives, a few gaps in the current water legislation and significant weaknesses in its implementation.


Photo: European Commission

European Commissioner for the Environment, Janez Potočnik opening the EU Water Blueprint Conference (Nicosia, Cyprus - November 2012)

In response to these challenges, in November 2012 the European Commission adopted 'The Blueprint to Safeguard Europe's Water Resources[1]', a Communication based on an extensive evaluation of existing policy. The 'Blueprint' identifies problem areas and suggests measures in relation to a number of interconnected water management challenges:

Land use and the ecological status of EU waters: The recent assessments of River Basin Management Plans (RBMPs) show that 'good ecological status' is currently achieved in only 43% of freshwater bodies (this may increase to 53% by 2015 on the basis of the measures foreseen by the plans).

The main pressures originate from changes to water bodies that break up river continuity and hamper fish migration. These include dams for hydropower and navigation, embankments for flood protection and changes caused by agriculture.

The Blueprint envisages the use of Strategic Environmental Assessments (SEA) in addition to Environmental Impact Assessments (EIA) whenever there are plans to make significant changes to water bodies. Pressure from agriculture and flood protection should be mitigated or prevented using buffer strips and green infrastructure (e.g. restoration of riparian areas, wetlands and floodplains). Expansion of such infrastructure requires that Member States make full use of the integrated approach to policy implied by RBMPs.

Other significant pressures caused by over-allocation and illegal abstraction can be addressed by means of sound quantitative water management based on the identification of the ecological flow[2] in the case of the former and the use of satellite imagery to identify areas being over-irrigated for the latter.

Chemical status and water pollution: Although monitoring indicates that the chemical quality of EU water bodies has improved in the last 30 years, the status of 40% of water bodies is still unknown. Monitoring obligations thus need to be fully fulfilled.

1 The Blueprint to Safeguard Europe's Water resources - Communication from the Commission (COM(2012)673)

2 The amount of water required for the aquatic ecosystem to continue to thrive and provide the services we require.

The Blueprint acknowledges that diffuse and point-source pollution still create pressures on the water environment, producing eutrophication. To counteract this, nitrate vulnerable zones should be extended and compliance with wastewater treatment requirements improved through long-term investment and implementation plans. The implementation of EU legislation on industrial emissions, chemicals and pesticides needs to contribute to addressing the risks to the aquatic environment.

EU water efficiency: Water scarcity and water stress are expected to affect half of all EU river basins by 2030 [3]. The Blueprint highlights the importance of water efficiency measures as means of saving water (and energy). Article 9 of the WFD requires implementation of pricing policies that provide an incentive to use water efficiently, as well as cost-recovery for water services. Since limited progress has been made in the implementation of such measures, the Blueprint proposes developing a guidance document to assess their costs and benefits. Proposed additional actions for improving water efficiency include water accounts at river basin and sub-catchment level to provide a realistic picture of how much water is available before allocation takes place, as well as water efficiency targets for water stressed river basins based on a common EU methodology. The Blueprint also foresees that water efficiency measures should be developed in the building sector, for the eco-design of water-related products, in irrigation and distribution networks. Water trading is another instrument that could help to improve water efficiency.

3 European Environment Agency *State of Water* report

Poster session at the EU Water Blueprint Conference in Cyprus

Photo: European Commission

EU water vulnerability: The resilience of the aquatic ecosystem to adapt to climate change needs to be improved, given the increasing trend towards extreme events. The Blueprint suggests implementing natural water retention measures, an example of green infrastructure, and reducing soil sealing to limit the negative effects of floods and droughts. Another option to improve resilience whilst increasing water availability is the re-use of water for irrigation and industrial purposes. Re-using treated water is considered to have a lower environmental impact than other solutions such as desalination plants or water transfers.

Cross-cutting solutions: The Blueprint proposes cross-cutting instruments to support the implementation of the foreseen measures. These include Innovation Partnerships on Water and on Agricultural Productivity and Sustainability that will help find solutions to water challenges in the urban, industrial and agriculture contexts. Other measures are designed to strengthen the knowledge-base and improve governance, such as expanding the scope of the Water Information System for Europe (WISE); further developing the Commission Joint Research Centre hydro-economic model (which can help water managers determine the cost-effectiveness of their RBMPs); and establishing a voluntary peer-review system for RBMPs.

Global aspects: Whilst it focuses primarily on EU waters, the Blueprint recognises the international dimension of water management. Thus, it proposes that EU development cooperation with regards to water management should focus on access to safe drinking water and basic sanitation services; integrated water resources management; water for economic growth and sustainable development; and water governance.

In conclusion, the Blueprint has set out a clear goal and path for EU water policy. Its measures should contribute to the protection of the EU's water resources; help in addressing biodiversity loss and the degradation of ecosystem services; and support efforts to adapt to climate change whilst helping the EU to become a more resource efficient economy based on green growth.

The Common Implementation Strategy under the WFD is expected to fully involve Member States and stakeholders to deliver together the implementation of the Blueprint proposals.

INTRODUCTION

LIFE's role in safeguarding EU water resources

For the past two decades, LIFE funding has supported numerous projects on the theme of water, both within the EU and beyond. LIFE projects have addressed many of the issues highlighted by the Water Blueprint, and the programme offers the potential to help tackle others as part of an integrated approach to safeguarding Europe's water resources.

Of the 3 708 projects co-financed by the LIFE programme since 1992, more than 900 have concerned water. A total of 395 of these have been LIFE Environment projects, with around one-third of those helping to contribute to the implementation of the Water Framework Directive (WFD - 2000/60/EC). In terms of country distribution, funding has spread out fairly evenly among the Member States, with Italy, Spain and Germany receiving the most funding.

Water is clearly an important thematic element of the LIFE programme and LIFE has been shown capable of contributing to EU policy at different stages in the policy cycle (including scoping, policy development, policy implementation and policy evaluation/review). Whilst some projects have successfully contributed to environmental policy at the national or EU level, most LIFE water sector projects act at the local level, where they have helped in the development of new technologies and shown how future legislative targets can be reached. Significantly, LIFE projects have contributed to resolving difficulties that Member States encounter when implementing the WFD and daughter directives and, as a consequence, provided innovative approaches that could influence policy development in the future[1].

MAPPING LIFE AGAINST THE BLUEPRINT

The LIFE projects included in this publication offer good examples of solutions to a number of the issues raised by the Water Blueprint, but more needs to be done. For instance, whilst the LIFE programme has been very strong in funding projects on water quantity, quality, river and wetland restoration and water-related agricultural projects, it has been less effective at targeting other areas such as water pricing; water efficient buildings and appliances; the re-use of water in agriculture; sustainable urban drainage systems (SUDS); or soil sealing (see Figure 1).

In this regard, the programme could be said to be mirroring wider trends in society, where water-efficient buildings are a relatively new concept, for instance, and where the application of water pricing schemes has proven problematic.

Photo: 2012 TOIVONEN Olli

LIFE Environment projects have contributed to the implementation of the WFD and to protecting EU water resources

1 See "Contribution of LIFE ENV/INF/NAT projects to the implementation, dissemination and further development of EU environmental policies and legislation - Water Sector" study by Astrale http://ec.europa.eu/environment/life/publications/lifepublications/generalpublications/documents/160812water_report.pdf (2012)

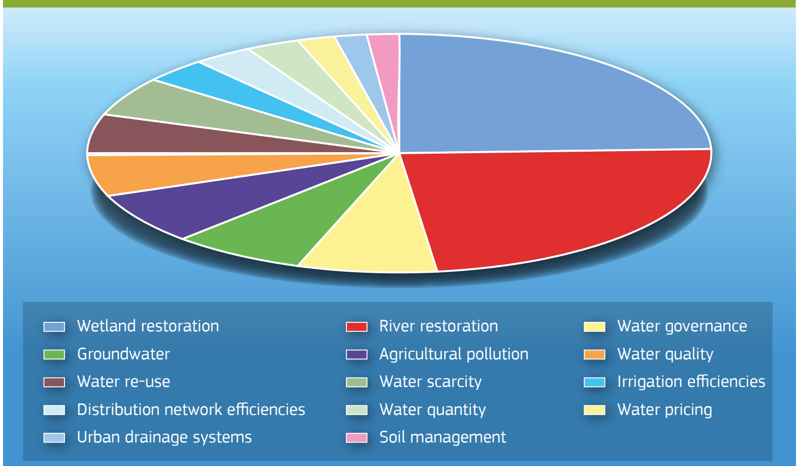
LIFE projects have been especially strong in delivering results on water quality and quantity targets, and in providing integrated approaches that have helped water authorities to adopt good water management solutions aimed at meeting the requirements of the WFD. LIFE has contributed, in particular, to the implementation of river basin management plans (RBMPs) through the integration of data capture, modelling and management techniques.

Water policy is a crosscutting issue, relevant to a wide range of economic sectors and geographical contexts. With regard to the latter, one of the strengths of the LIFE programme is that it has funded many projects that have developed solutions tailored to the differing needs of the Member States in terms of water scarcity, quality, quantity and efficiency, offering targeted solutions at a local level. A project in one Member State dealing with an issue such as saltwater intrusion or groundwater remediation will often have important lessons for another Member State facing similar issues. LIFE also supports transnational actions.

LIFE funding has provided excellent examples of stakeholder involvement that have helped in reconciling the contrasting economic interests that place stress on our water bodies and in promoting cooperation for effective policy implementation.

Numerous LIFE projects have improved the qualitative and quantitative status of water bodies either by developing new technologies or management techniques in agriculture or by demonstrating alternative cultivation practices. They have helped in combating eutrophication by reducing the use of pesticides and fertilisers and their run-off; limited soil erosion; demonstrated the effectiveness of using buffer strips; improved irrigation efficiency; and helped in solving potential conflicts between EU agricultural and water policies.

Figure 1: **LIFE projects and water issues**



Source: LIFE project database

LIFE has co-financed a large number of river and wetland restoration projects (via both the Environment and Nature strands of the programme). These have taken steps to improve natural water retention measures in both rural and urban areas, helping to alleviate flood risks and developing green infrastructure that has, in turn, reinforced the ecosystem services provided by the rivers and floodplains (such as the "cultural service" of enjoying a day out in a 'natural' river landscape). Last but not least, water projects have favoured the increase of biodiversity and the conservation of threatened species.

LIFE projects have also addressed the issue of improving efficiencies in distribution networks. Acoustic technology, remote sensing systems and other innovations have been applied to determine water leakages and projects have demonstrated good practices in terms of prevention and repair of leaks.

Opportunities to realise the Blueprint

The LIFE programme has the potential to address many of the issues outlined by the Water Blueprint. In the industrial sector, for instance, an array of projects already have focused on water re-use and water savings in the production process and there is room for further work in this area. There are also opportunities for projects that target improved use of water, whether through developing and promoting more water-efficient design, or by encouraging water re-use in the agricultural sector.

LIFE projects have the scope to address water pricing issues, in particular by devising means of incorporating not only the financial costs, but also the environmental and resource costs of water, for instance by helping to define and apply the concept of "environmental flows" (E-flows). LIFE could also play an important role in drafting a common set of water stress indicators and targets at river basin level to improve water efficiency.

Such future developments would build on the good work of many LIFE projects to date in addressing the key issues around Europe's water resources that are outlined in the Water Blueprint.

Water Quality & Quantity

The EU faces significant pressures on water quality and quantity. The LIFE programme offers a string of useful lessons about effective management of groundwater resources, ways to combat water scarcity and tools and techniques for implementing River Basin Management Plans and ensuring there is sufficient good quality water available for all our needs.

WATER QUALITY & QUANTITY

Grounding water management policy in practice

Good water management needs to address groundwater in order to ensure reliable supplies of water to support human activities, economies and water-dependent ecosystems. The LIFE programme has co-funded a range of innovative groundwater-related projects.

Photo: LIFE04 ENV/IT/000500

The 'CAMI' project developed an integrated approach to help river basin managers quantify groundwater

Groundwater provides the basic flow of rivers and wetlands. Maintaining this flow and avoiding its pollution is vital for surface water ecosystems. Groundwater is also an essential source for drinking water, supplying water to three out of four EU citizens.

Groundwater is generally abundant in the EU, however, water availability and population distribution are uneven, thus producing cases of water stress. This can arise when the demand for water exceeds the available quantity in a certain period and it usually occurs in areas with low rainfall and a high population density (i.e. in cities or in tourist destinations in Mediterranean countries) or in areas with intensive agriculture and industry. The main use of abstracted water is as a coolant in energy production (45%), followed by agriculture (22%), the public water supply (21%) and industry (12%)[1]. In general, aside from reducing water availability for end-users, over-exploitation of water resources can lead to salt water intrusion in aquifers and drying out of natural areas[2].

The Water Framework Directive[3] provides a framework for integrated management of groundwater and surface waters at EU level[4]. It highlights the importance of groundwater bodies and prescribes,

1 The European Environment – State and Outlook 2010 – Water Resources: Quantities and Flows
2 EEA
3 EU Water Framework Directive (2000/60/EU) http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32000L0060:EN:NOT
4 http://ec.europa.eu/environment/water/water-framework/info/intro_en.htm

among others, different steps to Member States in order to achieve good (quantitative and chemical) status by 2015. These include: defining groundwater bodies within river basin districts, establishing groundwater monitoring networks, setting up a River Basin Management Plan (RBMP) for each river basin district with a summary of pressures and impacts, monitoring results, making an economic analysis of water use and instigating protection programmes.

According to the directive, to achieve "good ecological status" there must be a balance between water abstraction and recharge of the groundwater bodies[5] that would thus guarantee minimum environmental flows for water bodies[6]. According to the Water Blueprint, quantative water management should establish water balances and targets. Water allocation should be optimised and prioritised and based on the analysis of past and future trends of water demand and related risks.

LIFE and groundwater

The LIFE programme has funded projects that have developed tools and models to help river basin managers quantify groundwater, analyse the environmental impact of human activities on water resources and determine ways to exploit this resource sustainably. The 'CAMI' project (**LIFE04 ENV/IT/000500**), based in the Torrate di Chions area of north-east Italy, developed an integrated approach that served to assess the characteristics of the whole river basin in view of its future management. The project managed to construct a comprehensive model of all groundwater. The first step was to model the hydrographic district of the Tagliamento river basin using integrated geophysics, including seismic and geoelectric surveys and ground-penetrating radar. The large amount of data produced by the many scientific disciplines working in the project was integrated into the Regional Geohydrological Information System (REGIS), a computer-based system developed by the beneficiary, in order to produce a comprehensive groundwater framework.

Groundwater flow data for the whole Friuli-Venezia Giulia region was entered into the groundwater model and simulations run using different scenarios. One notable result, which confirmed the potential of non-invasive geophysical methodologies for the location of underground water bodies, was the discovery of an aquifer using geophysical data collected by the project. The excellent qualitative characteristics of this aquifer mean that it could be strategically useful to deal with any future water crises.

The project's results provided an important aid to evaluating use of water resources and the effects of further groundwater extraction. The methods used have been widely promoted amongst national and international managers of water resources and the resulting final guide protocol includes detailed cost-benefit analysis of the procedures.

Reducing over-exploitation of groundwater

Groundwater exploitation rates often exceed recharge capability, thus increasing risks of pollution, depletion and permanent hydrogeological damage. The 'A.S.A.P.' project (**LIFE06 ENV/IT/000255**) demonstrated the economical and technical viability for preventing the over-exploitation of groundwater systems. The project was located in the Arno river plain (Pisa, Italy). Approximately 95% of the water resources in this area are drawn from wells that tap into the Bientina aquifer. Some 17 million m^3

Map of the Arno river plain in Pisa (Italy)

Photo: LIFE06 ENV/IT/000255

5 There is only a certain amount of recharge into groundwater each year, and of this recharge, some is needed to support connected ecosystems (whether they be surface water bodies, or terrestrial systems such as wetlands). For good management, only that portion of the overall recharge not needed by the ecology can be abstracted - this is the sustainable resource, and the WFD limits abstraction to that quantity. http://ec.europa.eu/environment/water/water-framework/info/intro_en.htm

6 Environmental flows (E-Flows) are the quantity of water that nature needs for the good ecological status to be achieved and the provision of ecosystem services to be maintained.

of groundwater is withdrawn from this aquifer each year, and this over-use has triggered a significant decrease of piezometric heads (water pressure measurement), subsidence phenomena and decreasing water quality.

The project used an integrated approach to optimising networks that combined technologies such as leak detectors, GIS and modelling systems and simulators. The project successfully demonstrated the approach on the aquifer-fed system in Pisa, reducing groundwater abstraction by 11% and system losses from leaks by 15% over the course of the project. As a result, the negative trend of the piezometric level of the aquifer was reversed with an average build-up of + 0.3m from 2005 to 2008 and peaks ranging from 0.5m to 1m. The approach also reduced energy consumption from pumping (and the related emissions) by 10%.

One of the most important outcomes of the project was the 'A.S.A.P. Protocol' of good practices, which raised considerable interest amongst local and regional public administrators. The protocol was included in the White Paper "A Strategy for Water Supply in Tuscany" and has been replicated at the water utility of the Fiora Aqueduct (Tuscany). The project also potentially contributed towards the development of a sustainable economic and pricing model for water supply (see pp. 64-66). The project protocol translates even limited resources into effective action plans for efficient abstraction and leakage cutdown, increasing the life of infrastructure, reducing maintenance costs of plants and facilities, reducing mean time between failures and mean time to restore.

The 'ENSAT' project tested an infiltration pond for the degradation of organic micropollutants and a decantation pond from where the aquifer is recharged

Photo: LIFE08 ENV/E/000117

Aquifer recharge

Artificial recharge (AR) is a means of counterbalancing natural water losses and thus an effective tool to protect groundwater. AR techniques have already been applied to saltwater aquifers to combat salt intrusion, but AR is not regulated at EU level and national water directives limit its application to saltwater aquifers. If not regulated, large-scale use of AR would entail risks both for the quality (pollution, accidental mixing of freshwater coming from different water bodies) and quantity of freshwater (e.g. changes in the dynamic behaviour of the aquifer).

The 'WARBO' project (**LIFE10 ENV/IT/000394**) seeks to develop new regulations for aquifer recharge that could be adopted throughout Europe. The initial test phase will concentrate on sites with AR problems. The project will develop experimental protocols that will define the administrative procedures to be followed, and will specify how to manage recharge activities. The protocols will concern direct (hydrogeological, geochemical and isotopic) and indirect (geophysical and remote sensing) methods, and will be finalised and applied to two main macro-areas. It will define a recharge method and develop a model to evaluate the response of aquifers to the 'WARBO' method. The expected outcomes of the project are a reduction in subsidence - since less underground water will be withdrawn - and the use of aquifers as water storage and transport systems as an alternative to building dams and costly water-supply systems.

The 'AQUOR' project (**LIFE10 ENV/IT/000380**) is also dealing with the sustainable management of groundwater resources but with a more participatory approach. The project is located in the Po valley of the Veneto Region, an area characterised by water stress and where the natural water availability barely matches demand. The valley's natural infiltration capacity has been compromised and changes in river flows represent an environmental problem, as well as a direct threat to public health. The hydrological water reserves are rapidly dwindling because of changes in precipitation patterns, soil sealing and an increase in water extraction for general and industrial uses. The project will develop a GIS information system for the upper Vicenza Plain and demonstrate the technical and economical viability of methods for groundwater recharge with the aim of reducing water extraction by 10% in the upper plain whilst achieving a 30% gain in recharge water coming from the Astico river. It will be based on a participatory approach that will establish a process for shared decision-making and clarify the role of the different stakeholders that affect the groundwater resources and develop integrated governance of groundwater resources at a local level.

Studies have shown that physical, chemical and biochemical processes associated with water movement within the subsoil – so-called 'Soil Aquifer Treatment' (SAT) - represent an alternative and natural way of reducing the presence of "emerging organic micropollutants" in water and soils. The Spanish 'ENSAT' project (**LIFE08 ENV/E/000117**) tested the potential of SAT as a tool for the managed aquifer recharge (MAR) of the Llobregat aquifer, the main source of water for the Metropolitan Area of Barcelona.

The goal of the beneficiary, CETaqua, was to use man-made technologies to enhance and optimise natural SAT processes and to disseminate the results. After lab testing to identify the best organic carbon source to enhance degradation of organic micropollutants, the chosen reactive organic substrate layer – which turned out be the vegetable compost - was installed at an existing MAR site at Sant Vicenç dels Horts. The site, which is used mainly to treat tertiary effluent from the El Prat del Llobregat wastewater treatment plant, consists of an infiltration pond, which promotes the degradation of organic micropollutants, and a decantation pond from where the aquifer is recharged.

The 'ENSAT' team placed the reactive layer at the base of the infiltration pond and monitored its capacity to remove pollutants and improve water quality. Results were positive: a reduction in concentrations of some micro-pollutants of 50-75% was observed. The beneficiary believes that the lessons learned from this LIFE+ project could be applied elsewhere in Europe in pilot and full-scale AR plants.

Saltwater intrusion

When groundwater abstraction exceeds recharge there is a lowering of the groundwater table, which can lead to saltwater intrusion into aquifers. Once this happens the water must either undergo desalination or freshwater needs to be abstracted from other groundwater or surface water bodies, which transfers water stress to other areas. The 'SALT' project (**LIFE07 ENV/IT/000497**), located in the Italian Marche Region, analysed the trends of saltwater intrusion into the Esino River catchment and related aquifer. Several wells located in the lower river valley were at risk of contamination as a result of the uncoordinated and unsustainable way in which water was being abstracted to meet the demands of the public water supply network, industry and agriculture.

The project developed a monitoring system for the Esino river basin and its groundwater in order to obtain the necessary data for mathematical modelling of the entire hydrologic system of the basin. Once the model was calibrated it was used for simulating the impact of saltwater intrusion both under present and future scenarios. The model was also used to formulate remediation techniques depending on local conditions. These included: artificial recharge of the groundwater (by using water from existing canals, collecting water in quarries, or through injection of fresh water in deep wells); extraction of saline and brackish groundwater; withdrawing less water; reclamation of land to create a foreland where a freshwater body may develop and delay the inflow of saline water; the creation of physical barriers, such as sheet piles or clay trenches; and the injection of chemicals. The tools used and developed within the frame of this project are designed to be easily updated and upgraded in the future and also to be transferable, so the project could be easily replicated in other river basins.

Photo: LIFE07 ENV/IT/000497

A monitoring system for the Esino river basin and its groundwater was used to obtain data for the basin's entire hydrologic system

DID YOU KNOW?

Over 95% of the world's freshwater, excluding glaciers and ice caps, is found underground.

Source: http://ec.europa.eu/environment/water/participation/pdf/waternotes/water_note3_groundwateratrisk.pdf

WATER QUALITY & QUANTITY

Dealing with **the impact of water change**

The 'WATER CHANGE' project developed a methodology and tool to assess the impact of "global change" on the availability of water resources in the Llobregat river basin in Catalonia, Spain. The project provides useful lessons for the sustainable management of water resources elsewhere.

The project developed a methodology to tackle Global Change that was applied to the Llobregat basin

The Llobregat river supplies water to the densely populated metropolitan area of Barcelona, which is home to more than 5 million people. The basin has three dams, which are crucial for water supply, and five aquifers. The upstream aquifers regulate the river flow, whereas the downstream aquifers are used for supply and as reservoirs in cases of drought.

"Water demand is quite high. The river basin supplies approximately 350 hm^3/yr for urban and industrial uses and 30 hm^3/yr to agriculture," explains Laurent Pouget, researcher and project manager at CETaqua, a Barcelona-based 'technology centre for Excellence in the complete water cycle'. As a consequence water availability is an issue for the Llobregat river basin. This is complicated by the fact that "water management in this area is rather complex," says Mr Pouget: "Aside from surface water extraction, water is also extracted from aquifers or transferred from other rivers. Furthermore, a desalination plant was constructed after a drought in 2007 and part of the water from the wastewater treatment plant is also reused."

These factors made it imperative to develop a comprehensive water management tool that would enable decision-makers to take into account the complexity of the river basin and its infrastructure.

The idea behind the project

To develop such a tool, CETaqua proposed a LIFE+ Environment project, 'WATER CHANGE' (**LIFE07 ENV/E/000845**), which started up in January 2009. The main goal of the project was to provide the tools and methodology necessary to model the impact of "global change"[1], focusing on the effects it may have on water resources, with regards to water quantity, quality and infrastructure. Through the modelling process, it was hoped to be able to propose different scenarios of cost-efficient adaptation measures to face global change impacts on water resources insupport of policy-makers regarding the strategies that need to be implemented.

'WATER CHANGE' was a way of identifying whether or not existing water resources and infrastructure were sustainable and long-lasting and, if not, "what investments were necessary to make them so," says Mr Pouget.

Methodology and modelling

To be able to simulate global change impacts and thereafter, develop adaptation strategies, it was first necessary to understand the cause of the changes and how they impact on water resources. The project used the DPSIR framework[2] to (I) define global change scenarios, (ii) develop an integrated tool that could analyse their impact and (iii) make a comparison of adaptation strategies based on a cost-benefit analysis.

The 'WATER CHANGE' team considered three drivers of global change: climate change (precipitation patterns, temperatures and extreme events), land use (urbanisation, agriculture and forest management) and water demand affected by demographic evolution.

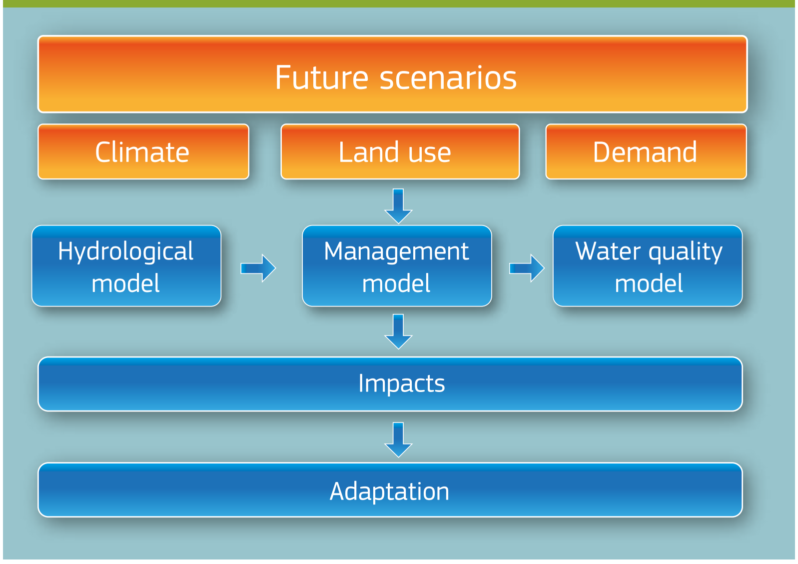
"At first we had to collect an enormous amount of data of all types to insert into the database that was connected to the modelling tool," recounts CETaqua researcher, Suzy McEnnis. "Topographic and geological data, as well as information about climate scenarios, aquifers and water uses and quality were all entered in the custom-created Water Change Modelling System (WCMS) database."

To address the interdependency between different water resource management issues at the river basin scale (hydrology, management) an integrated tool was developed linking several models of the water cycle. The WCMS incorporates two different models: a hydrological model and a water management model. "The innovation of our project was to create a tool combining these automatically as usually they are used separately, says Ms McEnnis. "The modelling system stores data from scenarios of global change and gives results in terms of impacts on water resources through a user-friendly graphical interface. It also incorporates a Decision Support System (DSS) for long-term planning of water resources, which helps in the water management decision-making process."

> *"If we don't do anything we are going to have problems of water availability and deficits in the future"*

The research team created its own hydrological model to predict the quantity of water flowing in the river basin in each month from 2011-2020. This was linked to a water management model and used to test a range of global change (climate change, land use and water demand) scenarios developed by the

Figure 2. **The Water Change approach and tool**



1 *Global change is defined as all the anthropic-related changes that have a direct or indirect impact on water quantity and quality and influence the sustainable management of the water resources in a river basin, including climate change, changes in land use and water demand.*

2 *This approach stipulates that: "the Drivers of change generate Pressure on the environment, modifying its State, therefore causing some Impacts that could finally stimulate a Response from society".*

project. "Given the uncertainty of predicting the future we had to create the greatest number of global change scenarios possible and input these scenarios in the model to determine the possible future impact," explains Ms McEnnis.

A total of 65 scenarios were created with the data acquired. "Once you have created a scenario of global change, you link it to the data in the database which is used to run the WCMS and then it gives us the results and future scenarios. It produces data and graphs giving you easy-to-read and comparable results," she continues.

With these scenarios as inputs to the modelling system, the project simulated the hydrological response of the Llobregat basin to evaluate the vulnerability of its water resources for three time horizons (2030, 2050 and 2100).

Alternative futures

"The results are different from one scenario to another: in 2100 we can have no deficit or deficits of up to 40%," notes Ms McEnnis, which makes it "hard to know what measures to adopt now and how much to spend." Thus the project set about developing a set of indicators that would enable decision-makers to analyse and understand the results and projections produced by the WCMS tool for the three timeframes. The team also made projections on the state of the aquifers in case of low, medium and great changes and in all cases the variation of the aquifer recharge is quite important. "If we don't do anything we are going to have problems of water availability and deficits in the future," says Ms McEnnis.

The hydrological model of the Llobregat river basin

The overall trend demonstrated by the results and projections is for the impact of global change to increase over time and for there to be significant water deficits in the future. In 2030 the deficit may reach 10% of the demand; in 2100 it could be as much as 40%. The different scenarios make it difficult to predict what will actually happen in the future. However, all scenarios lead to the conclusion that demand will not be met if we do not adapt. Therefore early adaptation is essential, from an economic as well as a social and environmental standpoint. For instance, whilst adopting different adaption measures to ensure an adequate water supply until 2040 would imply an investment equal to 1% of Catalonia's GDP, the cost of not adapting would be worse as this would imply financial losses for agriculture and industry as well as cuts to the welfare state. The costs for society in this case would amount to 4% of Catalonia's GDP in the years of drought.

Selecting strategies for adaptation

With the results in hand, CETaqua then assessed which adaptation strategies could best be applied to the Llobregat river basin in order to avoid future water shortages. A cost-benefit analysis (CBA) was carried out of the many temporary and permanent adaptation measures available. These include measures both on the supply-side (rainwater harvesting, desalination plants, aquifer recharge, wastewater re-use, reservoirs and water trucks) and on the demand side (irrigation efficiency, reduction of network leakages, metering, tariff models, water audits for industry and water scarcity awareness campaigns).

Each measure was at first studied in terms of amount of water gained and the price of implementation. Three adaptation strategies were identified for 2030 (economic projections for the long-term scenarios were considered unreliable) with the aim of avoiding water deficit at the lowest cost. Each of the three scenarios represents a possible future condition of water availability, ranging from no deficit to a 7% deficit.

"We did not propose measures but adaptation strategies because we need packages of more measures put together that offer feasible solutions avoiding deficits in the basin while optimising the investments and costs," explains CETaqua researcher Monica Reyes.

The strategies proposed were: a high-adaptation strategy covering 70% of the monthly deficits; a medium-adaptation strategy covering 50% of the monthly deficits; and a low-adaptation strategy covering 30% of the monthly deficits. Each of these strategies was tested for the three scenarios with the aim to knowing which water stress has been avoided and which cost should be assumed. "These alternatives were all inserted in a tool and the tool calculates the costs and benefits thus giving net results that can give decision-makers insights about how much adaptation is needed with respect to global change scenarios," says Ms Reyes. The benefits of adaptation refer to the avoided costs of global change impacts, such as the economic cost of droughts on different water uses (agricultural, industrial and domestic). "The net results (cost-benefits) showed that aside from the highly improbable scenario of no water deficit, in the other two cases the benefits were higher than the costs, thus demonstrating how adaptation to global change is necessary," she adds.

In the project's case study, the medium-adaptation strategy was identified as providing the best balance of benefits (higher) to costs (lower). In the real-world, the CBA tool will allow river basin authorities and water companies to combine different economic values with the indicators of impact, allowing them to select different strategies. This will help them in their medium and long-term planning activities and decision-making processes, in particular, by supporting the implementation of environmental policies associated with the Water Framework Directive (WFD).

Spreading the knowledge

Thus, the methodology and tools developed by 'WATER CHANGE' help find the balance between being able to predict how much water is available and knowing how, when and where to invest to achieve the maximum hydrological efficiency in the basin.

The Baells reservoir along the Llobregat river

Such know-how can only be useful if it is transferred to where it can do most good. Thus, a key element of the LIFE project was dissemination of its results, a task handled by the project partner, Agbar (a shareholder in CETaqua). Agbar's Knowledge Management and Transfer Manager, Isabel Escaler, explains that, through targeted training sessions, it is transferring the results of 'WATER CHANGE' to relevant stakeholders (such as public authorities and water boards), as well as to water and technology companies within the Agbar group. "If these companies take up the tools, it can have a ripple effect and we hope that their feedback will provide us with more 'customers'," says Ms Escaler.

Laurent Pouget believes that the outcomes of the project deserve a wider audience: "We have demonstrated that there could be important deficits in water demand bringing considerable socio-economic impacts in the Llobregat river basin. Long-term planning that considers global change is the only solution and the tool that we have produced makes it easier for water bodies and decision-makers in the EU to adapt."

Project number: LIFE07 ENV/E/000845

Title: WATER CHANGE - Medium and long term water resources modelling as a tool for planning and global change adaptation. Application to the Llobregat Basin

Beneficiary: CETaqua, Centro Tecnológico del Agua

Contact: Laurent Pouget
Email: lpouget@cetaqua.com
Website: http://www.life-waterchange.eu
Period: 01-Jan-2009 to 31-Dec-2012
Total budget: €1 238 000
LIFE contribution: €1 616 000

WATER QUALITY & QUANTITY

LIFE combats water scarcity

Climate change will lead to a change in precipitation patterns and rising temperatures in many areas. This will impact on water quality and availability, affecting many economic sectors. LIFE projects are playing an important role in improving knowledge of the effects of climate change, as well as in testing new means of mitigation.

According to a 2007 European Commission impact assessment on water scarcity and droughts, at least 11% of Europe's population and 17% of its territory had been affected by water scarcity[1]. In the context of climate change, this situation is expected to deteriorate further, with important implications for citizens and economic sectors such as agriculture, tourism, industry, energy and transport. Water quality will also be affected by climate change. Higher water temperatures, lower water flows and a lower dilution of pollutants will all impact on aquatic ecosystems, drinking water and water-based recreational activities.

The Water Framework Directive provides European countries with a common basis to address these problems. In particular, the directive's river basin approach to water management establishes a mechanism to prepare for and adapt to climate change impacts. A European Commission paper in 2007[2] identified more specific policy options for tackling water scarcity and drought issues. The White Paper on adapting to climate change also suggests that action should be taken to improve water management in order to increase the resilience to climate change of health, property and the productive functions of land. The results of a recent policy review of the EU's strategy for water scarcity and droughts[3], and of the vulnerability of water and environmental resources to climate change and man-made pressures, have fed into the Water Blueprint.

Improving knowledge

Further understanding of the potential impact of climate change and different land-use options is essential to devising effective approaches to tackling water scarcity. In Veneto and the Friuli Plain, in north-east Italy, the LIFE Environment project 'TRUST' (**LIFE07 ENV/IT/000475**) developed an innovative hydrological model for estimating climate impacts on precipitation rates and the flows of the rivers that feed groundwater aquifers.

Modelling simulations showed reductions of 7% and 11% respectively in the annual aquifer re-charge in the Veneto and Friuli regions by the end of the century, with the available annual groundwater volume being reduced by 175 million m³ and 335 million m³. In terms of water availability for irrigation, the reduction was estimated at 10-15%.

The model also showed how Managed Aquifer Recharge (MAR) techniques could restore up to 70% of the groundwater deficit induced by climate changes. The application of MAR on a test area of 100 ha recharged the aquifer with approximately 50 million m³ of water and, simultaneously, provided €60 000 from the sale of fast growing plants cultivated on the site.

Measuring the flow of the river using an Acoustic Doppler Current Profiler (ADCP)

Photo: LIFE07 ENV/IT/000475

1 http://ec.europa.eu/environment/water/quantity/pdf/non-paper.pdf
2 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0414:FIN:EN:PDF
3 http://ec.europa.eu/environment/water/quantity/pdf/COM-2012-672final-EN.pdf

This economic spin-off was seen by the project team as a potential "unifying concept", in terms of merging the relationship between environmental resources, economic systems and governance.

Water saving and protection

Irrigation is the main source of water consumption in Europe, especially in southern regions, where it accounts for over 50% of total water use. Efforts to reduce the demand for water for irrigation could, therefore, play a significant role in averting water scarcity.

One approach to achieving this is to promote the cultivation of crops that are better adjusted to dry conditions and have a lower water demand. The LIFE 'Almond Pro-Soil' project (**LIFE05 ENV/E/000288**), for example, successfully demonstrated the viability of new varieties of almond trees in semi-arid areas. These new varieties have the potential for more widespread cultivation in these areas, because of their improved resilience to frost and reproductive capacity.

This could have important benefits for local water regimes, as the new varieties also have positive effects on soil fertility, structure, and water-holding capacity. This not only helps to minimise the irrigation requirement, but also reduces the risk of excessive water run-off from the land, which can lead to eutrophication of water bodies, thereby reducing their value for recreation and other uses.

Climate change impacts water quality

As climate change progresses, one of the greatest threats to water bodies is eutrophication, leading to a decline in water quality.

This can have a significant impact on the ecosystem services provided by water bodies, which include the provision of clean water, healthy fish stocks, and areas that are suitable for recreational activities. If the annual cycle of hydrology changes, with spring arriving earlier and autumn being delayed, the nutrient retention capacity of water bodies may also decline.

'VACCIA' is a Finnish LIFE project (**LIFE07 ENV/FIN/000141**) that analysed the vulnerability of ecosystem services to climate change, focusing on 13 sub-projects located in different parts of the country. One sub-project looked specifically at catchment areas and water bodies. It found that an increase in eutrophication of water bodies and a deterioration in the quantity and quality of groundwater were expected impacts of climate change in Finland.

Photo: LIFE05 ENV/E/000288

Organic farming of new almond tree varieties increased the water holding capacity of the soil, thus reducing water use for irrigation

The project used Global Monitoring for Environment and Security (GMES) satellite-data services to assess the vulnerability of Finnish water resources, in particular in relation to expected changes in hydrology and respective changes in nutrient loading, and recommended that water protection actions should be intensified in order to avoid a negative impact on water services.

Protecting water services is also the main objective of 'SALT' (**LIFE07 ENV/IT/000497**), a LIFE project focusing on the lower Esino river valley, in Italy's Marche region. The project is evaluating the effectiveness of different measures to prevent saltwater intrusion, which represents one of the greatest risks to water availability in many coastal areas in Europe, especially along the Mediterranean Sea. To this end, it will simulate future scenarios of saltwater intrusion, using remote sensing, GIS and river and aquifer models, which will then be used to define appropriate remediation actions.

DID YOU KNOW?

The percentage area under high water stress in Europe is likely to increase from 17% today to 35% by the 2070s due to climate change.

Source: IPCC, 2007

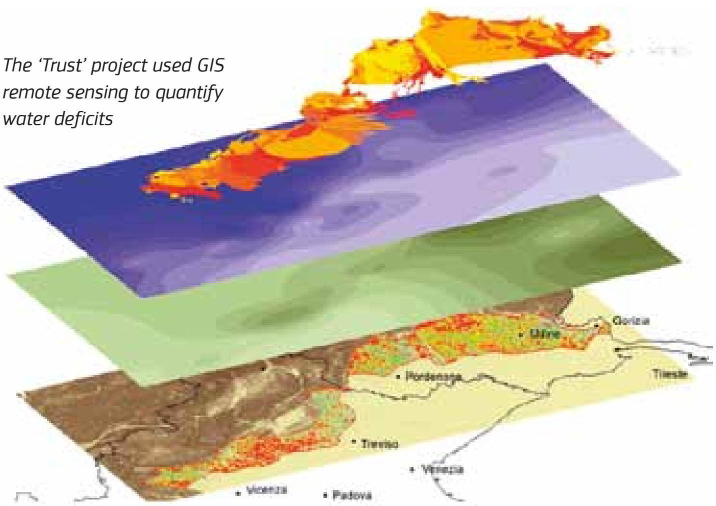


Photo: LIFE07 ENV/IT/000497

The 'Trust' project used GIS remote sensing to quantify water deficits

WATER QUALITY & QUANTITY

Helping to **ensure a quality water supply**

The LIFE programme has co-funded projects that have attempted to implement sustainable, long-term approaches to using surface water and groundwater with the goal of improving water quality for all.

The EU's Water Framework Directive (WFD) highlights the importance of both quantity and chemical status when it comes to achieving a good ecological status of groundwater by 2015. The two are interlinked, since water quality is closely related to the long-term sustainable use of groundwater.

The WFD outlines a number of steps that Member States must take with regards to groundwater. These include defining groundwater bodies within River Basin Districts so as to identify those at risk of not achieving good environmental status by 2015. In the preliminary assessments presented in 2005, Member States reported that 30% of the EU's groundwater bodies were at risk of failing to achieve the WFD's target. Member States are also required to establish groundwater monitoring networks and registers of protected areas. Programmes of measures for achieving WFD environmental measures must control both groundwater extraction and artificial recharge or augmentation of groundwater bodies (see pages 8-11).

Taking samples for metal analysis

Photo: LIFE08 ENV/FI/000609 - WESTBERG Vincent

Alongside the Water Framework Directive, the Groundwater Directive (2006/118/EC) sets underground water quality standards and introduces measures to prevent or limit inputs of pollutants into groundwater. Quality criteria established by the directive take account of local characteristics and allow for further improvements to be made based on monitoring data and new scientific knowledge. Key targets of the Groundwater Directive include: establishing groundwater quality standards; carrying out pollution trend studies; and implementing measures to prevent or limit inputs of pollutants into groundwater, so that pollution trends are reversed in line with the objectives of the WFD.

In line with the targets of the Water Framework and Groundwater directives, the European Commission's Water Blueprint stresses the importance of ensuring the availability of good quality water for sustainable and equitable water use.

LIFE improves groundwater quality

A number of LIFE projects have provided solutions to problems associated with groundwater contamination, either from heavy industry, landfill or natural processes. Groundwater pollution by arsenic and associated components is a common problem in the entire Carpathian Basin. Although not the result of human activities – the problem is caused by linked tectonic, geochemical, and biologic processes – the arsenic contamination is a major threat to human health.

As a result, the 'SUMANAS' project (**LIFE05 ENV/H/000418**) explored ways of sustainably managing arsenic-bearing groundwater in Southern Hungary. Within the project area, 170 000 people are supplied with drinking water derived from groundwater which contains arsenic levels 30 times higher than specified by EU norms, as well as variable amounts of methane, ammonia, iron and manganese.

The project team created a groundwater-management decision-support system, based on hydrogeological models, taking into account local needs, cost aspects and best practices. This was used to assess both the scale of the arsenic content of the region's groundwater and the costs of implementing arsenic reduction technology. The project also demonstrated at pilot scale an innovative arsenic-removal technology. This mobile solution was demonstrated at six sites in Hungary and Romania and proved capable of removing arsenic, methane, iron, ammonium and manganese from water in two steps with 98% efficiency. A cost/benefit analysis indicated that the cost of maintaining and operating a full-scale plant would be below € 0.38/m³ of arsenic-free water.

'INSIMEP' (**LIFE05 ENV/B/000517**) and 'MULTIBARDEM' (**LIFE06 ENV/B/000359**) were two Belgian projects that respectively tackled the problems of groundwater contaminated with non-ferrous metals from industry and contamination caused by leaking landfills and multi-pollutant sites. The 'INSIMEP' project demonstrated an alternative remediation approach at three sites in Belgium that had been heavily contaminated by 100 years of industrial activity. Central to this was the acceleration of naturally-occurring biogeochemical processes, a process known as in-situ metal precipitation (INSIMEP). The beneficiary's goal was to prove that this new technique was more economical and environmentally-friendly in the long term than traditional pump and treat (P&T) solutions.

The LIFE project successfully precipitated metals to levels below remediation targets at the three sites, each of which exhibited different hydrogeological conditions and varying combinations of metals. Importantly the project also made thorough use of modelling to explain the results and design a full-scale remediation procedure. INSIMEP was found to be more sustainable than P&T because no hazardous chemicals are required, less electricity is consumed, there is no discharge to surface water, no above-ground solid waste is produced and lower remaining concentrations of metals are reached more quickly. However, the cost of applying INSIMEP has been found to be strongly site-dependent, as it has significantly higher capital expenditure than P&T. Applicability therefore needs to be determined on a case-by-case basis.

Photo: LIFE05 ENV/BE/000517- LOWETTE Dimitri

'INSIMEP' demonstrated that metal-contaminated groundwater can be treated through the use of the in-situ metal precipitation techniquer

The 'MULTIBARDEM' team conducted one of the first field tests of a multibarrier technology designed to be a cheap alternative to landfill re-installation and/or leachate treatment. This new technology uses both physico-chemical and biological methods to treat groundwater contaminated with a mixture of pollutants. The LIFE project demonstrated the concept at both landfill and former industrial sites, where it was shown to be an effective and efficient means of treating contaminated groundwater. For instance, by the end of the project, a removal rate of up to 70% of ammonia was achieved.

Importantly, the 'MULTIBARDEM' project extrapolated the test results to compare the costs of a full-scale system with conventional P&T technology. In the case of the Austrian and Belgian test sites, the multibarrier was forecast to become cost-efficient after either seven or eight years of operation, an important finding with regards to the implementation of the Water Framework and Groundwater directives.

Extracting more benefits from groundwater projects

Several other LIFE projects have made an important contribution to improving groundwater conditions, including 'SERIAL-WELLFIR' (**LIFE04 ENV/IT/000503**), an Italian project that rehabilitated aquifers in the Lucca area that were polluted with terbuthylazine (a herbicide used in corn cultivation). The project developed an integrated methodology for safeguarding groundwater resources that combined a bottom-up participative approach, GIS tools, mathematic modelling and proposals for environmental policies.

The ongoing 'CATERMASS' project (**LIFE08 ENV/FIN/000609**) is developing climate change adaptation tools for environmental risk mitigation of acid sulphate (AS) soils in Finland. The goal of this LIFE+ project is to develop climate change adaptation tools for Finland's river basin districts to mitigate the impacts of increased leaching of acidity and metals from AS-soils that have been drained for agriculture and forestry. These tools will be field-tested to ensure they are capable of adapting to changing precipitation, run-off and temperature conditions and of providing effective mapping, identification and risk classification methods for AS-soils. The project is expected both to reduce loading of acidity and metals (with results that can be applied to other areas) and to improve the ecological status of water bodies.

The recently-started Greek project 'CHARM' (**LIFE10 ENV/GR/000601**) is tackling the problem of high concentrations of chromium and hexavalent chromium in the Asopos river basin. The project will seek to apply innovative technologies and methods to estimate natural background levels of chromium, establish threshold values (TVs) for this dangerous substance in accordance with the requirements of the Groundwater Directive and test and evaluate a range of appropriate remediation techniques.

The 'Ekorob' project is using ecotones to observe nutrients circulation (nitrogen and phosphorus) in partly-controlled conditions

Photo: LIFE08 ENV/PL/000519

The Water Blueprint recognises agricultural activity as putting significant pressure on water quality (and quantity), within the EU. The effects of agriculture include water eutrophication caused by fertilisers, contamination by pesticides, soil erosion and hydromorphological changes in many river basins. To counter the impact of agriculture, The Blueprint proposes to "Develop guidance through the agriculture working group under the WFD Common Implementation Strategy on the effective application of measures by farmers to deliver water quality and quantity objectives at catchment level. These measures include changing crop patterns, buffer strips, restoring riparian areas [and increasing] irrigation efficiency."

The LIFE programme already provides concrete examples of measures to reduce the impact on water quality of agricultural practices, in particular the impact on nitrate concentrations in surface and groundwater. For instance, using the results from four sampling sites in Alsace, the French project 'ISONITRATE' (**LIFE06 ENV/F/000158**) demonstrated the significant added value of using isotopic measurements (nitrogen and oxygen isotopes of nitrate, and boron isotopes) to precisely identify nitrate pollution sources (urban or agricultural), trace them in water and quantify their respective contributions.

The 'EKOROB' project (**LIFE08 ENV/PL/000519**) is currently tackling the effects of diffuse sources of pollution on the Pilica river basin in central Poland. The project team is testing the effectiveness (and cost-effectiveness) of using ecotones (transitional areas between two ecosystems, constructed using vegetation from surrounding habitats), to help achieve a good ecological status of water in the Sulejowski reservoir, which supplies drinking water to the cities of Łodz and Tomaszów Mazowiecki. The beneficiary is currently testing innovative technologies such as 'de-nitrification walls', which act as a barrier to protect against the inflow of nitrates from agricultural drainage areas, at a pilot site.

Developing and testing technological innovations for improving water quality has been a feature of a number of LIFE projects. These include 'RETOXMET' (**LIFE04 ENV/HU/000374**), a Hungarian project that built a demonstration plant to show how heavy metals could be removed from wastewater using a biosorbent produced by a newly-isolated strain of yeast. Binding the heavy metals made them more concentrated and thus easier to treat.

Photo: LIFE04 ENV/FR/000320

The purifying properties of willow coppice on sewage sludge reduced nitrates and phosphorous below levels required by European legislation on urban residual water

The 'VERBAL' project (**LIFE03 ENV/NL/000467**) constructed a vertical flow reed bed filter at Leisdsche Rijn in the Netherlands. This biological filtering system was found to be highly effective at removing phosphates and other pollutants from surface waters in urban areas. The success of the project led to the construction of a full-scale reed bed filter at the same location. The project team also developed a transferable model for calculating the dimensions and costs of building a similar system elsewhere in Europe.

The French project 'WILWATER' (**LIFE04 ENV/FR/000320**) also explored a natural and low-cost means of water treatment, planting short-rotation willow coppices on 20 sites (100 ha) in Brittany, where they were used as a bio-filter for the treatment of sewage sludge spread on agricultural land and for treating wastewater rich in nutrients such as nitrogen (N) and phosphorous (P). The project showed that the willow coppices reduced N and P levels to within legal limits for urban residual water. The impact on wastewater treatment plant sludge was harder to measure, but it is hoped that willow coppicing could offer an efficient way of preventing heavy metals effecting the quality of the water supply.

Common indicators

Perhaps one of the most important contributions the LIFE programme is currently making to improving water quality is in Cyprus, where the 'WATER' project (**LIFE08 ENV/CY/000460**) is developing methods and tools for the design and implementation of programmes for the preservation of the high environmental quality and good ecological status of water bodies. This highly technical project aims to deliver catchment-scale water-resources modelling and decision-support tools. These will be based on some 20-30 water quality and environmental assessment indicators and a set of total maximum daily loads for five pollutants that the project will also develop for the Kalo Horio Basin. Furthermore, as well as creating a geospatial pollutant sources database, the project will publish a Water Management Tools System Guide, an important step towards developing a common set of EU water quality indicators, which is one of the aspirations of the Water Blueprint.

In its quest to identify transferable indicators of water quality, the Cypriot project is following the example of an earlier LIFE project, 'Ziemelsuseja' (**LIFE02 ENV/LV/000481**). This Latvian project solved water sector problems in a number of small rural municipalities in the Ziemelsuseja river basin, including creating sets of indicators and procedures that the public can use in monitoring river basin quality and development. Stakeholder groups were extensively involved in the design of the river basin management process, a participative approach to helping ensure good quality water which echoes that of other LIFE projects such as 'SERIAL-WELL-FIR' in Italy and illustrates how the programme is helping to implement good water management practices across Europe.

DID YOU KNOW?

Economic growth CAN be decoupled from emissions of pollutants to water. While the Dutch economy grew by 43% in the period 1995-2008, heavy metal emissions from point sources decreased by 56% and nutrient emissions from point sources decreased by 52%.

Source: Statistics Netherlands, 2010 (See EEA Report No 1/2012: Towards Efficient use of water resources in Europe)

WATER QUALITY & QUANTITY

Better tools to implement river basin management plans

The 'M^3' project developed and tested existing and new methods of monitoring river quality and modelling pressures at the catchment level. This important work will help EU Member States implement River Basin Management Plans (RMBPs), a crucial step in the process of improving the ecological status of Europe's waters.

One of the monitoring sites on the river Wark in Luxembourg

The Water Framework Directive (WFD) outlines a series of milestones for EU Member States on the road to the ultimate goal of good ecological status of waters by 2015. One such marker is the definition (by 2009) of an RBMP (also known as a "Programme of Measures" - POM), listing the main strategies that Member States will use in order to achieve good ecological status within the required timeframe.

POMs are expected to balance implementation costs and ecological benefits. However, as Tom Gallé from the Centre de Recherche Public (CRP) Henri Tudor in Luxembourg explains, meeting the WFD's timetable required some important knowledge gaps to be plugged.

"There is some genius behind the WFD because the evaluation of the status of surface water is now shifted to the biological quality level," he says. The problem for those tasked with implementing the directive is that cause-effect relationships can be unclear. "Often we cannot really pinpoint the cause for non-attainment of good ecological status, i.e. the most impacting pressure is unknown or there's a multi-stress situation," says Mr. Gallé. As a result, "The administration and even the scientific community were not at all ready to implement the WFD requirements and yet you had this stiff agenda...This triggered a huge amount of research on the quality standards and on defining the reference status."

Origins of a LIFE project

One area in which the science was still racing to catch up with the policy concerned the availability of tools that could evaluate proposed actions in terms of their impact on the ecological status of surface water. Realising that this could present serious problems when it came to drafting meaningful RBMPs, in 2007, the CRP Henri Tudor, together with partners from Germany and the Netherlands, proposed a LIFE+ project (**LIFE07 ENV/L/000540**) to assess whether or not currently available methods for monitoring and modelling catchment areas could be used to assess the viability of POMs.

"We proposed a review because the monitoring and modelling are often related - you need monitoring data to feed your models but monitoring can also be an independent way of verifying the success of a management action," explains Mr. Gallé, who managed the LIFE project, which was dubbed 'M3' (for "Modelling, Monitoring, Management").

The project set out to assess the applicability of existing models applied by the project partners: Erftverband, a German water utility based in Bergheim, near Cologne, and Hoogheemraadschap van Delfland ("Delfland Water Board"), one of the Netherlands' 27 water authorities. "We had four models in total - two for emissions to see what pollutant loads and nutrient loads would be and two for water quality" recalls Mr. Gallé. The initial goal was to take these models and test them in the field with monitoring data of variable density from river basins of varying size and pollutant loads in Luxembourg, Germany and the Netherlands. It was hoped to demonstrate the reliability of model predictions for different POMs and the transferability of the concept to different Member States and within different river basins.

The project kicked off at the start of 2009, with the first stage comprising a review of current monitoring efforts in the three partner regions in the light of their pertinence towards pressure identification and quantification for the evaluation of successful POMs. "Can the monitoring quantify these pressures accurately? For instance, are monitoring points close to sources, are the frequencies and techniques adapted to the occurrence of the pollutants and finally are the chemical and biological measurements coordinated?", explains Mr. Gallé.

CRP Henri Tudor concluded that regulators and river basin managers are sticking to threshold motivated monitoring rather than monitoring aimed at improving process understanding and source allocation/quantification.

Monitoring next to a sewage facility in the Mamer river basin

"Routine grab sampling schemes remain the backbone of monitoring efforts in the WFD implementation. Little effort has been put into the analysis of the representativeness of the data in terms of organism exposure and the appropriateness of the datasets to calculate accurate loads," reported the beneficiary.

Adapting to change

At this point (2010), the project was faced with a challenge when the Dutch partner was forced to withdraw because of internal restructuring and budget cuts. However, says Mr. Gallé, this inspired some modifications to the project that proved extremely beneficial.

The intention had always been to test monitoring techniques that went beyond the classical grab sample - the project proposed four (more or less) innovative types of monitoring techniques as a back-up or alternative to traditional grab sampling: ambient pesticide exposure; river metabolism; baseflow suspended matter sampling; and autosampler campaigns during flood waves.

Monitoring station on the river Wark

With the enforced changes, the beneficiary was able to show in detail via case studies, "the design, the costs and the benefits for the whole process of our models: a distributed process-based model for emission modelling instead of bulk substance flow models; and for water quality a model that links chemistry to food webs and community composition instead of pollutant exposure only," explains Mr. Gallé. However, he adds, "the disadvantage was that we had much less time - 2011 was really the starting point to get these models implemented."

"Monitoring and modelling are often related"

Much of the revised project's work centred on the application of monitoring for model support using two river basins wholly located within Luxembourg as case studies. One catchment was the Wark, a medium-scale (82 km^2) river basin in the north of the country characterised by hill slopes with farming activity on them and low-permeability soils, hence significant run-off. Thus, the Wark river basin was seen as ideal for addressing the effect of pesticides, a pressure that had been neglected in impact assessments.

Mr Gallé points out the importance of having appropriate data at the right time: "You can measure every five minutes for the whole year, but really important for pesticides for instance, is the season when they are applied and are most likely to produce run-off. Then you have to be there and measure with the right technique - you have to know what you want to know and know the situations that are critical."

The 'M3' team used two monitoring techniques for pesticides in the Wark case study, one using an event-triggered autosampler, and the other involving two types of passive (POCIS) samplers (for continuous monitoring of the pesticide immission concentration and of pesticide emissions respectively).

The project manager says that whilst passive samplers require less intensive management than autosamplers, they have the disadvantage normally that "you get one mean concentration over the whole period...You don't really know, because you have different sources of pesticides - was it from groundwater, wastewater treatment plants, run-off? You have to unravel this."

That is what the 'M3' team proceeded to do: placing the passive samplers at critical points and calibrating them based on the pesticide uptake rates (one of the advantages of choosing a catchment area unique to Luxembourg was that relevant agricultural data such as pesticide use statistics was readily available). "The innovation was the use of POCIS throughout the catchment," says Mr. Gallé. "This was successful and it gives very interesting complementary information. You can localise where the pesticides are coming from, you can also quantify it to some degree and see if the behaviour of the pesticides is corresponding to what you expect in terms of modelling. For instance, the mass of pesticide mobilised by run-off following application depends on its degradation half-life. Degradation rates are dependent on soil management methods and soil characteristics - these are not fixed, there's a relatively big spatial variability, he adds. This can be tested locally by relating the different run-off events and then adjustments made to the model.

Lessons from the Mamer

The second case study was the Mamer river basin, chosen so as to examine urban pressures caused by storm water pollutants. The ecotoxological effects of substances carried in the solid phase - including metals such as copper, lead and zinc, as well as Polycyclic Aromatic Hydrocarbons (PAHs) - have rarely been addressed, something the LIFE Environment project set out to change. Monitoring campaigns involved the use of river metabolism parameters (oxygen, nutrients and pollutant levels, which were used to calibrate the Aquatox model – see below) and autosamplers – to capture storm water run-off in floodwaves and combined sewer overflow. They also involved an innovative means of monitoring low-flow suspended matter quality downstream of the source area: suspended sediment nets.

"All those pollutants that are less water soluble are normally transported attached to particles, and we can position these nets on longitudinal profiles and see how they evolve in the river," explains Mr Gallé. "Until now, most people don't do this analysis at all and those who do, do it with a flow-through centrifuge. It's a huge enterprise, it is really expensive, you spend a whole day somewhere and you get not much more than we get with these funny nets," he says.

He sees the project's use of suspended sediment nets as a cost-effective and transferable outcome that fulfils the goal – see box – of developing good practice guidance for monitoring design.

The beneficiary is also proud of the mobile monitoring system it developed during the course of the project. "We started with these oxygen probes that we use to characterise the metabolic state of the river," recalls Mr Gallé. "Then we introduced this Italian probe to measure at the same time the nutrients: phosphorous, nitrates and ammonia. We developed this device in a way that we can hop from one site to another very quickly. We do a measurement for a week on one site and then we take out the equipment and go to the next river segment."

The project developed its own portable solution for river basin monitoring

This portability is particularly important for modelling. "In most cases the modeller is sitting there saying I don't really know what's going on upstream of a routine monitoring point - what can we do? They can't do anything. But we have the equipment now. If we want to model a stretch of river we can pack it in the van, drive there, install the mobile system for a week and have the basic data that are important: everything they need to do the modelling." Mr Gallé adds that "this will not answer all the questions, but what we show is a practice that is much more flexible, much more pragmatic and really linked to the modelling expectations."

M3's six objectives:

1. Characterise emission sources and loads through modelling and monitoring;
2. Carry out uncertainty assessments in river basin mass flow modelling and monitoring;
3. Develop good practice guidance for monitoring design;
4. Evaluate the accuracy and cost-efficiency of modelling and monitoring approaches;
5. Characterise an immission situation through water quality modelling;
6. Carry out scenario-building and outcome forecasts for river basin management measures.

Project manager Tom Gallé: "What we show is a [monitoring] practice that is much more flexible, much more pragmatic and really linked to the modelling expectations"

Surprising and useful outcomes

Improving the relevancy of the monitoring process enabled the project to be more confident in its models, such as the food web and bioaccumulation model, Aquatox: "We calibrated the sensitivity of a whole lot of species from different levels in the trophic network and created a community that would correspond to a good ecological status. And then we put this community - virtually of course in our model - in the river, expose it to the situation there in terms of oxygen levels, nutrients and pollutants and see if it survives," explains Mr Gallé.

These tests of the Aquatox model produced some surprising and counter-intuitive results. For instance, whilst the 'M3' team expected the relatively high concentrations of herbicides to have a noticeable effect, "they didn't have any direct or indirect effect on the food web or the communities," he says. However, for the metals and PAHs from sewer overflows in the Mamer Valley, "the levels are really quite low, but the model shows it has an impact. The intuitive, chemically driven, result would be the inverse – herbicides are very important, very effective, in fact there is no effect; and PAH levels are relatively moderate, but these have an effect."

Mr Gallé believes that he and his colleagues "are getting now to a point where we are getting much more precise about what the real causes are and it's only through this whole process - not only being able to monitor and model the exposure situation, but also to look at the effects."

The project thus has important outcomes for the application of the WFD. Firstly, by improving identification of the pressures, the relevancy of POMs for river basins should increase, hopefully with a knock-on effect on water quality. Secondly, the monitoring campaigns provide a rich source of information about the usefulness and applicability of a range of techniques and technologies, knowledge that can be transferred to other catchment areas. "We showed how you can use different tools in a complementary way. What is practical, how many people you need, what information you get, what is useful. We have a better understanding of what is applicable when and where," says Mr Gallé.

Speaking about the project's transferability, he notes that administrations "are interested and they find [the project] really useful...Passive samplers they really like. The adaptation and implementation is slower, but we got them interested. The good thing is they are trying to do things themselves, to get their own experience, to learn from it."

CRP Henri Tudor has also learned from 'M3' and is looking to build on its lessons with a national research project on macrophytes using the same model and the same passive sampling techniques. "In a lot of rivers the biological indicators are really bad because of macrophytes and we don't know what the cause is. Maybe herbicides are the cause, but there's no model how to approach this: we're going to check that in a follow-up project," reveals Mr. Gallé.

Project number: LIFE07 ENV/L/000540

Title: M^3 – Application of integrative modelling and monitoring approaches for river basin

Beneficiary: Centre de Recherche Public Henri Tudor

Contact: Tom Gallé

Email: tom.galle@tudor.lu

Website: http://www.life-m3.eu

Period: 01-Jan-2009 to 31-Dec-2012

Total budget: €2 580 000

LIFE contribution: €1 239 000

Water-related green infrastructure

LIFE has made a significant contribution to the development of water-related green infrastructure. Projects have demonstrated sustainable water use in farming (including helping farmers to better understand EU water conservation funding). They have also highlighted the 'ecosystem services' provided by river and wetland restoration schemes, tackled urban drainage problems and supported the natural water management functions of soil.

WATER-RELATED GREEN INFRASTRUCTURE

Demonstrating **sustainable water use in farming**

Our countryside provides us with bountiful supplies of fresh high quality water and LIFE projects are involved with safeguarding this precious resource through working in partnership with agriculture to better protect and preserve EU water sources.

Photo: LIFE06 ENV/E/000044

LIFE projects have involved farmers to pioneer new ways of addressing water quality and water quantity challenges

Farms provide us with the food that we need to survive and agriculture also provides other important 'public goods' such as shaping culturally important rural landscapes that EU citizens value. Farms use enormous volumes of water to maintain these public goods and agriculture is in fact responsible for around one-third of all EU water use.

Agriculture hence has a significant role to play in helping Member States contribute to the principles promoted by the Water Blueprint. The Blueprint Communication notes that the Common Agricultural Policy (CAP) needs to become more coherent with mainstream EU water law. It also highlights how land use impacts from agriculture threaten both the quality and quantity of water across much of Europe. Furthermore, inappropriate agricultural practices are associated with deregulation of water flows, which can increase water scarcity and flood risks.

A series of mitigation and adaptation measures for agriculture have thus been discussed during the development of the Blueprint. These include actions focused on improving guidance for farmers in water-sensitive practices such as changing cropping patterns, introducing buffer strips, restoring riparian zones, increasing irrigation efficiency, and re-use of wastewater. Territorial approaches to farm-based water management using such techniques are promoted on a catchment level and innovation is encouraged as a tool for helping agriculture identify win-win solutions for both farmers and water supplies.

LIFE projects have a long and successful track record in pioneering new approaches that can be used by farmers to address water quality and water quantity challenges. Astrale's Water Sector report confirms LIFE's positive contributions in these agricultural fields and notes how results have been achieved using three broad categories of project intervention: Farm-based LIFE projects that develop new technologies; those that demonstrate alternative cultivation practices; and projects that have helped to design new management solutions.

New technologies

Many of the LIFE projects involved in testing new water-friendly technologies for agricultural use are aimed at helping Member States to comply with the Nitrates Directive. This promotes code(s) of good agricultural practice covering measures limiting the time when fertilisers can be applied on land in order to introduce artificial nitrogen only when the crop needs nutrients. The directive also discourages fertiliser applications on steeply sloping ground, frozen or snow covered ground, and land near water courses.

Manure storage conditions are also regulated by the Nitrates Directive, which promotes sustainable approaches to agriculture involving rotation of crops, soil winter cover, and catch crops to limit leaching. In areas designated as Nitrate Sensitive Zones, compulsory controls are placed on the use of these types of good agricultural practice techniques.

Italy's 'UNIZEO' (**LIFE10 ENV/IT/000347**) is one of the many LIFE projects that are involved with helping identify new technological solutions that can be applied as good agricultural practice. Its contributions to the Nitrates Directive focus on demonstrating the potential for a new type of urea-based nitrogenous fertiliser product that is coated with zeolite. Urea is widely used as a farm fertiliser because it contains large proportions of nitrogen and is relatively cheap to source. However, urea can leach easily into groundwater and so it represents a very real threat.

Photo: LIFE05 ENV/DK/000155t

'AGWAPLAN' project partners still cooperate today on efforts to help farms make positive contributions to Denmark's WFD commitments

The LIFE project is testing a newly patented form of urea granules that are coated with zeolite in order to reduce the rate at which nitrogen is released from the fertiliser. Zeolites are a group of minerals with special physical and chemical properties (such as high and selective cation exchange capacity, molecular adsorption and reversible dehydration). This allows them to 'fix' the fertiliser compounds' nitrogen content and then release it at a slow enough rate so that it can be absorbed by the roots of plants.

Such a system aims to better reflect a crop's actual demand for nitrogen. Results from the zeolite tests are anticipated to offer economic savings for farmers and drastically reduce water pollution problems associated with nitrate leaching.

Outcomes from a parallel Italian project testing zeolite's potential are also expected to be useful for livestock farms that need to better control their use of nitrates. This 'ZeoLIFE' project (**LIFE10 ENV/IT/000321**) is exploring the effectiveness of applying an 'integrated zeolitic cycle' to reduce nitrogen content in livestock effluents and agricultural soils. 'ZeoLIFE' has targets that not only intend to reduce nitrate pollution in groundwater and surface water, but also benefit coastal lagoons and decrease demands for water consumption through farm irrigation.

Innovative solutions for a similar problem in horticultural businesses have been demonstrated by the 'FERTIGREEN' project (**LIFE05 ENV/E/000289**) from Andalusia in Spain. Here, the LIFE co-financing was


Photo: LIFE10 ENV/IT/000321

Porewater sampling in the experimental field via lysimeter suction

used to validate a new industrial-scale technique for reducing nitrate pollution by adding carbon dioxide (CO_2) and oxygen (O_2) in gas form to irrigation water in commercial greenhouses. Outcomes from the project's 'fertirrigation' methods were impressive and confirmed that applying CO_2 and O_2 to irrigation water ensures effective and steady pH control. The method used helped to increase the solubility of some nutrients, increase absorption by the plant and obviate the need for nitric acid in pH controls. The outcomes included positive effects for plant health and reductions in risks to ground waters.

Application of the LIFE-funded fertirrigation system led to higher yields and the technology holds considerable scope for replication in the horticulture sector elsewhere in Europe. The equipment has been proven to be easy-to-use and adaptable in different circumstances, as well as involving relatively low investment costs.

Other new and transferable techniques for improving farms' ecological impact on Europe's waters have been developed by LIFE. France's 'ArtWET' project (**LIFE06 ENV/F/000133**) tackled pesticide pollution in water bodies. To do this it investigated the pollution control potential of artificial wetlands, and six experimental prototypes were developed to test new systems for treating non-point-source pesticide pollution using bioremediation in the wetlands.

LIFE funds helped to cover the cost of building four full-scale demonstration prototypes in three European countries. The prototypes integrated hydraulic and biological aspects and were fine-tuned during the project lifespan to identify the right type of parameters that are needed to optimise pesticide bioremediation processes. Detailed information was published in a technical guide presenting advice about choosing, adapting and building the appropriate system.

'ArtWET' showed that bioremediation can totally remove some pesticides, such as glyphosate, and high efficiency was shown for several herbicides used in corn, wheat and tomato crops. Such a technology is considered appropriate for either farm or catchment level applications, and several new versions of the bioremediation plant, in France and Germany, have been introduced since the LIFE project completed its work.

Uptake of the technology is a sign of its validity and the project team is particularly happy with the implications for reducing costs associated with drinking water treatment (a positive contribution to the EU Directive covering drinking water quality).

Alternative cultivation

In addition to helping establish new technologies for mitigating water pollution from farm sources, LIFE projects have understood the value in finding alternative approaches to the way that existing technologies are used. This approach is recognised by the European Environment Agency (EEA) in its assessment of the options that are available for helping improve agriculture's contributions to EU water policy goals.

Statements from the EEA[1] draw attention to the importance of "changing how we do things" and highlight the point that, "there is significant potential to improve water quality throughout Europe with little or no impact on [farm] profitability or productivity by, for example, reducing pesticide use, modifying crop rotations and designing buffer strips along water courses."

LIFE has been at the forefront of such efforts to help update agricultural practices in order to improve the

1 *http://www.eea.europa.eu/articles/water-for-agriculture*

quality of EU water bodies. One of these projects is 'OptiMa-N' (**LIFE04 ENV/IT/000454**) from northern Italy, which launched a new support programme for farms located in environmentally vulnerable areas. ICT played a key role in the project's introduction of a self-regulatory tool to help farmers better understand how to achieve the correct nitrogen balance in their soils.

Over 130 farmers participated in the project's online nitrate management system, which analysed soil samples (taken by the farmers themselves) and calculated real-time results providing advice on the amount of fertiliser that needed to be used in any given field (for any given weather condition, season, and crop variety). The simplicity of the system was welcomed by farmers, who appreciated LIFE's support in helping them improve their fertiliser use and save them money, whilst also taking care of the environment.

Similar economic justifications for water conservation actions have been common outcomes for a variety of other LIFE projects that have achieved changes in the way that farms "do things". Amongst these is the 'SWAP-CPP' (**LIFE04 ENV/FR/000350**) project, which confirmed cost-effective methods for vineyards and potato growers in preventing crop protection products from reaching surface waters.

'Zero run-off' of pesticides was found to be feasible by directing and storing annual rainfall in a natural treatment lagoon. Further gains were achieved by sowing strips of grass catch crops to act as buffer zones, and leaving other sections of the field unploughed.

The same types of benefits for water quality were identified by Denmark's 'Odense PRB – AgriPoM' project (**LIFE05 ENV/DK/000145**). This was a pilot initiative in river management planning linked to the Water Framework Directive (WFD) and it included a study to find options for encouraging farmers to use their land differently in defined localised areas. The project found that significant improvements to the "good status" 'of surface water in the River Odense could be achieved by developing a targeting methodology covering just 19% of the farmland in the river basin.

Such tools can be easily transferred to other parts of Europe and LIFE has helped to develop many of these types of farm-management methods that are centred on improving the status of water quality. In

Solving a slurry problem

Water contamination by piggery slurry is a significant problem for numerous Member States. New technologies and alternative systems offer opportunities to reduce risks of water pollution from piggeries and the 'ES-WAMAR' project (**LIFE06 ENV/E/000044**) typifies the positive outcomes that can be gained from focusing LIFE funds on tackling such a challenge.

'ES-WAMAR' was set up within the context of the regional Integrated Waste Management Plan for Aragón. The project sought to reduce water pollution threats from pig waste in this Spanish region by introducing a technique for coordinating the management of slurry across a network of farms. New slurry management companies were set up in three different locations and each of these quasi-public enterprises was given responsibility for planning, organising and implementing manure collection, treatment (where needed), distribution and field application as a fertiliser.

Day-to-day activities of companies involved monitoring slurry volumes in their territory and then identifying outlets to use the slurry so as to prevent it from building up and becoming a pollution risk. Computer systems onboard tractors ensured the correct dosage was applied on fields, thus helping to avoid contaminating the soil with excess phosphorous (P), nitrogen (N) and heavy metals and preventing excess nitrate leaching in surrounding water bodies. All three quasi-public enterprises developed successful systems and tools for matching the fertiliser needs of arable farmers with the need of pig farmers to dispose of their slurry appropriately and economically through collective action.

Project results were praised by the local waste management authorities for their innovative use of novel techniques that represent a highly cost-effective mechanism for protecting water quality against farm-based nitrate pollution hazards. Initial monitoring of the water body confirms an improvement in water quality.

Photo: LIFE05 ENV/B/000510

The 'TOPPS' project advised farmers on best practices for cleaning sprayers, such as away from surface waters

the Netherlands for example, staff from the 'CEPE' project (**LIFE05 ENV/NL/000021**) demonstrated how pesticide contamination could be minimised by helping horticultural businesses change they way they monitor their crops. An early warning tool was developed to help diagnose pest threats and facilitate early, site-specific, treatments that are intended to avoid the need for universal or whole-crop spraying of potential toxic pesticides.

New management solutions

Innovations in crop and land management practices such as those mentioned above are considered by the EEA and other commentators to be one of the key long-term solutions to helping agriculture strengthen its contributions to EU water policy objectives.

'TOPPS' aimed to prevent point source pollution incidents on farms

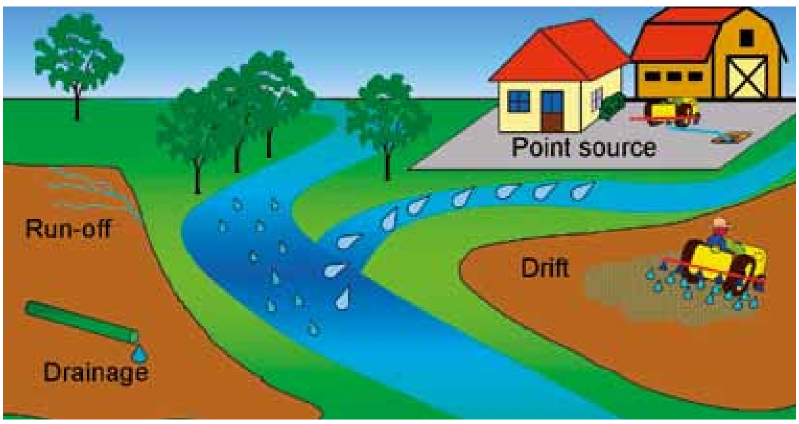


Photo: LIFE05 ENV/B/000510

LIFE has promoted and tested a diverse range of new farm management approaches that provide effective solutions for addressing water quality challenges. As one example, Germany's 'WAgriCo' project (**LIFE05 ENV/D/000182**) adopted a participatory approach to including farmers in the decision-making process for new agricultural management measures that were directed towards meeting policy objectives in the EU's Sixth Environmental Action Programme.

Conclusions from 'WAgriCo' confirmed how agricultural assistance programmes, like those funded by the CAP, can be tailored to support the implementation of the WFD. The LIFE team also observed that synergistic actions could be used to increase cost-efficiency of sustainable agriculture by merging new thinking into the management structure of farm support bodies.

The 'TOPPS' project from Belgium (**LIFE05 ENV/B/000510**) launched a capacity-building strategy helping farm workforces to improve the way they handled and managed agri-chemicals. Under the banner of "Best Practice, Better Water Protection", the overall purpose of this LIFE Environment project was to prevent the causes of water and other pollution incidents from point sources on farms.

'TOPPS' won a 'Best LIFE Environment' project award for its mainstreaming successes and training of more than 4 000 farm workers and 1 500 advisors in best management practices (BMP). A transnational partnership of stakeholders took part in the project and the BMP handbook it produced is now considered to be a reference guide for mitigating point source pollution. National authorities (e.g. in Poland) have even adopted the BMPs as their official recommended standard. Whilst the project's emphasis was on pesticides and other plant protection products, its approach to facilitating farm-level management solutions can also be applied to other agri-chemicals that pose a risk to water quality, such as fertilisers.

Integrated management systems for managing nitrate applications present many advantages, and an Italian LIFE project (**LIFE00 ENV/IT/000019**) was one of the country's pioneers in this field. Based in the Petrignano area, LIFE funds were used to run a series of demonstration plots on 18 different sites. These plots provided the raw material for an awareness-raising programme among the region's farmers about how management solutions could help

Photo: LIFE00 ENV/IT/000019

The 'Petrignano' project demonstrated solutions for agricultural practices that helped farmers comply in nitrate vulnerable zones

them comply with the requirements for agricultural practices in nitrate vulnerable zones (NVZs). Outputs from the project informed the preparation of a regional NVZ Action Plan that introduced management measures to tackle groundwater pollution problems from nitrates over 77 000 ha of farmland.

Territorial management solutions were also the outcome of Greece's 'STRYMON' project (**LIFE03 ENV/GR/000217**), which took an ecosystem approach to increasing positive environmental impacts from agriculture. A specialised 'hydrology-hydraulic modelling tool' was developed and tested by project partners, who worked in the north of the country targeting water quality improvements for the Strymonas river basin. Satellite technology was harnessed to help construct a spatial management model that can be used to optimise both the consumption of water by irrigation systems and the application of agri-chemicals that would have downstream benefits for the Strymonikos Gulf.

EU coastal water quality was also a beneficiary of Denmark's 'AGWAPLAN' project (**LIFE05 ENV/DK/000155**). Here, a network of environmental authorities, agricultural advisory services, agricultural research institutions and farmers carried out a co-ordinated package of pilot actions to assess, compare and manage the levels of nitrogen and phosphorous that were flowing from farm fields into water systems around the Baltic coast. A strong legacy was left by the initial LIFE support which was a catalyst for ongoing cooperation between the project partners, who continue to work together on efforts to help farms make positive contributions to Denmark's wider WFD commitments in terms of managing and complying with quality tolerance standards.

Benefitting water resources

As the projects highlighted in this article demonstrate, LIFE has played a useful role in supporting agricultural actions that complement the Water Blueprint's objectives. An in-depth look at these and other LIFE projects shows how actions focused on developing new technologies, demonstrating alternative cultivation practices, and designing new management solutions can have substantial benefits for the quality and quantity of EU water resources.

DID YOU KNOW?

One-third of water use in Europe goes to the agricultural sector.

Source: EEA

WATER-RELATED GREEN INFRASTRUCTURE

Helping farmers **better understand EU water conservation funding**

Europe's Common Agricultural Policy (CAP) offers opportunities to contribute to the Water Framework Directive's (WFD) goals and a French LIFE project has identified methods for encouraging farmers to use CAP agri-environment actions that promote water conservation.

Agriculture is a mainstay of the rural economy in the Midi-Pyrenees region of southern France. Arable farming dominates the landscape and many of the farm systems have been intensified over recent decades to improve their productivity and competitiveness. Such trends have increased use of nitrates and pesticides, which can pose threats to the quality of the region's scarce water supplies.

Geological features, including a barrier of foothills to the north of the main Pyrenees range, restrict natural water flows into the region's farmland. These quantity limitations exacerbate quality threats and create 'water stress'.

LIFE has helped identify solutions to reduce this water stress through a project targeting the region's agricultural sector. Named 'Concert'Eau' (**LIFE06 ENV/F/000132**), it was developed with local water authority support as a pilot initiative to improve use of CAP funds for meeting the targets of the WFD.. This involved encouraging uptake of environmentally-sensitive farming practices to reduce water stress.

Balancing act

'Concert'Eau' was a multi-disciplinary project that brought together economic, environmental, social and technological skill sets. The project coordinator, Philippe Vervier, describes the context: "Here in the south of France agriculture is important because it provides us with a high quality of food and drink for which the region is famous. Farming also supports jobs and services and it has a big influence on our natural environment. We knew that we needed to better balance these socio-economic and environmental benefits in order to safeguard them all for the long term."

'Concert'Eau's methodology has already been replicated by agricultural stakeholders in Spain

Photo: Tim Hudson

LIFE gave the beneficiary an opportunity to develop and test ways of ensuring that farming practices achieve a good balance between socio-economic and environmental impacts. "Agri-environment scenarios such as organic systems, crop rotations, farm buffer strips, or agroforestry could be applied to reduce water stress in our region. Our aim was to find effective methods for encouraging farmers to become more involved in the voluntary uptake of such practices, using funding support schemes from the Rural Development Programme," says Mr Vervier.Since farmers in the Midi-Pyrenees had previously found such schemes unattractive, the 'Concert'Eau' team needed to find ways of persuading them to make greater use of water conservation measures. "For this to happen we believed we had to involve farmers more in processes which helped them understand the schemes and their effects on individual farm businesses," recalls Mr Vervier. "We were aware of the benefits from running bottom-up processes to involve important stakeholders such as farmers in environmental management schemes. We also realised that other groups and organisations could gain advantages from being involved in discussions to determine effective approaches for using the CAP to create WFD-related results."

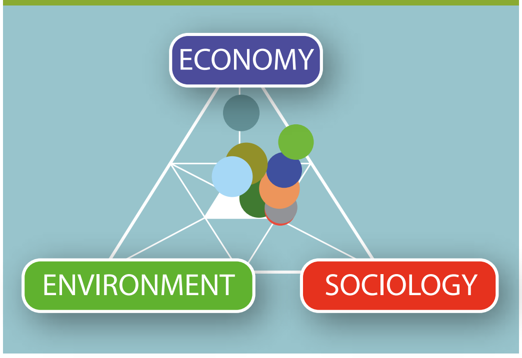
Finding a credible approach

The project thus sought to promote consultation and cooperation between farmers, public authorities and other environmental experts with the goal of agreeing on a range of farm-based actions that would have a positive impact on water resources, without hurting farmers' productivity or bottom line.

"Early on during the project design we agreed that it would be important for the methodology to have credibility with the target audiences. As such we focused much of the LIFE project co-financing on developing a tool that could properly assess and evaluate different agri-environment scenarios," says Mr Vervier. This meant drawing on the strengths of the multi-faceted project team "to produce objective information covering the various socio-economic and environmental outcomes which might be expected if a farm committed to a particular type of agri-environment action," he explains.

By increasing each farmer's knowledge about different scenarios, it was hoped that they would be able to identify for themselves the sort of schemes that they would be most likely to participate in. Such an approach would then help the Rural Development Programme authorities to concentrate on designing

Scenario comparison



Modelled scenarios, proposed by stakeholders, are compared using a sustainability triangle including economic, sociological and environmental aspects

and providing a smaller number of scheme options, all of which would be properly understood in advance by their intended end users – the farmers. Efficiencies in public fund management could be gained by this technique and it could act as an effective mechanism for promoting a more rapid absorption of the agri-environment budget, plus of course the related benefits for regional water quality.

> *"This approach is more likely to succeed than top-down schemes, which farmers may feel are imposed on them"*

Mr Vervier observes that the key to improving farmers' appreciation and acceptance of the agri-environment options was, "an innovative and purpose-built scenario-modelling tool that we developed to illustrate the effects of many different agri-environment scenarios. The tool worked by converting data about specific water conservation methods into a 'sustainability triangle'. Ecological, economic and social effects were all able to be compared within the model. Scenarios which gave balanced results for these three factors were judged most likely to be acceptable by all the different stakeholders The model was designed to present those agri-environment scenarios with the best balances in the centre of the triangle (see figure 3)."

Discussions with the farmers and water authorities enabled the project team to discover which type of agri-environment scenarios they wanted to be analysed by the model. This consultation process resulted in a list of more than 50 different farm-based water conservation options. "During our discussions with the farmers we asked them to complete questionnaires about their opinions on each scenario, in terms of its likely impact on their business and

Photo: Tim Hudson

'Benchmark' farms were used during the project to demonstrate the water conservation potential from agri-environment scenarios such as agro-forestry

whether they thought it was something that they would apply given the right type of conditions, information and support," notes Mr Vervier.

His colleague Claude Vautier explains how "evaluating the questionnaires gave us essential data about the 'social acceptability' of different agri-environment scenarios." The 'Concert'Eau' team then modelled the effects on water quality of each scenario, as well as estimating the economic impact on farm businesses of water conservation measures.

A farmer's perspective

The reception in the farming community to the project's methods has been positive. "It is important that we understand how agri-environment scenarios affect our businesses, not just in terms of profits but also day to day operations like the amount of working time needed for new tasks and what type of equipment or techniques might be required to produce the desired results," explains Philippe Baron, a farmer from the Gers area. "If we don't know this information we won't change our practices," he adds.

For Mr Baron, "'Concert 'Eau' gave us the right amount of properly evaluated information that we needed to feel reassured. Furthermore, and very importantly, the project's bottom-up approach meant that we farmers felt we were involved in decision-making processes about agri-environment support schemes that were suited to our area. I think this approach is more likely to succeed than top-down schemes, which farmers may feel are imposed on them."

Another of the farmers involved with this LIFE project was Christophe Cap de Comme. He agrees with Mr Baron and notes an additional benefit from the bottom-up methodology. "My farm is an organic business and the thing I found very useful about 'Concert'Eau' was its meetings and demonstration events. These gave me a chance to exchange my experiences with other farmers about environmentally-sensitive practices, like reduced tillage, that I now use on my land."

Agricultural advisory specialists played a big part in facilitating such meetings and events and Gerard Descamps from the regional advisory service remarks that, "the LIFE project showed us an alternative and much more participatory way of promoting the use of agri-environment schemes from the Rural Development Programme. I learnt a lot from 'Concert'Eau' and it showed me new skills for delivering farm guidance support."

Alain Canet, an agro-forestry advisor also considers that the 'Concert'Eau' method has much to offer. "I found that the project's bottom-up principles helped to create a very useful 'neutral' forum for discussion. No one side seemed to dominate the process. This made it more acceptable for us all and so we were willing and interested in hearing each other's ideas and perspectives."

Potential outcomes

The project's positive links to the farming sector have helped it to identify socially acceptable agri-environment measures that hold the potential to reduce nitrates concentration to under 25 mg l-1 in surface water. Other scenarios confirmed as suitable by farmers could lower the total pesticide average concentration in surface waters to close to 0.5 µg l-1.

Project number: LIFE06 ENV/F/000132

Title: CONCERT'EAU - Collaborative technological platform for implementation for WDF within agricultural context

Beneficiary: ECOBAG

Contact: Philippe Vervier

Email: philippevervier@acceptablesavenirs.eu

Website: http://concerteau.ecobag.org/

Period: 01-Oct-2006 to 30-Sep-2009

Total budget: €2 808 000

LIFE contribution: €1 394 000

WATER-RELATED GREEN INFRASTRUCTURE

Tackling urban drainage problems

LIFE projects have pioneered new ways to meet water management challenges in urban areas, especially through the design of Sustainable Urban Drainage Systems (SUDS) that serve to bolster natural water retention measures.

Urban areas face particular water management challenges. One such is the fact that the replacement of vegetation – and its ability to absorb water – by so-called "grey infrastructure" (i.e. buildings and concrete) prevents rainwater from easily seeping into groundwater reservoirs. Instead, the rain is directed into surface water drainage systems, increasing the likelihood of flooding. The resulting sewer overflows and surface water run-off also can lead to the contamination of groundwater that supplies the city's taps.

SUDS have been developed to help combat these risks by behaving like natural systems, draining away surface water through collection, storage, and cleaning before releasing it slowly back into the environment. However, they are also a relatively recent development and knowledge transfer concerning SUDS is under-exploited.

The Spanish LIFE project, 'AQUAVAL' (**LIFE08 ENV/E/000099**), is implementing systems at two demonstration sites – the municipalities of Xativa and Benaguasil. The beneficiary hopes the results will promote the use of SUDS regionally, nationally and in other areas of southern Europe. Nearly every year, the sewer system of Xativa in the province of Valencia overflows after heavy rainfall. 'AQUAVAL' is aiming to avoid this problem, the source of which is the failure of the local treatment plant to cope with large volumes of water. SUDS tackle surface run-off at source by developing and improving surface run-off systems – thus the water quality of the receiving water courses is improved.

Similar problems are found in Benaguasil, and the discharge of sewer overflow into the river during periods of flooding is also being tackled by the project. Whilst it is difficult to demonstrate results on such small-scale sites, the project offers many potential benefits. Not only will the use of SUDS improve water quality, it foresees the use of rainwater in irrigation and street cleaning, for example, and helps support green roofs that boost biodiversity. The systems can also be incorporated into urban planning requirements for new developments (though they are not always legally enforced) as well as helping to alleviate the low capacity of sewage systems that have lagged behind urban growth.

Photo: LIFE07 ENV/UK/000936

'GRACC' promoted innovative approaches to roof greening combined with other sustainable features, such as the installation of photovoltaic cells and SUDS

Another aspect of 'AQUAVAL' centres on an attempt to take into account the impact of climate change on water levels. One of the apparent effects of climate change in much of northern Europe has been widespread heavy rainfalls leading to flooding. In recent years, local authorities in the UK have responded to this increased environmental threat by adopting more stringent standards for new and existing buildings. Green roofs, in particular, have a role to play in climate change adaptation, and the UK project, 'GRACC' (**LIFE07 ENV/UK/000936**), set out to establish guidelines for such roofs.

As a result, the Green Roof Organisation (GRO) Green Roof Code was published in 2011; the LIFE project beneficiary aims to expand this into a pan-European code in collaboration with the European Federation of Green Buildings, of which it is a member. Dissemination and adoption of the Green Roof Code was also encourage through an 'Innovation Awards' scheme that recognised inspirational approaches to roof greening combined with other sustainable features, such as the installation of photovoltaic cells and SUDS.

Water treatment in urban areas

LIFE projects have also addressed the quality of the storm water itself. Rainwater becomes polluted on contact with roads, buildings and other urban surfaces, and whilst its runoff into ponds and rivers does not usually kill fish directly, it adds to the amount of pollutants in the food chain, and over time it leads to a reduction in biodiversity.

The Danish project, 'TREASURE' (**LIFE06 ENV/DK/000229**) showed that it is possible to use robust, efficient and simple technologies for the removal of pollutants from storm water run-off. These treatments were demonstrated as being capable of reducing the pollutant content of urban run-off water by up to 80-90%.

The most effective treatment process for reducing a broad range of dissolved and colloidal pollutants in the storm water run-off was found to be the wet retention pond with a sand filter and fixed-media absorption filter. The project also showed that whilst plants are only of marginal benefit for cleaning, they help ensure that facilities become recreational elements of the urban environment.

A further two (non-LIFE) projects have since been launched to apply the methods that were successfully pioneered by 'TREASURE'. Application is not restricted to a particular urban context and could also be expanded to include the treatment of contaminated drinking water and phosphorous-polluted surface waters.

Improving the quality of water in urban reservoirs is the focus of the 'EH-REK' project in Poland (**LIFE08 ENV/PL/000517**). This LIFE project is trialling an innovative 'ecohydrological' approach to the restoration of a complex of interconnected reservoirs. It foresees the conversion of the upper reservoir into a sedimentation-biofiltration system, leaving the lower and middle reservoirs free for recreational purposes.

Photo: LIFE06 ENV/DK/000229

'TREASURE' technologies reduced the pollutant content of urban run-off water by up to 80-90%.

The project promises to be highly valuable for the consolidation of knowledge of urban water ecosystems and their management in compliance with the Water Framework Directive. Actions carried out by the project team should increase the reservoirs' value as recreational sites.

The role of monitoring

Demonstrating that monitoring also has a major role to play in urban drainage systems, the Italian 'IMOS' project (**LIFE00 ENV/IT/000080**) combined real-time tools, such as rain gauges, flow-meters, turbidity monitors and low-cost meteorological radar, with modelling activities and upgraded infrastructure (sluice gates, pumping stations, etc.) to achieve integrated multi-objective management of Genoa's drainage system.

The challenge of drainage water is particularly great in Genoa, where the effluent discharges of wastewater treatment plants combine with sewer overflows in closed bodies of water. The project increased the system's capacity for treating first-flush flows, for controlling the pollution load to treatment plants and, consequently, for safeguarding water bodies receiving wastewater. In emergencies, it controls peak flows through the use of by-passes and temporary storage of water.

The system's integrated nature allows decisions to be taken on underground temporary storage and on the separation of the water depending on its pollution status. Moreover, this new system is reducing the frequency of floods.

DID YOU KNOW?

Approximately one-fifth of the total freshwater abstracted in Europe supplies public water systems

Source: EEA

WATER-RELATED GREEN INFRASTRUCTURE

Natural water retention measures provide an important service

The EU Water Blueprint highlights the importance of such water retention measures as floodplain restoration and the re-meandering of rivers. A wide range of LIFE projects have developed green infrastructure that has improved the ecosystem services of the rivers and floodplains targeted for restoration.

In the UK three completed projects – 'Smurf' (**LIFE02 ENV/UK/000144**), 'QUERCUS' (**LIFE05 ENV/UK/000127**) and 'STREAM' (**LIFE05 NAT/UK/000143**) - have taken important practical actions to improve the status of urban and rural river environments and floodplains, whilst an ongoing LIFE Information & Communication project ('RESTORE' – **LIFE09 INF/UK/000032**) is aiming to engage stakeholders and transfer key knowledge about river restoration.

The 'Smurf' project aimed to reduce pollution and flooding on a stretch of the once heavily industrialised River Tame, in England's West Midlands. The local community was actively involved in the process of defining targets for renovating the project site: measures taken included clearing undergrowth, planting bulbs and shrubs and creating a landscaped path to make the river more widely accessible. Parts of the Tame were also reconstructed to allow it to pursue a more natural course, thereby further increasing the pleasure and hence ecosystem services it provides. This inclusive project, which offers an excellent example of how public participation can be used to implement the Water Framework Directive (WFD), has been recognised with an award from the Royal National Institute for Blind People (RNIB). It was also a LIFE Environment "Best" project 2006-2007.

'QUERCUS' applied a model known as 'designing out crime', previously used on housing estates, to regenerate urban river corridors – contributing to the creation of green infrastructure – and increase access, use and enjoyment in three locations: the river Ravensbourne in the London Borough of Lewisham (UK), the Dee in Chester (UK), and the Dommel in 's-Hertogenbosch (Netherlands).

Restoration of Kostonjoki River

Photo: LIFE09 INF/UK 000032

The 'River Skjern' project helped restore arable land to its original river floodplain and delta area wetland status

Again community engagement and 'ownership' of the project played a significant role in its success. The three local communities were involved both in the planning and implementation of improvements to the water corridor environment, which included landscaping of the river banks and – in the case of the Ravensbourne – re-meandering of the river to follow a more natural course. As a result, measurable public use at one site increased by over 250%. The project produced a toolkit so that other local authorities can apply the lessons learned to improve their urban rivers, increase usage and sense of 'local ownership' and reduce the fear of crime.

The 'STREAM' project targeted improvements to the River Avon Site of Community Interest (SCI) in Southern England, enhancing some 7km of the river and its banks and, in the process, demonstrating a range of innovative river restoration techniques appropriate to chalk rivers for local, national and European audiences. By increasing the spawning area of Atlantic salmon, the project has also provided an important service to local anglers. A dissemination programme helped improve stakeholder and public appreciation of the sites.

A water blueprint for forest lands

'ForestForWater' (**LIFE03 ENV/S/000601**) was a Swedish LIFE Environment project that demonstrated how forestry could contribute to achieving the goals of the WFD. Using LIFE funding, authorities in Sweden, France and the UK carried out a range of innovative forest management techniques within pilot watersheds representing different geographical zones, institutional management structures and economic conditions. Importantly, this participatory project showed how forest management could make useful contributions to the restoration of water habitats for ecological and socio-economic purposes, such as angling and rural tourism. The project also demonstrated techniques for mitigating climate change impacts, such as using riparian shade to reduce thermal stress on freshwater organisms and planting floodplains with woodland species to alleviate downstream flood risks. Lessons learned have fed into river basin management handbooks.

River networks

The goal of the currently-running 'RESTORE' project is to develop a network linking policy-makers, river basin planners, practitioners and experts across Europe to share information and good practice on river restoration activities. Outcomes will include the creation of a database of river restoration projects; regional and European communications plans; preparatory reviews of current policy, planning and project activity; and the publication of a river restoration handbook.

'RESTORE' builds on the work of earlier LIFE-supported river restoration networking projects, notably the 'ECRR' project (**LIFE99 ENV/DK/000619**), which led to the creation of the European Centre for River Restoration, an important partner of the 'RESTORE' project.

Generating ecosystem services

Another Danish project 'Skjern River' (**LIFE00 NAT/DK/007116**) helped pioneer the restoration of reclaimed arable land to its original river floodplain and delta area wetland status, greatly improving hydrological conditions whilst demonstrating a range of compatible land uses (such as extensive grazing and recreation). New recreational facilities financed by the project, such as trails and hides for birdwatching, led to an increase in visitor numbers without disturbing birdlife. Alongside this cultural service, through carefully planned hydrological interventions (e.g. building dams and dykes), the project was able to increase the water level inside the target area without increasing the risk of flooding outside.

A 2002 study by the Royal Danish Agricultural University concluded that the projects along the Skjern River were a good public investment and that the overall cost will be more than compensated for by the local economic opportunities generated.

The 'FOK WATMAN' project (**LIFE03 ENV/H/000291**) also applied innovative water regulation and land use systems, in this case to an area of Hungary associated with very high floods and river contamination from cyanide and heavy metals. By introducing an FOK (natural depression in a flood plain) water regulation system and establishing a natural water supply in a 35 000 ha area bordering the River Tisza, this pilot project was able to marry the demands of nature conservation, agricultural production and integrated rural development. In doing so, it built on the achievements of an earlier project, 'Theiss – Management of floodplains on the Tisza' (**LIFE00 NAT/A/007051**).

As well as being partly able to handle the occasional high floods in the area, the new water management system has enabled the development of a new land use plan based on extensive cattle grazing and fisheries. Before the project, the land in the project area was dry and unproductive, now the beneficiary estimates it is able to provide a sustainable living for 900 - 2 100 people through extensive animal husbandry, rural and green tourism and handicrafts. The lessons of this LIFE pilot project can be applied in most other parts of the River Tisza catchment area (which extends to Romania, Slovakia, Serbia and Ukraine).

Managing river basins and water bodies

In order to ensure the good ecological status of EU waters, one of the requirements of the WFD is the drafting of River Basin Management Plans (RMBPs).

Monitoring the ecological status of the Meuse basin

Photo: LIFE07 ENV/B/000038 - VERNIERS G.

Advanced hydropower

One of the recommendations of the Blueprint is to enlarge the scope of the Strategic Environmental Assessment Directive to cover all hydropower development plans. LIFE co-funding has recently been put to good use in Germany on an innovative hydropower scheme that offers an alternative to small electricity-generating weirs that are impassable by fish. Such structures have had a negative impact on fish numbers and biodiversity in European rivers. The 'Moveable HEPP' project (**LIFE06 ENV/D/000485**), a LIFE Environment "Best of the Best" project 2011, demonstrated the use of a moveable hydroelectric power plant on weirs in southern Germany. Results have shown clear benefits in terms of both fish protection and energy production.

An ongoing Italian LIFE project, 'INHABIT' (**LIFE08 ENV/IT/000413**) is aiming to integrate information on local hydromorphological features into practical measures to improve the reliability of RBMP implementation in southern Europe. The focus is on rivers and lakes in two areas in Italy, covering a wide range of environmental features and water body types. The outcome of the project depends upon the compilation and interpretation of large amounts of accurate data, but if successful, it could serve as a basis for the implementation of RBMPs over larger areas in Italy and, possibly, the whole of Europe. This will, of course, depend upon buy-in from regional authorities and other agencies.

In Belgium, another project, 'WALPHY' (**LIFE07 ENV/B/000038**) has offered a direct response to the requirements of WFD implementation by undertaking work to maintain or recover the good ecological status of two water bodies. This includes proposing tools to expand the experience to other water bodies and creating a decision-making tool for the preliminary evaluation of the relevance and efficiency of management measures. The project, which is largely based on existing data, provides a good example of how hydropower can function in the context of the WFD (see box – Advanced hydropower). The 'WALPHY' team suggested and implemented alternatives to dam removal (such as bypass rivers or fish ladders), an important development in a region where most dam owners wish to convert them into a source of hydroelectric power.

What these and other projects illustrate is that, by demonstrating and promoting such natural water retention measures as floodplains, the restoration of riparian areas and the re-meandering of rivers, the LIFE programme is making a significant contribution to the development of an EU framework for green infrastructure.

DID YOU KNOW?

Summer mean and maximum water temperatures are on average 2-3°C lower in shaded versus open rivers. Restoring riparian trees can help reduce local stream temperatures on hot summer days, providing important benefits for river ecology - and anglers.

Source: ECRR News 1/2012

WATER-RELATED GREEN INFRASTRUCTURE

Restoration on the Danube

The European river that has perhaps seen the most benefit from LIFE projects utilising the types of natural river and floodplain restoration measures highlighted in the previous article is one of the continent's greatest and most important: the Danube.

LIFE projects have introduced water retention measures all the way from Austria to its delta in Romania. One of the earliest projects to develop the river's green infrastructure was 'Donauauen' (**LIFE98 NAT/A/005422**), which first applied in practice a theory of flood defence for Vienna, based not on the conventional wisdom of building dams, strengthening dykes and straightening channels, but on lowering river banks and altering weirs to give the Danube more room to sprawl. The LIFE project drew up detailed technical plans and made the first reconnections (at Orth and Untere Lobau) between the main river and former side channels in the floodplain. Later, the dyke closest to the river was breached, allowing the old floodplain itself to become a retention basin.

More than 30 LIFE projects have restored the natural river and floodplain dynamics over hundreds of kilometres of the Danube

Photo: LIFE06 NAT/A/000127

Increasing the "permeability" of the riparian forests for flood events led to noticeable and impressive results. Indeed, the subsequent self-restoration process of the floodplain dynamics exceeded all expectations.

The 'Donauaen' project had an important demonstration value and conservation benefit, and a number of its innovative side channel re-connection actions have been transposed to other river engineering projects along the Danube and its tributaries in Austria (see box). One such was the 'WACHAU' project (**LIFE03 NAT/A/000009**), which recreated gravel banks and islets along one of the most picturesque and culturally-important Austrian stretches of the river – the Wachau gorge, between Krems and Melk. The gravel used was recycled from the 400 000 m³ dredged annually from the Danube's shipping channels and the project also drafted a 'gravel plan' that foresaw the re-use in the river of all gravel excavated from the navigation channel between 2005 and 2020.

In implementing such large-scale river restoration measures, the project provided a great demonstration value, which it capitalised on through intensive media work and networking activities with experts from Austria, Germany, Switzerland, Japan and Poland.

Improving the landscape

Running almost concurrently with the 'WACHAU' project, LIFE Environment 'LIRiLi' (**LIFE02 ENV/A/000282**) demonstrated how it is possible to restore a heavily modified waterbody in an urban environment, in this case the River Liesing, a small tributary of the Danube. In order to maximise the ecological potential of the Liesing in accordance with the Water Framework Directive, a 5.5 km section was re-designed from a concrete channel to a semi-natural river that is still capable of meeting relevant flood protection requirements. The project also restored flora and fauna – planting only indigenous trees and bushes for instance - and installed recreational facilities such as a children's playground to greatly increase the public utility of the newly landscaped site. The construction of a new sewer system also helped to improve water quality.

Landscaping was a significant element of another LIFE project working on one of the Danube's major tributaries, the Drau (Drava). The goal of the 'LIFE Obere Drau II' project (**LIFE06 NAT/A/000127**), which was completed in 2011, was to continue a programme of measures started by an earlier LIFE project (**LIFE99 NAT/A/006055**) along the Upper Drau, a typical Alpine river. Expanding the run-off area and stabilising the river bed has enabled the project team to improve flood protection in the Drau Valley. Increasing the river's capacity for water retention has also led to the creation of new wetland habitats and enabled the establishment of pristine local recreation zones. The "River Oasis" Upper Drau was opened at Dellach in 2007, as part of the project's visitor management concept, a means of concentrating appropriate leisure and recreational activities at selected, optimal sites, and of protecting ecologically-sensitive riverbanks from use. The "River Oasis" includes a play and bathing area on the river with an adjoining sunbathing lawn, a barbeque area, tree house with lookout and an information point that encourages visitors to treat nature with respect. A brochure informing the general public about the new recreation zones was published in conjunction with the LIFE project.

The project also improved international cooperation with the neighbouring states through which the river flows, for instance proposing strategies to solve water management and ecological problems along the border between Croatia and Hungary. Such transnational actions are vital to achieving the Water Framework Directive's goal of good ecological status for Europe's water bodies, since rivers are no respecters of borders.

LIFE at the delta

The Romanian 'GREENDANUBE' project (**LIFE06 NAT/RO/000177**) also focused on integrating recreational needs into a nature conservation plan for eight selected islands along the transboundary part of the Lower Danube, between Romania and Bulgaria. These islands, which are located within the Danube Delta Biosphere reserve, one of Europe's most outstanding freshwater regions, contain rich floodplain ecosystems that are threatened by riverbank erosion from ship traffic and by the commercial pressure to convert floodplain forest into poplar plantations.

'GREENDANUBE' proposed an alternative socio-economic use – eco-tourism. The project developed a strategy to promote the islands as eco-tourism destinations. This involved testing a certification model of the floodplain forest and actively involving the local community in the project's implementation, including providing training for foresters and other key stakeholders.

Canoeing on the Danube

Georg Frank was employed by the Donau-Auen National Park in Austria as project manager for its second LIFE river restoration project, 'Donauufer' (**LIFE02 NAT/A/008518**). He highlights the ecosystem services a river restoration project can provide:

"When we started this LIFE project there was an embankment covered by big, big stones. At a public event in the village of Hainburg everyone wanted to know what it would be like in the future. We tried to explain that hopefully there would be a natural river bank, but it's not easy to transport this message.

"But then, some months after the restoration I returned to the place that had been dominated by these big stones and it had become a gravel bank. People were sitting there, they came by canoe and they were sitting on this gravel bank. And then I realised this is not only nature conservation - it's also creating more valuable areas for people... It's nice to go there for swimming, for canoeing - the most attractive way to explore the Donau National Park is by boat."

Stabilising the river bed has enabled the project team to improve flood protection in the Drau Valley

Photo: LIFE06 NAT/A/000127

DID YOU KNOW?

The Danube River Basin covers 800 000 km², or 10% of continental Europe. Extending into 19 countries, it is considered the most international river basin in the World.

Source: International Commission for the Protection of the Danube River (ICPDR)

WATER-RELATED GREEN INFRASTRUCTURE

Wetland restoration provides **natural benefits**

Wetlands have an important role to play in providing natural water retention measures that regulate the water cycle, in contributing to Europe's "green infrastructure" and in delivering such ecosystem services as water purification and provision. This importance is recognised by a plethora of LIFE projects that have restored and reconnected wetlands in the EU.

Wetlands provide important natural water retention functions, such as reducing or delaying flooding, recharging aquifers and improving water quality. Improving or restoring wetlands not only regulates the water cycle, but also contributes to EU green infrastructure through improved connectivity and enhanced landscape permeability. Wetlands also provide multiple ecosystem services, including improving water purification and availability, supporting biodiversity, aiding climate change adaptation, carbon sequestration and cultural services.

However, wetlands are also among the most threatened of ecosystems – rapidly disappearing in Europe and around the world, mainly due to drainage and deterioration of water quality for economic reasons. The environmental impact of wetland loss and degradation affects much wider regions than the wetlands themselves, due to the ecological association between aquatic and terrestrial ecosystems: The need for a more integrated approach to their management, alongside that of other 'green infrastructure' natural water retention measures is a focus of the Water Blueprint, which emphasises the need for their integration into River Basin Management Plans and other wider policies.

Although wetland drainage has been common practice in Europe for centuries, the extent of this human intervention (for agriculture, forestry and for urban development) has increased significantly in the last 100 years, and especially in recent decades: In 1995, the European Environment Agency (EEA)[1] estimated that some 25% of the most important wetlands in Europe were threatened by groundwater over-exploitation.

The arid climatic conditions typical of the Mediterranean basin make wetland loss there a particular prob-

1 LIFE and Europe's wetlands, p5 (2007)

The 'Habitats-Birds' project restored the natural steppe habitats and unique hydrology of the target area, which also enhanced bird species such as the spoonbill

Photo: LIFE02 NAT/HU/008638

lem. Spain, for example, has lost more than 60% of all inland freshwater wetlands in the past 30 years or so, and as a consequence, has left many remaining areas vulnerable and in need of conservation. The LIFE Nature project, 'Lago Bañolas' (**LIFE03 NAT/E/000067**) has been working to re-establish lost wetlands surrounding Lake Banyoles (north-eastern Spain), a popular recreational area and the site of the rowing events during the 1992 Barcelona Olympics. The eastern shore of the lake has undergone considerable urban development, with subsequent negative affects on the environment. In particular, a rare wetland habitat type (intermittent Mediterranean lagoons), had all but disappeared from the site.

After carrying out preliminary studies, four semi-permanent lagoons were created by the project in these areas, all of which have been recovering well. Other restoration activities included the naturalisation of brooks, the restoration of ditches and plantations – measures that help to restore ecosystem services such as water retention by slowing water run-off and reducing flood risk. Two important outcomes for the future conservation of the site are the approval of a special conservation plan for the whole lake basin and the creation of a consortium to oversee the management of the lake's natural and cultural assets.

A variety of threats to valuable Mediterranean wetlands were identified and successfully addressed by another Spanish LIFE Nature project, 'Humedales andaluces' (**LIFE03 NAT/E/000055**), in Andalusia. The project implemented a variety of works to restore the ecological and hydrological integrity of the region's wetlands. These include the acquisition of lands to recover flooded areas; restoration of freshwater and coastal lagoons that had been drained, or were still used for agriculture; and replanting of shores/slopes to avoid erosion that silts up the lagoons.

The Greek island of Crete has also lost some 60% of its wetlands in recent years, following the intensification of agricultural practices and the development of coastal tourism. The LIFE Environment project, 'Reservwet' (**LIFE00 ENV/GR/000685**), successfully demonstrated the multiple-objective management of Cretan reservoirs and wetlands. Specific restoration measures included the creation of several small new wetlands, the establishment of native wet vegetation (which helps slow surface water run-off and reduce downstream flooding) and the restoration of hydrology to existing degraded wetlands. Seasonal marshes were also restored and vegetation buffer zones were planted. Although there was little time to monitor the effectiveness of these interventions within the lifetime of the project, in the longer term, by improving water retention and water quality they are expected to create a substantial positive environmental and social impact on the island's overstretched water resources.

Photo: LIFE03 NAT/E/000055

LIFE funding helped to restore drained freshwater and coastal lagoons in Andalusia

Some LIFE Environment wetland projects have dealt with improving water quality by using various forms of phytoremediation[2]. The ongoing Italian project, 'REWETLAND' (**LIFE08 ENV/IT/000406**), for example, is aiming to set up an integrated environmental enhancement programme for the implementation of constructed wetlands and widespread biofiltering techniques along reclaimed canal networks. The pilot wetlands will test the system's ability to reduce water pollutants and increase biodiversity closely connected to the process of environmental restoration of the basin network of the Agro Pontino.

A 'holistic' approach

A key issue to be addressed by the Water Blueprint is the need for a more consistent approach to water policy in the EU, in particular related to transboundary river basins, to ensure that measures taken in one area do not have unintended negative impacts elsewhere. The Blueprint also calls for integrated management of water/land use, "bringing together spatial planning and RBMPs in coordination with other aspects of EU environmental policy (biodiversity, nature, soil)."

2 The use of plants to remove or neutralize contaminants in soil or water

DID YOU KNOW?

Some 35% of the change in wetland areas between 2000 and 2006 was the result of conversion to agriculture and 49% due to forest creation and afforestation.

Source: EEA, 2009

One of the main outputs of a large-scale UK LIFE Nature wetland restoration project in England's New Forest (**LIFE02 NAT/UK/008544**) was the creation of a Water Basin Management Forum to coordinate the conservation efforts required within three of the site's six water basins (Lymington River, Avon Water and Hampshire Avon). An earlier LIFE project had indicated that the forest's 'priority'[3] woodland/wetland habitats were in particular need of restoration, having suffered from a lack of a holistic approach to the hydrological networks on which they depend. As a result of the coordinated actions, more than 600 ha of these valuable wetlands have been restored to recovering conditions. Moreover, the forum, made up of key statutory agencies and stakeholder groups, provides the structure for continuing the work after-LIFE for at least another 10 years.

Two other successful examples are in Germany. The first project, (**LIFE00 NAT/D/007038**), carried out major works to raise the water level of the wetlands surrounding the Galenbecker See (Lake Galenbecker) – an area vastly reduced in size because of a programme of farmland reclamation and bog drainage. A key action was the construction of a 7.3 km-long dyke to prevent water drainage and the creation of a 600 ha re-wetting zone.

The second German project, 'Rewetting of the western Dümmer fen area' (**LIFE02 NAT/D/008456**), forms a major part of a broader plan to restore the entire Lake Dümmer area of Lower Saxony. The Dümmer wetlands had been in decline since 1953, when a dyke was built around the lake and regular flooding of the meadows ended. A plan to restore the area was already drawn up in 1987 and restoration work started under a first LIFE Nature project. This project focused on the re-hydration of formerly drained agricultural lands, through the use of adjustable weirs to modulate water levels. Over 1 000 ha of land was re-wetted and 28 adjustable and 14 overflow weirs were installed. As a result, the water levels in the (43 km) of drainage ditches can be controlled and adjusted to levels that were typical for the area before dykes were built. Peat mineralisation, which had led to a decline of the peat soil of 1-2 cm/yr before the re-wetting of the soils, has also been stopped.

3 Priority habitat - listed as in special need of conservation in the EU Habitats Directive

LIFE helped to rewet 1 200 ha of land in the Dümmer wetland area

Photo: LIFE02 NAT/D/008456

Reviving a traditional landscape

Finally, while primarily concerned with improving habitats for wild birds, an ambitious project (**LIFE02 NAT/H/008638**) located in the natural salt steppe- and marsh region of Hortóbagy National Park (in eastern Hungary) also indirectly addressed the issue of a degraded landscape suffering from periodical desertification and erosion and other water-related problems following extensive changes in land use since World War II. .

One of the project's main objectives was to restore the natural steppe/marsh habitats and unique hydrology of the target area. This included the removal of shrubbery from 400-500 ha of degraded steppe, the restoration of the natural soil topography (restoring hydromorphology) on more than 1 000 ha of steppe and the creation of a shallow 200 ha marshland.

The project successfully eliminated all unfavourable impacts on 2 000 ha of the salt steppe, including the periodical desertification and harmful agricultural practices. The area of shallow-water wetland habitats was also significantly enlarged from 37 ha to 295 ha, through hydromorphological works, inundations and the elimination of drainage channels.

Continuing to eliminate paddy field and irrigation systems in the region will not only protect wetland habitat, but also facilitate rainwater retention. Another significant result of the project was the introduction of sustainable management practices (i.e., the reintroduction of high level grazing with agri-environment support) on the open grasslands.

WATER-RELATED GREEN INFRASTRUCTURE

Supporting **soil's natural water management functions**

LIFE projects from around the EU have been involved at national, regional and local levels in helping water stakeholders to take better care of an essential component of the water cycle: soil.

Soil has been referred to as 'the 'factory of life' by the European Commission[1] and EU soils play a vital role in regulating the quality and quantity of our water supplies. They do this in several ways. Firstly soils purify water through a natural filtration process that fixes and removes hazardous contaminants and pollutants. This purification capacity depends on the soil being rich in microorganisms to perform the work: the more biodiversity in soil, the better this function can be performed.

At the same time, the channels, nests and galleries created by earthworms, ants and termites in our soils all promote water absorption. Plant material, comprising leaf litter and root networks, also helps to capture water and to sustain the structure of soil systems.

Insensitive soil management practices, such as intensive tillage or excessive sealing, do the opposite and diminish our soils' natural ability to regulate water. Without an active soil community, the soil becomes poor in structure and water run-off increases, leading to erosion and flooding. Furthermore, if a soil's ability to absorb, cleanse and store water is compromised, groundwater can then become badly affected, resulting in a need for more water treatment facilities.

Soil support

LIFE funding has been focused on helping Member States to maintain their soil's ability to process, cleanse and retain water. Projects have helped to save money as well as safeguard the health, wellbeing and quality of life of EU citizens.

1 http://ec.europa.eu/environment/soil/factory_life.htm

Photo: LIFE07 ENV/GR/000278

Soil and water sampling in the Anthemountas river basin during the 'So.S' project

A typical example of LIFE's role in supporting soils' water management functions is the 'SOWAP' project (**LIFE03 ENV/UK/000617**). Involving beneficiaries from Belgium, Hungary, the UK and Czech Republic, this transnational initiative was focused on identifying new and effective systems that could be applied by farmers to protect soil and water resources.

The project sought to identify best practice approaches to soil management that maximised economic benefits for farmers and minimised negative impacts for society. Tests included assessing commercial factors related to different soil tillage techniques and monitoring biodiversity indicators to analyse effects on birds, aquatic invertebrates and earthworms.

Trials were established on 48 demonstration plots, covering 18 farms in three different countries, allowing direct comparison between different land management techniques. Farmers' workshops and open days were organised to promote zero-

DID YOU KNOW?

Soils without earthworms can be 90% less effective at soaking up water to mitigate environmental problems such as erosion or flooding.

Source: 'SOWAP' project


Photo: LIFE03 ENV/UK/000617

Farming techniques implemented by the 'Sowap' project showed that soil erosion could be reduced by as much as 95%

till techniques and non-inversion tillage, as well as to discuss the pros and cons of conservation agriculture.

Hundreds of farmers visited the LIFE-funded demonstration sites to receive first hand knowledge about the benefits from these applied water conservation technologies. The 'SOWAP' project concluded that conservation agriculture could help reduce water run-off in soils by as much as 90%, even during heavy rainfall. Visiting farmers were also shown that soil erosion could be reduced by as much as 95% on light sandy soils and soil functions could be improved resulting in higher levels of carbon, nitrogen and soil water retention.

In Spain, farmers again have been at the forefront of working with LIFE to help protect soils' water regulation functions. Both the 'Sustainable Doñana' (**LIFE00 ENV/E/000547**) and 'Sustainable Wetlands' (**LIFE04 ENV/ES/000269**) projects were managed by the Young Farmers' Agricultural Association of Seville (ASAJA-Sevilla), which used LIFE funds to help roll out its strategy for involving more than 3 000 of the region's farmers in sustainable soil management approaches. José Fernando Robles was involved with both projects and he explains that, "They arose from the need to reduce erosion and improve the overall conservation of important wetlands that are influenced by the agricultural activity which takes place in their watersheds."

Conventional tillage approaches in this part of Spain had in the past increased the loss of soil on sloping land and the negative impact of erosion following periods of high rainfall was severe. It led to increased run-off of turgid water from farms, which adversely affected wetland biodiversity in Natura 2000 sites around the Doñana National Park.

Results from these two LIFE projects have significantly improved local understanding and appreciation of farming methods that promote soils' water management functions. "The project has led to a change in the ways that farmers use their soils," observes Mr Robles: "LIFE has shown everyone involved how techniques such as direct seeding in arable crops and the introduction of cover crops in olive orchards can significantly reduce soil loss. LIFE's support highlighted how these techniques could be economically viable and improve the quality of run-off water that entered the Natura 2000 wetland areas."

Soil sealing

The tendency of building projects to 'seal' soil has a negative impact on natural water systems - it reduces the availability of soil to capture and process water. Such soil sealing can lead to a dramatic increase – both in volume and velocity - in surface water run-off, increasing flood risks, particularly in settlements that are built without adequately considering environmental issues.

LIFE projects active in raising awareness about how to redress soil sealing challenges include the 'Greece Soil Sustainability (SoS)' project (**LIFE07 ENV/GR/000278**). Here, partners from towns and rural areas have worked together to show how water-friendly soil-use techniques can be applied to a Mediterranean river basin management approach.

This project provided a transferable model of how the European Soil Thematic Strategy can be implemented in Mediterranean areas. Its outcomes were tested in the Municipality of Thermi and offer interesting, replicable tools and methods for other parts of the EU. After first assessing the pilot area to determine its future urban development, the project team fed a set of input values into its model of the soil-water system in various urbanisation scenarios. The result was a number of suggestions for urban planning interventions in private dwellings to prevent sealing, promote rainwater harvesting and recycling facilities and propose measures for soil sealing control that are set to be introduced into Thermi's urban planning guidelines. A set of best practices was also published, enabling the dissemination of useful lessons about how to understand and calculate soil sealing threats and better conserve the vital water management functions of soils.

Increasing water efficiency

Ineffeciencies in the way Europe's water is distributed and used can have serious repercussions. In this section we highlight LIFE projects that have fostered innovative approaches to identifying and fixing leaks in water distribution networks. We also highlight LIFE's role in the development of water-efficient buildings and less wasteful systems for irrigating crops.

INCREASING WATER EFFICIENCY

Improving **water supply by improving distribution networks**

Water losses caused by leaks in the distribution network are a problem across the EU. LIFE projects have shown how technologies can make the identification and repair of leaks a cost effective option for water companies, tackling a key supply-side problem for managing water resources sustainably.

The important issue of water loss from pipes is highlighted in the Commission's Water Blueprint, which notes that "as much as 50% of water abstracted is lost in distribution". Leakages are particularly "problematic in areas which are water stressed or at risk of becoming water stressed," notably in Southern Europe. These losses not only have a negative impact on the environment in terms of reduced water efficiency but also in terms of reducing water quality.

Preventing water loss

Improving the efficiency of water distribution systems, through leakage reduction, reduces the need to exploit new water resources, helping fulfill the legal requirements of the Water Framework Directive (WFD).

The 'AG_UAS' project is using airborne remote sensing systems with thermal infrared or multi-speed cameras to detect leaks

Photo: LIFE09 ENV/ES/000456

The ability to effectively reduce leakage rates to acceptable levels is dependent upon a range of factors. These include mains pressure, local climate and topography, local value of water, age of the infrastructure, types of mains and soil types. In addition, issues of water use efficiency are given less emphasis in those countries or regions where water supplies are abundant, where there is limited competition for these supplies and when promoting socio-economic development is prioritised above other needs. Furthermore, the systems for monitoring, identifying and repairing leaks have not been cost-efficient enough for water companies and more research is needed on optimum ways to detect and repair leaking pipes.

The Water Blueprint identifies the promotion of leakage reduction measures as a potential priority for funding and investment from various EU sources, including the Structural Funds and European Investment Bank. It also suggests that Member States integrate methods for determining and tackling levels of water loss from leaks in their water management strategies.

Lessons can already be learnt from several LIFE projects that have been exploring innovative ways of reducing water loss from leaks.

Efficient and effective leak detection

Even when it is known that a distribution network is leaking water, it is usually not obvious where. The costs involved in detecting leaks along an entire network are typically prohibitive and so responses have often been limited to urgent and obvious cases.

A smart solution to leaks

Leaks from sewage systems can pose a number of problems. There is the self-evident one of pollution of surrounding soil and water. Another is the fact that where leaking sewage pipes lie below the water table, clean groundwater can enter the sewage system making it part of the drainage network. This can cause the unnecessary treatment of large amounts of clean water in water purification centres.

The Dutch project 'RAS' (**LIFE00 ENV/NL/000791**) tested an innovative solution to this problem. It installed new sewage pipes, retaining the previous sewage system only for rainwater drainage where leaks are not a problem. A "Smart Flow" system discharged the first flow of rainwater - containing high levels of nutrients and debris - into the sewage pipes for treatment and diverted subsequent cleaner flows into the rainwater drainage system.

The Spanish project 'DROPAWATER' (**LIFE02 ENV/E/000183**) employed electro-acoustic methods, digital signal processing and sound correlation devices - depending on the conditions of the soil, pipe materials, depth, etc. – to detect leaks in the Autonomous City of Ceuta. The work covered the entire network of pipes metre by metre during the night when the noise conditions were best for sound-based detection.

Such methods provide a cost-effective and undisruptive means of successfully identifying the precise location of leaks. The ongoing Italian project 'PALM' (**LIFE09 ENV/IT/000136**) has also been using acoustic technology to detect leaks. This detection work forms a key part of a comprehensive leak management system that aims to reduce water lost by 50%.

An alternative leak detection technology is being used by the Spanish project, 'POWER' (**LIFE08 ENV/E/000114**), which has inserted moisture probes in various depths of the soil. This detects leaks from the presence of water where it is not expected, enabling targeted interventions. Another Spanish project, 'AG_UAS' (**LIFE09 ENV/ES/000456**) is testing the technical feasibility and cost-effectiveness of using airborne remote sensing systems with either a high-resolution thermal infrared camera or a multispectral camera to detect leaks and seepage from water infrastructure.

In Estonia, the 'RAKWANET' project (**LIFE00 ENV/EE/000922**) used flow measurements and inspection of valve chambers to identify sources of leaks in a degraded Soviet-era water distribution network. It reduced the time taken to detect leaks from 5-6 to 2-3 days and enabled a 16% decrease in water lost through leakage.

Once leaks have been detected they need to be repaired in ways that are easy-to-implement and cost-effective. The 'DROPAWATER' project demonstrated a roll-down system that involves inserting a polyethylene pipe into the affected distribution pipes. This is then repressurised to form a close-fitting inner lining. No roads needed to be dug up to repair the pipes, and the leak-fixing technology worked so well that it enabled an uninterrupted drinking-water supply in Ceuta for the first time.

Network stability

As well as detecting leaks, it is also important to prevent them. Long-term sustainability of the distribution network requires improvements in the dynamic efficiency of the supply network to reduce stresses on the infrastructure.

To this end, the Italian 'A.S.A.P.' project (**LIFE06 ENV/IT/000255**) developed a reliable model of the supply network with monitoring of water flow and pressure. It created a protocol to respond to fluctuations in demand and provide dynamic flow/pressure regulation to reduce the stress on pipes and the likelihood of leaks.

Both 'RAKWANET' and 'PALM' have also shown the benefits of using computerised hydraulic models and flow measurements to maintain water pressure within optimal ranges and help preserve the network.

DID YOU KNOW?

As much as 50% of water abstracted is lost in distribution.

Source: Water Blueprint Consultation Document

Photo: LIFE09 ENV/IT/000136

The upstream and downstream pressures of the pump and general performance were tested to determine the head whilst measuring the flow

INCREASING WATER EFFICIENCY

Building-in **water savings**

Much of the focus of LIFE eco-design building projects in recent years has been on demonstrating energy efficiencies. However, architects increasingly need to take into account growing pressures on our water resources and to also build water efficiencies into future developments. A number of LIFE Environment projects show how this can be done.

Many LIFE projects over the past 20 years have been dedicated to the greening of buildings in Europe. These have looked in particular at ways of reducing energy in building design and in materials for construction. However, architects, engineers and town planners also increasingly need to build water efficiencies into the design of future developments. This is important both for economic reasons and also to address the impact on water resources of emerging challenges and changing production and consumption patterns (for example, from climate change and other human-induced pressures). This is also a main focus of the Water Blueprint, which stresses that the design of buildings and water-using appliances has up-till-now, not sufficiently factored in water efficiency; if it did, 10% or more of water consumed in the EU could be saved.

A number of eco-design LIFE projects have already demonstrated new technologies and/or systems for conserving or reducing water usage, alongside other resource efficiencies. One example is 'SUSCON' (**LIFE05 ENV/GR/000235**) - the first full-scale application of integrated product policy (IPP) and sustainable construction in Greece and Cyprus. The project developed a web-based building design and assessment tool for the evaluation of the economic and environmental performance of construction sites, adopting a lifecycle approach. The tool combines all the factors that go into sustainable construction (i.e. land use, energy efficiency, material resources efficiency, water conservation, health and safety and economic performance), rather than focusing only on some of them. This enabled the project team to develop eco-design criteria with respect to some major environmental issues related to the construction sector, including for resource efficient building materials, construction and demolition waste, energy efficiency and water conservation. The latter includes strategies for reducing water usage,

'EDEA-RENOV' is demonstrating rainwater collection systems to reduce water consumption in gardens

Photo: LIFE07 ENV/E/000805

Photo: LIFE00 ENV/NL/000808

Water efficiencies were realised in the building sector of the Netherlands using lifecycle assessment software

water saving devices, efficient water management and wastewater recycling.

In addition to the web-based tool, which can be used by public authorities in Greece and Cyprus (or elsewhere) to monitor, evaluate and promote all areas related to sustainable construction, the project also created a portal where businesses, consumers and other interested parties can find information about sustainable construction, including about efficient water use.

A second noteworthy example is 'Equation' (**LIFE00 ENV/NL/000808**), a LIFE Environment "Best" Project in 2004-05 that encouraged architects and local or regional authorities in the Netherlands and Belgium to build in a more sustainable way, using specially-developed lifecycle assessment (LCA) software, Eco-Quantum. The software can be used to calculate the environmental impacts of water, energy and building materials at different stages of the building process. More than 100 sustainable building projects in the Netherlands were evaluated using it, showing an average improvement of their environmental performance of 15% compared to the Dutch standard.

Water and other resources

More recently, a handful of innovative eco-building LIFE Environment projects are working to demonstrate water savings alongside other resource savings. Two examples are being run by the ministry of public works of the regional government of Extremadura in Spain. The goal is to build houses under sustainability criteria – including incorporating water efficiencies – and using new renewable energy resources. The first, 'EDEA' (**LIFE07 ENV/E/000805**) is nearing completion, targeting social housing in the region. Specifically, it has constructed two new houses – one following traditional building methods and a second 'experimental house' to test and demonstrate different sustainability measures. Both houses have been subjected to the same climatic conditions and their environmental performances compared. As many technologies as possible are being tested in the experimental house, including ones for reducing water use or re-using rain and grey waters. Looking at the overall building lifecycle, the hope is that the project's findings can be transferred to other regions in a similar housing context. Education and awareness-raising is targeting all citizens, as well as potential residents.

Continuing the theme is 'EDEA-RENOV' (**LIFE09 ENV/ES/000466**), which is aimed principally at architects, and seeks to further develop the energy and water efficiencies identified during the initial project, but this time focusing on old buildings in need of renovation. It will achieve its goals through three main areas: renovation, innovation and the use of ICT. Both private and public development urban housing projects have been selected for testing the project's eco-innovation designs and technologies for architects.

These include systems for rainwater collection to reduce water consumption in gardens. The project will also promote the use of treated grey waters for gardens and swimming pools – and as toilet water where the water installation is dual. This intervention could reduce water consumption by up to 20%, but only where there is sufficient rainfall and enough space to house storage tanks without affecting the structural integrity of the building. The project is also exploring other methods of reducing water use, including installing plumbing with volume flow rate limiters, dual-flush toilets and water pressure reducers.

Finally, a German LIFE+ project, 'HWC- Jenfelder Au' (**LIFE10 ENV/DE/000158**) is in the early stages of demonstrating an integrated wastewater disposal and energy generation system for a new development of almost 600 apartments in Hamburg. The flats will be fitted with water-saving vacuum sanitation technology and separate wastewater collection, drainage and treatment systems. The black water stream will be used for energy generation; and grey and storm water streams will be treated separately, using a new and simplified approach. Amongst the main expected results – based on the planned fitting of 1 000 vacuum toilets, and a vacuum pipe system – is a reduction in water consumption per WC of 7.3 m^3 per person per year. An environmental and economic cost benefit analysis will be carried out to assess the viability of the scheme and its transferability to other housing developments.

DID YOU KNOW?

Public water supply (mainly for buildings) represents 21% of total water usage in the EU.

Source: 'Water Performance of Buildings' European Commission (DG Environment) 2012

INCREASING WATER EFFICIENCY

Water-saving solutions at a French campsite

Campsite owners Wendy and Richard Curtis share their experiences of water-saving measures implemented through the LIFE 'Eco-camps' project (LIFE04 ENV/FR/000321).

Camping Beau Rivage in Navarrenx, Aquitaine, was one of five campsites to test the 'Eco-camps' High Environmental Quality methodology – aimed at demonstrating the environmental and economic benefits of using greener materials and techniques at the design stage of campsite buildings and facilities. The revamp of the Beau Rivage campsite, during the (2005-07) project included: installing a new swimming pool and children's play area; 10 wooden chalets; water, electricity and drains for 18 serviced pitches; two shower blocks and a water recovery system.

Photo: LIFE04 ENV/FR/000321

The Beau Rivage campsite installed four rainwater collection systems thanks to LIFE funding

> *"At the end of the day it is a process of compromise"*

Wendy Curtis, who runs the campsite together with husband Richard, explains that with the help of the project advisor, Olivier Hantz, they went through a very long process of analysing in great detail the products and methods they would be using and the environmental impact of each choice: "There's no magic list available to tell you which products or methods are more environmentally friendly than any other, so it becomes a process of consideration, comparison and justification." Saving water was important, she says, not just from an environmental aspect, but also from an economic point-of-view, with rising water bills.

The couple wanted to reduce the site's overall consumption of water and also access different water sources. The measures to save water included: installing new low-debit push-button taps everywhere on the site; smaller WC flushing reservoirs; and a recirculation pump in one of the two shower blocks, to reduce the amount of water wasted as people wait for hot water to arrive.

Rainwater butts

The Curtises originally planned to install a water recovery system as well. However, because their suppliers installed larger water filters than necessary in the pool filtration system, they had to build an extension to the pump house, which used the space designated for the recovery system. As a compromise, she says, they have installed four "very attractive" rain water collection butts of 1 000 litres each, and use these for watering plants etc around the site: "At the end of the day it is a process of compromise between the ideal and legal and budgetary restrictions," she observes.

Another water-saving measure was to remove all the privet hedging between the lower camping pitches on site and to replant them with a wide variety of native grasses, shrubs and trees that are able to cope with the soil and climate without needing to be watered. She says the project has made them very conscious of the choices they now make – even down to judging when to cut the grass to avoid unnecessary use of fuel!

And, finally, they are satisfied that the measures put in place more than five years ago have helped to reduce water consumption: "Even though we've put in a swimming pool and 10 new chalets (each with its own bathroom facilities), our overall water consumption has only increased by 30% since our first years," says Mrs Curtis.

INCREASING WATER EFFICIENCY

Optimising irrigation practices is a win-win for Europe

Agriculture accounts for 24% of EU water abstraction and some Mediterranean countries use as much as 70% of their water for irrigation. Inefficient irrigation is a drain on Europe's water resources and may lead to water shortages and damage to ecosystems. LIFE projects have demonstrated ways to improve the efficiency of irrigation practices, bringing water savings whilst maintaining productivity.

Efficiency gains in the irrigation of crops are both greatly needed and increasingly achievable. Across Europe, efficiencies are being obtained through both conveyance efficiency (the proportion of abstracted water that is delivered to the field) and field application efficiency (the water actually used by a crop in relation to the total amount of water that was delivered to that crop).

Policy plays a crucial role in inducing the agricultural sector to adopt more efficient irrigation practices. In the past, agricultural subsidies obtained through the EU's Common Agricultural Policy (CAP) were indirectly encouraging farmers to produce water-intensive crops using inefficient techniques. Furthermore, pricing mechanisms have failed to create those incentives that would persuade farmers to use water efficiently. Farmers have rarely had to pay the true price of water – i.e. a price that reflects the environmental and resource costs.

Water pricing mechanisms based around true costs (i.e. the volume of water) would induce water-efficient behaviour in agricultural irrigation. In addition, water savings can be obtained through training and knowledge-sharing programmes that educate farmers about more water-efficient practices. These could include: improving irrigation infrastructure, changes in irrigation practices, use of more drought-resistant crops, re-use of treated sewage effluent and adoption of new irrigation technologies.

Avoiding unnecessary irrigation

Over-use of water in irrigation is likely to occur where farmers have a lack of information on how much moisture is already in the soil. Without this knowledge, they have to adopt a safety-first approach of watering too much rather than too little. LIFE projects have experimented with the use of moisture sensors to provide real-time information that can inform irrigation decisions and reduce water consumption.

Already 10 years ago, the Spanish project 'HAGAR' (**LIFE02 ENV/E/000210**) was demonstrating a system for calculating the real-time water requirements of soils using moisture sensors embedded into the ground. It successfully tested the technology on 12 pilot fields in Castile-La Mancha and demonstrated that watering could be avoided when it was clear that enough moisture was already present.

The 'POWER' project is developing new technologies to improve efficiencies in irrigation

Photo: LIFE08 ENV/E/000114


Photo: Katerina Raftopoulou

Differential irrigation system

The ongoing Greek project 'HydroSense' (**LIFE08 ENV/GR/000570**) is using similar technology to provide a support system for optimised irrigation. It hopes that moisture sensors will enable it to apply variable-rate irrigation to the Thessaly Plain, which should reduce water consumption by 20% in comparison with uniform irrigation practices.

An important element of the ambitious Spanish project 'Optimizagua' (**LIFE03 ENV/E/000164**) was that watering took place automatically based on the data being received from the sensors. Information from humidity sensors at various soil depths, as well as climatic sensors of wind, temperature and other parameters were transmitted to a server using General Packet Radio Service (GPRS). This provided dedicated software with the information it needed to trigger automated watering, or alarms requiring action for farmers and park managers.

The project addressed two problems: firstly the fact that if watering took place during windy conditions much of the water would blow onto uncultivated land and be wasted; and secondly that a lot of water was being lost through evaporation because watering was taking place during the heat of the day. The climatic sensors were important in ensuring that watering did not take place when conditions were not suitable. By automatically watering only when appropriate, the system demonstrated impressive reductions in water consumption of over 60% in public parks, 50% for private lawns and 40% for wheat and corn fields.

DID YOU KNOW?

A quarter of water used for irrigation in Europe could be saved, just by changing the type of pipe or channel used

Source: EEA

Improving river-basin level irrigation planning

The Spanish project 'gEa' (**LIFE05 ENV/E/000313**) used a system of meters to monitor water quality and water consumption and detect leaks for the El Vicario community in the province of Seville. The information fed into a centralised web platform that used algorithms to calculate optimal use of irrigation water for the community as a whole and thus facilitate irrigation programming.

Although the project was hampered by a drought that prevented some irrigation activities being tested, it saved more than one million litres of water on two fields alone. More importantly, the technology offers the potential for the improved technical, hydraulic and administrative management of entire river basins by responding to real-time information on water supply and irrigation requirements at that scale.

The Greek project 'STRYMON' (**LIFE03 ENV/GR/000217**) used state-of-the-art hydrology-hydraulic modelling tools to assess the impact of agricultural activities on surface and groundwater levels in the Strymonas river basin. Satellite image analysis, remote sensing and automated water-flow measurement enabled the calculation of water in the basin, water losses for irrigation and actual water needs. Combining the data with a survey of local farmers, the project was able to develop 25 alternative scenarios for the re-arrangement of local agriculture to manage water resources and agro-ecosystems more sustainably. Modelling of the two scenarios deemed most appropriate by local stakeholders found that water consumption for irrigation would be reduced by 20%.

Harnessing alternative water sources

Water for irrigation can be supplied through different sources, thereby reducing the need to abstract water. The 'Optimizagua' project harvested rainwater – i.e. rain from roofs and run-off was collected and used to irrigate agricultural land.

It is also possible to use wastewater in agriculture, thereby making fresh water resources available for other needs. If the quality of the reclaimed water is properly managed, treated wastewater can provide an effective alternative means of meeting agricultural demand for water.

'PURE' (**LIFE08 ENV/GR/000551**) is a Greek project that has been working to upgrade a system for delivering treated wastewater to farms as another high quality alternative water resource for irrigation. Using advanced treatment, distribution and monitoring technology, the project aims to increase the area irrigated by the water from a specific treatment unit by 35% in a manner that is efficient, equitable and safe.

Water re-use

Treated wastewater could be a significant source of clean process water for industry or for the irrigation of agricultural land. The LIFE programme has supported a number of projects that demonstrate the value of re-using water. Outputs from these projects could feed into a set of common EU standards for water re-use.

WATER RE-USE

Leading the way to **a common standard for re-using wastewater**

Wastewater is a significant source of water that could potentially contribute to the needs of agriculture and the industrial sector. A number of LIFE projects have demonstrated how to make more efficient use of our water resources, providing a demonstration value that could help in the drafting of a single EU-level standard for the re-use of treated wastewater.

Photo: LIFE07 ENV/IT/000421

Olive oil production generates approximately 5 kg of wastewater per kg of olive oil produced

The re-use of wastewater is one of the policy areas under consideration in the Water Blueprint. Although some Member States have adopted their own standards for re-use, a common approach would help make the most of this source of water and ensure adequate environmental protection.

Without an EU-wide standard, some Member States could refuse market entry to products grown or produced with re-used water in other EU countries. Moreover, common standards could help the water industry in its need for certainty, which is necessary to make the investments to enable water re-use and comply with safety standards.

'Greening' olive oil production

A wide range of sectors have already benefitted from LIFE co-funded measures that have demonstrated ways in which wastewater can be effectively re-used. In particular, the olive oil sector, which produces highly pollutant wastewater, has been the focus of a large number of projects. Such wastewater, it has been shown, can be treated to produce valuable new products.

The EU is responsible for 78% of the world's olive oil production, with Spain, Italy and Greece the main producer countries. The industry consumes 20 million tonnes/yr of water and produces 30 million tonnes of wastewater. This means that approximately 5 kg of wastewater are generated for each kg of olive oil produced.

In Greece, the majority of olive oil mills are owned by small producers that cannot afford to invest in the equipment required to treat this wastewater properly and instead dispose of it in rivers, streams and the sea, impacting on water quality.

Olive oil industry wastewater has a high organic load and high concentrations of suspended solids and oil residues. It also contains phenols, biotoxic compounds that cannot be removed by conventional biological treatment.

A Greek LIFE project – 'MINOS' (**LIFE00 ENV/GR/000671**) – offered a solution to this problem, successfully demonstrating a wastewater treatment process that enables the retrieval of the biotoxic – but valuable – polyphenols, whilst also recovering water for re-use.

The project pioneered an integrated process that, through successive wastewater filtration steps, manages to capture and recover the polyphenols, commercially desirable compounds that are used in the production of cosmetics, food additives and pharmaceuticals. The wastewater also gives two different waste products: a compostable sludge that can be marketed as an organic fertiliser; and clean water suitable for re-use in the treatment plant, for irrigation or for disposal in water bodies.

'RE-WASTE' (**LIFE07 ENV/IT/000421**) is another LIFE project that demonstrated the viability of re-using wastewater from olive oil mills, in this case to improve the water efficiency of the production process. The project team installed a pilot wastewater treatment plant at an olive producer in Italy. The pilot plant combines three technologies: membrane filtration (a clean technology that operates without the addition of chemicals and with low energy consumption and simple operating systems), adsorption and anaerobic digestion. The system was shown to be capable of recovering substantial volumes of purified water (60-70%), thereby providing a cost effective and water-efficient source of process water for olive oil production.

Water and wine

Wine production also generates a lot of wastewater: around 2 litres for every litre of wine produced. The high concentration of organic material in this wastewater creates a serious disposal problem.

As well as olive oil, Greece is also a major producer of wine – some 500 000 tonnes/yr – and the 'DIONYSOS' project (**LIFE03 ENV/GR/000223**) aimed to develop an economically viable process for re-using this waste product. Again small producers often lack the means and incentives to treat this wastewater and it is merely run off into water bodies.

The 'DIONYSOS' team introduced a new way of managing this waste, one that extracts the valuable phenols contained in the waste. The remaining sludgy wastewater is re-used in the production of high nutritional value animal feed and the treated liquid effluent is recycled in the production processes of the winery. This technology can also be applied with only slight modifications to other agricultural products, such as olive oil, tomatoes, apples and peaches.

Food processes

The production of potato starch uses large amounts of water and energy. Increasing environmental requirements along with the need to remain competitive, however, are encouraging potato starch factories to find alternatives to disposing of wastewater. One such alternative was developed by the Danish LIFE project, 'New potatopro' (**LIFE04 ENV/DK/000067**).

The beneficiary, Karup Kartoffelmelfabrik, built a new factory at which the proteins present in the wastewater could be extracted for industrial use and animal food production and where the purified water could then be re-used in production. During the process the wastewater containing the protein

Photo: LIFE07 ENV/IT/000421

The 'RE-WASTE' wastewater treatment system recovers up to 70% of purified water, which can be used as process water for olive oil production

DID YOU KNOW?

Industrial water re-use has resulted in higher production yields and minimised waste.

Source: Towards efficient use of water resources in Europe - EEA


Photo: LIFE05 ENV/NL/000035

The 'CLB' project's closed-loop blanching technology for the potato-processing industry demonstrated considerable water savings

is combined with an acid and heated up. The combination of acid and heat makes the protein precipitate in the water. The protein is separated from the liquid in a decanter, after which it is dried down to form a waste product that contains phosphorus, potassium and just 10% water and which can be sold as fertiliser sludge. The remaining purified water can then be used in the production process instead of freshwater. The beneficiary reduced its water consumption by 40% by re-using wastewater in this way.

Potato processing was also the focus of a Dutch LIFE Environment project. The 'CLB' project (**LIFE05 ENV/NL/000035**) addressed the wastewater produced through hot-water blanching – a standard procedure in the production of chips and other potato-based products. It demonstrated a concept known as closed-loop blanching: selective leaching out of sugars during the blanching, by keeping the concentration levels of all components in the blanching water (ions enzymes, amino acids, antioxidants, vitamins and organic acids) at a constant level, and selectively removing sugars from the water. The sugars are removed from the blanching water using a batch fermenter and the water is subsequently pumped back into the blancher, resulting in considerable water savings. The project achieved a reduction in groundwater use of some 240 l/tonne of potatoes and a reduction in wastewater treatment requirements of 240 l/tonne.

Finally in the area of food production, LIFE has also focused on the dairy industry. Here, the aim was to show that the industry could support its own water needs for internal processing and cooling. While these needs are considerable – conventional cheese factories need 0.8 l of water to process one litre of milk – the Dutch project, 'Dairy, no water!' (**LIFE03 ENV/NL/000488**), attempted to show that they could be met by wastewater and surface water alone.

The project came up against a few obstacles, however. Water management at the factory is a complex business and the water demand was higher than expected at the new plant where the project was carried out. Nevertheless, re-using wastewater greatly reduced the consumption of groundwater, drinking water and energy at the site. Moreover, the potential for transferring the technology to other cheese factories and food processing plants is good. Interest amongst dairy products producers in water self-sufficiency is likely to grow with the expected increase in discharge taxes and costs of drinking water and groundwater.

Impacting on industry

The industrial sector uses large quantities of (process) water. As a result industrial companies face substantial water management costs (including wastewater treatment and sewerage). A total of eight industries were targeted by one Dutch project – 'Maastricht water' (**LIFE00 ENV/NL/000790**) – which demonstrated that substantial groundwater savings can be made by implementing an integrated water management system.

The project was situated in Limburg province in the Netherlands, an area that is home to several companies with inadequate wastewater treatment systems. The basic idea of the LIFE project was to cluster industrial companies and connect them to central facilities. One facility was a centralised water supply created to produce process water using water extracted from the river Maas. This river water, which before treatment contains nitrates from fertilisers and heavy metal residues from industry, is, after treatment, fit for use as process water.

The project also implemented a semi-collective wastewater treatment site, which greatly reduced discharge of heavy metal residues into the Maas from the participating industrial facilities. However, the ultimate objective of totally eliminating groundwater use could not be reached as not all the companies involved in the project could be connected to the common facilities. Groundwater use was nevertheless reduced by some 1 000 000 m^3/yr through the use of river water, whilst optimisation measures introduced by the project helped the companies reduce process water use by some 500 000 m^3/yr in total.

Dyeing and finishing processes in the textile industry consume huge quantities of water and produce vast quantities of wastewater. Pigments and other products present in the dyeing baths, however, make re-using the water problematic.

The Spanish project, 'Dyeing bath reuse' (**LIFE03 ENV/E/000166**), attempted to meet this challenge. It accurately determined the volume of residual colour in the bath, together with the concentrations of other products, in order to prepare a new dyeing bath. Analysis showed that reusing residual dye baths does not affect the quality of the new dye.

The project tested a technique to measure the residual baths using RAMAN spectroscopy; this technique allows new dye baths to be prepared with enough precision to ensure that colours are reproduced with sufficient accuracy. The savings achieved by the project were impressive: 90-100% reduction of water consumption; 70-90% reduction of wastewater pollutant load.

Another significant problem for the textile sector is the large amounts of organic chemicals present in the wastewater discharge from production processes. These are particularly harmful to the environment because of their low biodegradability and high salinity. Whilst several successful research and pilot projects had attempted to recover, on a full scale, effluents for re-use in production, no textile company had yet implemented such a process. SMEs were still using fresh high-quality water prior to the launch of a LIFE project in 2005.

The Italian project, 'BATTLE' (**LIFE05 ENV/IT/000846**), demonstrated a new "Best Available Technique" (BAT) for efficient wastewater re-use in the textile industry. The water re-use BAT was shown to be feasible for a representative medium-sized textile finishing company, Stamperia di Martinengo.

The project first carried out a study on the processes and the potentially re-usable effluents, and evaluated the water quality needs of textile processing. Based on these initial findings, the most cost-efficient technology for water reclamation was selected and different water re-use schemes were designed for cost/benefit comparisons. A water re-use pilot plant was then designed and developed to demonstrate the applicability of the methodology.

This pilot plant treated some 500 m^3 of effluents/day and produced on average 374 m^3 of recovered water/day. The company planned to increase the plant capacity to up to 1 000 m^3/day, which represents around half of its total freshwater use. With this full-scale plant in operation the production processes will use a mix of primary water and reclaimed wastewater in equal proportions. Water re-use by treatment of segregated effluents has also reduced the hydraulic load, thus allowing more contaminants to be removed before the discharge of wastewater.

The technology was moreover included in a recent review of the BAT Reference Document (BREF) reference guidelines for the textile sector.

This winery in Cyprus uses an innovative solar oxidation method on its wastewater. The treated effluent is then used to irrigate the vineyards

Photo: Christos Demetracopoulos

Re-use in crop irrigation

An ongoing Greek LIFE project is aiming to show that wastewater can not only be treated to make valuable products such as animal feed and fertiliser, but that it can re-used directly in farming in the irrigation of crops. The 'WASTEREUSE' project (**LIFE10 ENV/GR/000594**) is attempting to recycle wastewater along with other agricultural waste materials.

The project aims to address two significant environmental problems: the uncontrolled disposal of agricultural waste (such as that from olive oil mills and wineries) and the excessive use of nutrients and natural resources such as freshwater for irrigation. Intensive farming systems use excessive amounts of water in irrigation, one of the reasons why conventional water resources are becoming seriously depleted. As a result, wastewater reclamation and re-use is increasingly being integrated in the planning and development of water resources in the Mediterranean region, particularly for irrigation.

The LIFE project aims to re-use the wastewater generated by the agricultural industry in the cultivation of crops. The team is first assessing the suitability of traditional and modern techniques for treating waste. It will then develop best practices for the management of application in order to maximise yields and minimise the impact on the environment. The project plans to produce a report on the soil quality following the use of the treated wastewater in crop cultivation.

The project will also propose a set of measures and actions that should be taken by national policymakers in the Mediterranean to conform to European legislation requirements, as well as legislative recommendations for the re-use of agricultural waste in terms of water and nutrient management. A significant expected outcome of the project will be the increased competitiveness of Mediterranean agricultural products as a result of reduced water consumption and fertiliser use.

The 'WINEC' project in Cyprus (**LIFE08 ENV/CY/000455**) has developed an environmental management system (EMS) and wastewater treatment plant for the Tsiakkas Winery in the Troodos Mountains. It is hoped that this will have an important demonstration effect, since many small Cypriot wineries still spread their untreated effluent in fields, thereby polluting groundwater resources. Wineries also consume large large quantities of water in cleaning fermentation tanks, barrels and other equipment (approximately three to four litres per litre of wine produced).

The new wastewater treatment plant was developed by the University of Cyprus, the LIFE project beneficiary. Pilot scale tests showed that the combined membrane bioreactor (MBR)/Solar Advanced Oxidation system was able to reduce chemical oxygen demand (COD) by more than 80%, as well as cutting the toxicity and phytotoxicity of the final effluent to zero.

The demonstration plant at Tsiakkas Winery has been operating regularly since October 2011, enabling the business to re-use the treated wastewater to irrigate all its vineyards, with potential savings of up to 400 tonnes/yr of fresh water. The plant has the capacity to treat up to 1 500 tonnes/yr of water and the winery intends to install 200-300 tonne storage tanks to enable re-use of a significant proportion of the treated water.

In conjunction with the University of Cyprus, the winery has also implemented steps to reduce the environmental impact of its processes. Lessons from this "eco mapping" process fed into a good practice guide for improving the environmental performance of wineries and specifications for wastewater treatment plants, which was developed by the beneficiary as part of the 'WINEC' project. The work also provided the impetus for Tsiakkas Winery in its quest for EMAS certification (awarded in 2012).

The wastewater treatment plant and solar oxidation system achieved the removal of over 80% of the organic load

Photo: Christos Demetracopoulos

Management tools for efficient water use

The LIFE programme offers many valuable examples of how water pricing schemes can be designed so as to take account of local economic, social and environmental conditions whilst meeting the objectives of the Water Framework Directive. Projects have also provided local, regional and national administrations with better tools for decision-making, an important step towards more efficient water use.

MANAGEMENT TOOLS FOR EFFICIENT WATER USE

Paying the price

Water pricing is a key element of European water policy and an essential tool in promoting the sustainable management of water resources. To date, only a few LIFE projects have directly addressed the issue of water pricing, but some projects have explored related issues that can help to inform pricing schemes.

Photo: LIFE09 INF/UK/000032

The 'RESTORE' project is developing a network to share information and good practice on river restoration activities across Europe

One of the main challenges of EU water policy is to establish water pricing regimes that adequately reflect the sensitivity of water resources. The Water Framework Directive (WFD) calls for water services to be charged at a price that fully reflects the costs of the services provided, which includes the operational and maintenance costs of water supply and treatment, the costs of infrastructural investments, as well as environmental and resource costs.

Under the WFD, Member States had until 2010 to introduce water pricing policies. However, the European Commission's analysis of the first River Basin Management Plans, submitted at the end of 2009, suggests that, "water pricing levels and structure do not provide sufficient incentives to increase water efficiency." In some cases, it states that, "water users are either not charged at all or are not charged in relation to the quantity of water used."

The analysis also highlights gaps in the quantification of environmental and resource costs, which prevent the development of tools such as 'Payments for Ecosystem Services schemes' linked to reduced water resource depletion or land-use changes that could lead to cost-effective solutions for the achievement of WFD objectives.

In line with this analysis, the Water Blueprint will propose EU action in areas such as promoting more widespread use of water metering and water pricing as a tool for improved water efficiency, and increasing knowledge of the cost of water services and how these costs can be fairly recovered from the different water users.

Awareness raising

Raising awareness of the potential of water pricing as a tool to promote sustainable water management is a prerequisite for its wider uptake in the EU. In Italy, where domestic water consumption in urban areas is amongst the highest in the EU, 'WATACLIC', a LIFE Information & Communication project (**LIFE08 INF/IT/000308**) has sought to promote the adoption of water pricing, in conjunction with more widespread use of new technologies, such as rainwater harvesting, to enable more sustainable urban water use.

During a series of stakeholder workshops involving the general public and specialist target groups, the project found a high level of awareness of, and interest in the issues of water pricing and economic incentives, but a much lower interest in water saving strategies and technologies. It concluded that an appropriate water pricing system, integrated with economic or fiscal incentives to promote innovation, was a crucial first step to raising interest in water issues. Once this interest grows, it suggested that other policy tools could follow, "opening the way to new approaches and technological innovation."

The project recommended the use of water pricing as a means of to discourage water abstraction, including water losses in the distribution process, and excessive consumption by final users. However, in setting pricing levels, it underlined the need to take account of the financial position of users and avoid a situation where water becomes unaffordable.

Counting the cost

Establishing appropriate pricing levels starts with a good economic analysis of existing water prices, and of the pressures and impacts of each river basin. However, some Member States do not have adequate information to carry out such economic analyses, especially with regard to industrial and agricultural users, and the resource and environmental costs of water services.

Taking up this challenge, the Romanian LIFE project 'DIMINISH' (**LIFE03 ENV/RO/000539**) developed a methodology, using an Open-GIS system, to assess the environmental costs associated with different socio-economic scenarios in the Siret river basin. Led by the National Institute of Hydrology and Water Management in Romania, the project developed scenarios for different nutrient management strategies by changing human pressures in areas such as agriculture, the fertiliser and chemical industries and wastewater disposal. It then determined the environmental costs associated with each scenario. The environmental costs were calculated on the basis of the cost of measures for reducing pollution or the costs of wastewater treatment in order to achieve a target water quality standard.

'Wataclic' is raising awareness of the potential of water pricing as a tool to promote sustainable water management

Photo: LIFE08 INF/IT/000308

Knowledge transfer and research

In the Water Blueprint, the European Commission underlines the important role of research in the implementation of EU water policy, and the need for "effective knowledge sharing" and more timely provision of research results. The 'WaterRtoM' project (**LIFE09 ENV/FR/000593**) aims to contribute to this objective by reducing the time-lag for transferring excellent research outputs to practitioners in the water-sector, down from 10 years currently to 3-5 years. The project will develop a Research-to-Market Assessment Strategy (ReMAS), which it will use to assess the outputs of 20 to 30 of the most promising research projects in the EU. For projects considered to be "close-to-implementation", it will then identify and target sites and companies that could adopt the innovation.

Similarly, the 'RESTORE' project (**LIFE09 INF/UK/000032**) is developing a network linking policy-makers, planners, practitioners and experts to share information and good practice in river restoration. The project is calling on all river restoration practitioners to share experiences through a new River Wiki.

Photo: LIFE08 ENV/GR/000570

The 'HydroSense' project is developing a new approach to water pricing for agricultural users

The 'DIMINISH' online GIS system was developed using a distributed architecture, which allowed the project partners and end users to access the system in order to store, display, query, analyse and retrieve information. Users could adjust the model inputs and process spatial data for specific computations, including calculating the environmental costs and cost-effectiveness of different measures. The system provides both short and long-term data to aid decision-making on a range of issues, including water pricing.

Another LIFE project, 'HydroSense' (**LIFE08 ENV/GR/000570**) is seeking to improve knowledge of the financial, environmental and resource costs of water use for agriculture, focusing specifically on cotton-growing areas in the Mediterranean. Agriculture is the sector with the greatest water consumption in the EU and the Blueprint document foresees that future payments for farmers under the Common Agricultural Policy (CAP) would be conditional on compliance with certain water metering and water pricing obligations.

The 'HydroSense' project will contribute to knowledge in this area by constructing a new approach to water pricing for agricultural users. The project carried out a full cost assessment of water uses at the watershed level. An estimate of the total cost of irrigation in the study area was then derived by aggregating the financial cost, the environmental cost and the resource cost. This contributed to establishing the amount that needed to be recovered via water pricing. The project is currently conducting an economic analysis of different pricing methods.

DID YOU KNOW?

More than eight out of 10 Europeans agree that water users should be charged for the volume of water they use.

Source: Eurobarometer March 2012

Piloting the use of water meters

In terms of cost recovery, the absence of metering remains a key impediment to linking price to water usage, especially in the agricultural sector. Spain's 'Optimizagua' project (**LIFE03 ENV/E/000164**) trialled the use of water meters as part of a wider initiative to reduce water use for the irrigation of crops and public parks in the north-east of Spain. This helped to improve knowledge of consumption patterns and to devise systems to improve water efficiency, but could also provide a basis for the introduction of water pricing.

In addition to consumption by end users, water losses during abstraction and distribution also impact on the sustainability of water resource use, as well as on the levels of costs to be recovered. The 'A.S.A.P.' project (**LIFE06 ENV/IT/000255**) tested new approaches to minimising leaks and improving the efficiency of the water distribution network in the Arno river plain, near the town of Pisa.

The project produced a protocol for reducing ground water abstraction, which also brought about a number of cost benefits (increasing the life of infrastructure, reduced maintenance costs, etc.). By adopting this approach, water managers will have the information needed, firstly to reduce water abstraction, but also to determine the tariffs, which can then be largely based on the amount of water use, with a reduced requirement to factor in losses, maintenance of infrastructure and other 'non use' costs.

The Blueprint document discusses the importance of valuing ecosystem services in determining water prices. A number of LIFE projects have demonstrated different approaches to demonstrating and enhancing the value of water-based ecosystem services. A good example is Polish project 'Lake recultivation in 'Gniezno' (**LIFE07 ENV/PL/000605**), which demonstrated the use of coagulants to inactivate phosphorus in bottom sediments in two urban lakes - Jelonek and Winiary – in the historic city of Gniezno.

This new methodology helped to substantially improve the quality of water in the lakes, thereby increasing their potential for tourism and recreational use, whilst also improving the health benefits for local residents. Monetising the recreational value of the lakes and the avoided health costs now requires an additional step, but an essential one in terms of ensuring that associated costs are adequately considered in terms of water pricing.

MANAGEMENT TOOLS FOR EFFICIENT WATER USE

Pricing water for sustainable use

A LIFE project in Greece's Anthemountas river basin has demonstrated the potential of water pricing as a tool to reverse the over-exploitation of groundwater resources and contribute to the establishment of a more sustainable approach to water management.

Situated in the region of Central Macedonia, close to Greece's second largest city, Thessaloniki, the Anthemountas river basin covers an area of some 320 km². In recent decades, the area has experienced significant urbanisation and a marked increase in in agriculture and the tertiary sector. This led to a growing demand for water, to the extent that abstraction from groundwater resources was occurring at a faster rate than it could be replenished.

Data collected by the local authorities in the area showed a significant decline in the groundwater level from 1993, and in 2000, a new body, Anatoliki, was set up to coordinate the collection and analysis of water data for the basin.

Water out of balance

"We calculated a fall of 1m/yr in the groundwater level, leading to a dramatic decline in the water balance, with a deficit in the water table of 17.5 million m³ in 2005 and 16.5 million m³ in 2006," explains Sokratis Famellos, of Anatoliki, the development agency of Eastern Thessaloniki's local authorities.

The Anthemountas river basin

"The earlier construction of two dams and a wastewater treatment plant did have a positive impact, as seen in the figures for 2006, but it was clear that a more coherent water policy for the area was required, including a more widespread use of metering and a more effective and transparent system of water pricing," he says.

Developing such a policy was complicated, however, by the fact that farmers, who account for over 80% of water use in the area, were opposed to the idea of water metering.

"A process has been started that is already showing good results"

"Most of the irrigation needs of farmers, and industry, are met by private wells and because we have no way of telling how much is abstracted, it was difficult to establish a pricing system based on water use," adds Elisavet Pavlidou of Anatoliki.

To address these issues, the development agency successfully applied for LIFE co-funding to put in place an integrated water management plan for the Anthemountas river basin, including establishing a new water pricing system. The 'Water Agenda' project (**LIFE04 ENV/GR/000099**), which kicked off in 2004, was co-managed by Sokratis Famellos and Elisavet Pavlidou.

One of the first project actions was to set-up a dedicated water unit, which would be responsible for collating and assessing all the available data on water use and availability in the basin. Using these data, a model was developed that analysed three possible water management scenarios and the impact on the area's water resource up to the year 2020: business-as-usual, where water availability would be regulated mainly by natural, hydrologic processes; engineering, which foresaw works such as the construction of reservoirs and wastewater treatment plants in order to increase the availability of water; and the hand-in-hand scenario, which included engineering works, as well as the application of sustainable water policies, new agricultural practices, changes in consumption and behaviour and water pricing. Each scenario was also subject to a cost-benefit analysis to help in determining the most effective solution in environmental and economical terms.

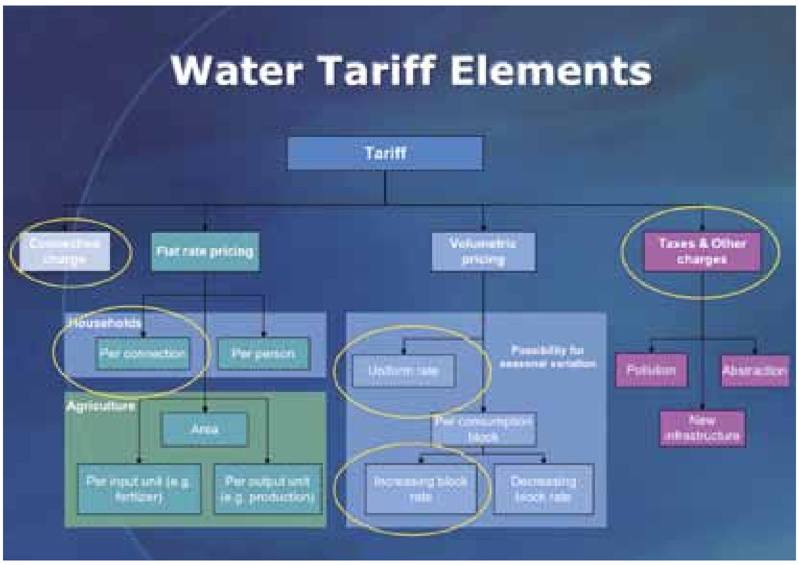
The results of this exercise showed that only the hand in-hand approach could deliver a positive water balance by 2020. Based on these results, proposals for a protocol and water policy for the area were then developed and these were presented to, and eventually agreed by local stakeholders as part of a public participation process. One of the chapters of the protocol concerns water pricing.

According to Mr Famellos, the consultation process was a key part of the project. He believes that it led to important benefits, helping to build a consensus around a common policy, including a water-pricing component, and also promoting a noticeable shift in attitudes towards the conservation and the sustainable use of water resources amongst the citizens and social groupings of the .Anthemountas river basin.

Pricing for cost recovery

"Water pricing was a key component of the new policy, but we knew that some stakeholders, especially the farmers were opposed to [metering], so it was essential that this principle was agreed by everyone, and that subsequent price setting was open and transparent," says Mr Famellos.

'Water Agenda' evaluated different solutions in establishing the elements of water tariffs



The water pricing aspects of the project were coordinated by the National Technical University of Athens (NTUA), in accordance with Article 9 of the Water Framework Directive. In establishing a pricing system, the project drew on a methodological approach that considered both the river basin level and the water service providers' level.

At the river basin level, three different types of cost were assessed: the external environmental costs; the resource costs; and the financial costs related to the construction, operation and maintenance of water infrastructure. At the water service providers' level, the focus was on the financial costs associated with the provision of water services.

Since available data were limited, especially in relation to water use for irrigation, the assessment of costs was performed only for services provided by public service providers. Specifically, cost recovery was estimated for:

- The provision of drinking water by the municipal domestic water supply services;
- The provision of irrigation water by the municipal irrigation water supply services; and
- The provision of wastewater collection and treatment services by the corresponding municipal services.

Estimates were based on financial cost data for the 2001-2004 period, which were mainly obtained from receipt and expenditure statements of the municipal services. The capital cost estimation for existing infrastructure was based on the historical value method, taking into consideration the useful lifetime of the infrastructure.

The main goal of developing domestic pricing schemes was to achieve financial cost recovery at levels above the currently estimated ones. Three alternative pricing structures were examined: firstly, a constant volumetric pricing scheme, with no fixed or connection charges; secondly, a two-part tariff, which includes a connection and fixed charge for ensuring a minimum recovery of costs, and a volumetric charge; and thirdly, two alternative two-part rate tariffs, where the volumetric part follows an Increasing Block Tariff (IBT) structure. These pricing schemes were then evaluated on the basis of the affordability of household charges and the potential for demand reduction.

In relation to irrigation, the goal was to define appropriate rates for achieving financial cost recovery above 50%, whilst also ensuring a uniform and consistent volumetric pricing policy per municipality. However, the development of realistic volumetric pricing schemes was not possible because of the absence of metering. Instead, estimations were based on a theoretical calculation of supplied volumes, while also taking account of the area irrigated and the type of crop.

"It should be underlined that the rates estimated on the basis of this theoretical calculation of water usage, are purely indicative," emphasises Mr Famellos. In fact, a comparison of estimated and metered consumption in three MINs (where some limited data is available) demonstrated a very high deviation, which suggested that a more realistic cost recovery would require much higher prices.

An important first step

The local authority has built on the work the NTUA did on water pricing during the LIFE project and, despite continuing gaps in terms of data availability, it had put in place a new pricing policy for drinking water by the end of 2011; this was followed by a policy for other users that became operational at the start of 2012.

"For households, we now have one pricing policy, based on volumetric pricing (see Table 1). Households are charged every four months, based on the volume of water they consume, and according to five blocks. This is made easier by the fact that many houses are now metered, which wasn't the case before," says Mr Famellos.

The new system is transparent and cost-effective, as the municipality recovers the full financial cost of water supply and network maintenance through a fixed charge. It also recovers environmental costs, as consumers are charged for sewage treatment and they pay more if they consume more water. Affordability is also taken into consideration, with reduced tariffs for lower income households or people with health or mobility problems.

Thermi Municipality has adopted a pricing policy thanks to LIFE funding

"We have also introduced a special pricing policy for irrigation, for animal husbandry, for the private sector and for the public sector, where there was a big gap," adds Mr Famellos. "We are not yet recovering the actual cost of irrigation as we don't have a metering system in place, but we are recovering the costs incurred in the maintenance of the irrigation networks, which is a step forward."

An ardent support of the project, Mayor Theodoros Papadopoulos, believes that it has played a vital role in helping local citizens to better understand that water is a social good for which there are costs. "There is still work to be done," he insists. "Resource costs are difficult to calculate without knowing what is being abstracted from each individual well, and pricing is not easy without metering, but we have made progress. A process has been started that is already showing good results and in the long term, I am certain that it will lead to a more sustainable management of our water resource."

Project number: LIFE04 ENV/GR/000099

Title: Development and implementation of integrated water resources management policy to a river basin, through the application of a social wide local agreement, based on the principles of Agenda 21 and the provisions of WFD 2000/60/EC

Beneficiary: Development Agency of Eastern Thessaloniki (Anatoliki)

Contact: Sokratis Famellos

Email: environment@anatoliki.gr

Website: www.lifewateragenda.org

Period: 01-Sep-2004 to 31-Oct-2007

Total budget: €1 403 000

LIFE contribution: €688 000

MANAGEMENT TOOLS FOR EFFICIENT WATER USE

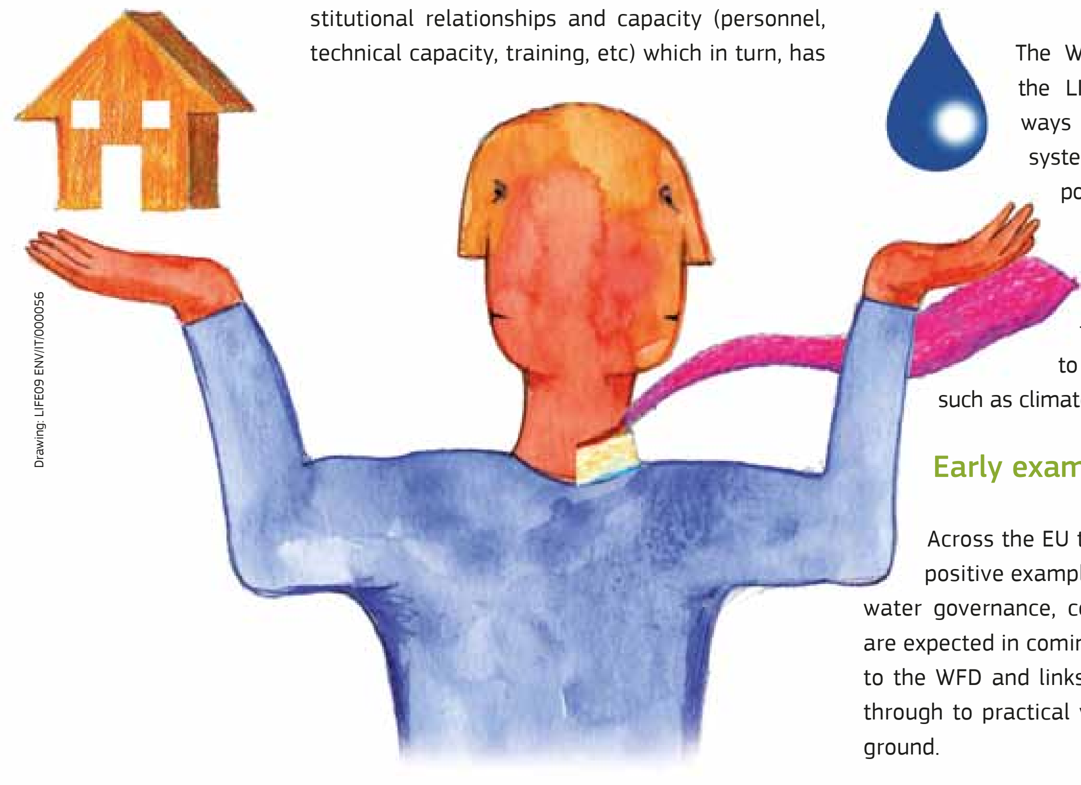
LIFE supports **good water governance**

Good water governance is seen as a key management tool to address some of the problems that are emerging with the implementation of the Water Framework Directive (WFD), in particular, problems highlighted by the analysis of the River Basin Management Plans (RBMPs) and the Water Scarcity and Droughts (WSD) Gap Analysis. A number of important LIFE projects support governance strategies towards the achievement of EU water policy goals.

Since its adoption in 2000, the WFD has been the main driver for improvement of governance in European water management. However, implementation has sometimes been difficult – not least because of the very significant differences between and within countries in terms of water availability, quality, quantity, efficiency and so on; and also because of climate change and other human-induced pressures.

According to the recent reviews of the WFD, implementation has proved difficult for some Member States because of issues such as fragmented institutional structures, poor intra- and inter-institutional relationships and capacity (personnel, technical capacity, training, etc) which in turn, has undermined the ability of authorities to carry out the detailed reports and monitoring required. Governance gaps that need to be bridged range from the administrative, to policy (sectoral fragmentation), capacity (personnel and technical skills) and funding (budgetary) issues.

Other specific problems affecting water governance include difficulties in removing or changing water rights or concessions that may have been in place for a long time; and the governance of transboundary river basins - whilst there are positive examples of joint planning and coordination in shared river basins, this is not always the case.



Drawing: LIFE09 ENV/IT/000056

The Water Blueprint, supported by the LIFE programme will look at ways to improve the governance system stemming from EU water policy, including the administrative set up and the potential to reduce the administrative burden, whilst providing the reactive capacity needed to face emerging challenges such as climate change adaptation.

Early examples

Across the EU there have been a number of positive examples of successful or improved water governance, co-financed under LIFE. More are expected in coming years, as the amendments to the WFD and links with other EU policies feed through to practical water-related actions on the ground.

A noteworthy earlier project is 'MOSYM' (**LIFE99 ENV/RO/006697**) carried out in Romania in 2000-02 – i.e., during the first years of implementation of the Water Framework Directive – to develop a new computerised system to better manage the environmental and economic impacts of the country's regular flood events. The project managed to bridge some capacity gaps by creating a means of allowing local authorities to gain direct, low-cost access, via the Internet, to essential flood exposure/warning data and forecasts, thus allowing them to draft and update physical planning strategies and zoning policies. By using the real-time information on water levels, the central and local authorities are also better able to respond rapidly to the danger of floods. The project team also outlined an RBMP that was one of the first examples of how to implement the WFD.

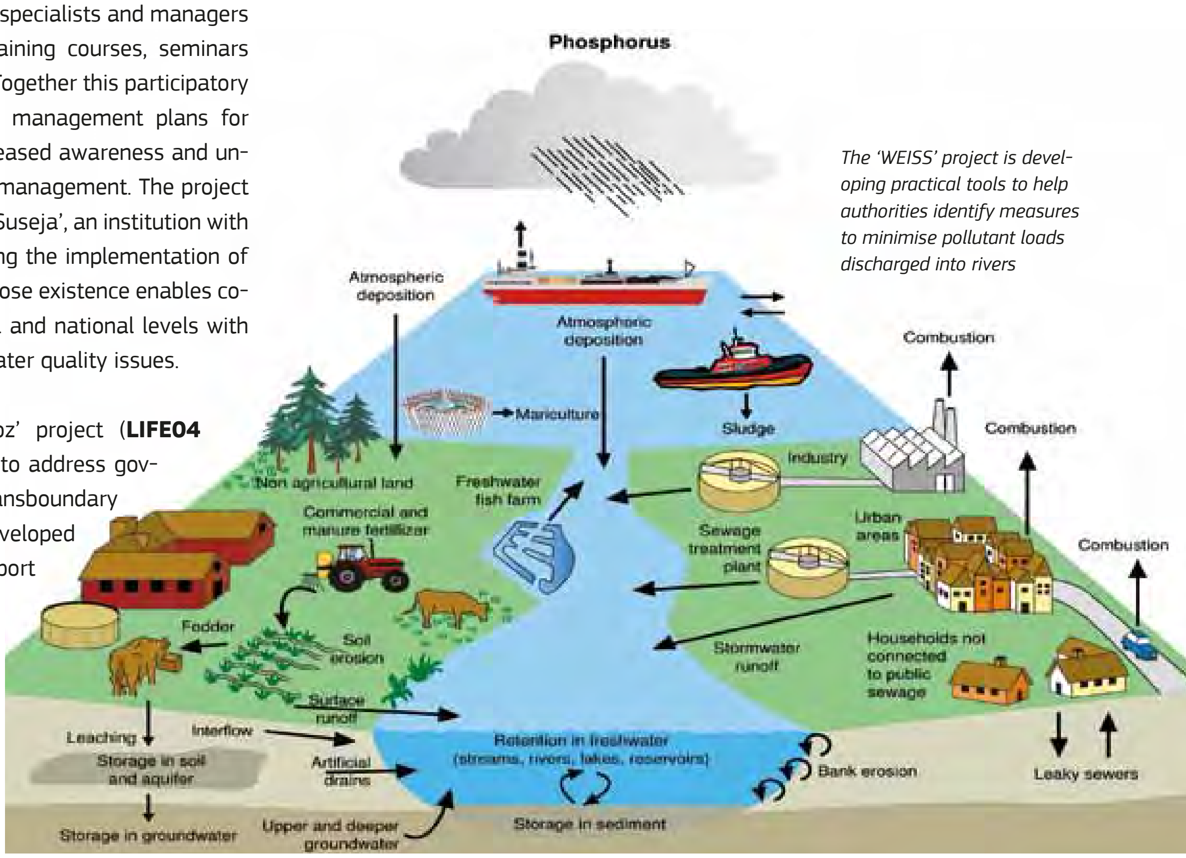
In Latvia, the 'Ziemelsuseja' project (**LIFE02 ENV/LV/000481**) extensively involved stakeholder groups in the design of an RBMP to resolve water quality problems affecting a number of small rural municipalities. Stakeholder involvement allows for coherence between the WFD and other policies, enabling better implementation. Eighteen public meetings were held in the municipalities during the project - recruiting more than 600 people (i.e. some 10% of the total population) in participation and monitoring activities. The knowledge and skills of the local decision-makers, technical specialists and managers was also improved via training courses, seminars and experience exchange. Together this participatory process resulted in water management plans for each municipality and increased awareness and understanding of river basin management. The project also led to the creation of 'Suseja', an institution with competence for coordinating the implementation of the Ziemelsuseja RBMP, whose existence enables co-operation at local, regional and national levels with regard to governance of water quality issues.

In Hungary, the 'Szigetkoz' project (**LIFE04 ENV/HU/000382**) helped to address governance concerns at a transboundary level. The project team developed an innovative decision-support tool (DST) for sustainable water and land-use management planning in the Hungarian-Slovakian Transboundary Danube Wetland Area. Historically, there had been little cross-border cooperation between decision-makers in the Szigetköz area, with negative impacts on river basin management. The LIFE project broke new ground in terms of Slovakian-Hungarian scientific cooperation and stakeholder involvement, leading to the development, testing and implementation of an integrated action plan based around the use of the DST. The GIS-based decision-support tool enabled environmental, economic and social needs to be evaluated at the same time and by the same parameters.

Thus, the DST, together with the other main result of the project, a flow-supplementation system, provided a means for Hungary and Slovakia to develop planning for sustainable development in line with the requirements of the WFD.

Lessons from Spain

A number of Spanish LIFE Environment projects are also looking at strategies aimed at improving water governance (see 'Water Change' – pp.11-13). LIFE 'CORBONES' (**LIFE03 ENV/E/000149**) developed and implemented a methodology based on the participation and involvement of local communities surrounding the Corbones river basin. The involvement of a wide range of individuals and organisations – from community groups to public authorities to farmers – has led to a broader and



The 'WEISS' project is developing practical tools to help authorities identify measures to minimise pollutant loads discharged into rivers

Drawing: LIFE08 ENV/B/000042

Photo: LIFE09 ENV/IT/000056

Integrating the protection and sustainable management of water in urban spatial planning by creating a platform for local authorities is the aim of the 'WIZ' project

more participative solution to a problematic environmental situation.

Extensive stakeholder involvement helped the project overcome problems caused by administrative barriers, as well as raising awareness and creating acceptance around the implementation of the WFD (and other legislation), especially amongst farmers. This was achieved through three means, the first of which was a Register of Environmental Information (RPIM). This database stored and displayed extensive information about water quality, typically only available through very technical final reports. By making existing information and management decisions more transparent, the RPIM has been a key tool for social participation.

The second element was the Platform for Corbones River Protection, a forum that directly involved numerous organisations, including the most polluting companies. This set the basis for an open consultative process and facilitated a general improvement in practices related to the river, including a decrease in pollutant discharges, waste disposal and illegal behaviour.

Finally, the project established an interpretation centre (CIRC), which became an essential element in its success and has been the key reference point for all issues related to river protection.

A second project, 'POWER' (**LIFE08 ENV/E/000114**), is targeting water efficiencies in irrigation for the agricultural sector – the country's highest consumer of water, accounting for 68% of all available water. It aims to validate models of "good water governance" combining principles of water and energy efficiency with applications based on renewable energies for the eco-management of water in irrigation uses. One of its main objectives is to use environmental local authority networks to promote models of good water governance based on its findings to 10 irrigation communities, 10 regions and 10 southern European cities. The project team is also developing an exemplary model at regional level to reinforce the transfer potential of the project. The model will incorporate measures of a financial and regulatory nature, with social and institutional support for examples of "good water governance".

DID YOU KNOW?

The main principles for effective water governance are: openness and transparency, inclusion and communication, coherence and integration, equity and ethics.

Source: Bareira, 2006

Latest developments

Water governance is an ongoing concern of LIFE Environment projects in Belgium and Italy. The Belgian project, 'WEISS - Water Emissions Inventory Planning Support System' (**LIFE08 ENV/B/000042**) aims to support authorities across Europe in their implementation of the WFD. Specifically, the beneficiary is working to develop practical tools to help authorities identify which measures could minimise pollutant loads discharged into rivers, thus helping to improve water quality and ecological status.

Finally, the Italian project 'WIZ – WaterIZe' (**LIFE09 ENV/IT/000056**) will help integrate the protection and sustainable management of water in urban planning processes and local policy areas. This will increase policy coherence, help guarantee effective governance and break down the barriers that have impeded local, national and transnational cooperation among water authorities.

The project aims to incorporate long-term analysis of drinking water management in urban spatial planning by creating a platform for local authorities to be involved in decision-making processes. 'WIZ' will contribute to the integration of the European Framework for Adapting to Climate Change into other local and EU regulations particularly in relation to future water management conditions. Another important project outcome will be the creation of a network of European projects within the water technology platform, thereby helping to increase transnational co-operation on water management. The project will also involve citizens and SMEs in water governance with the aim of increasing public participation and understanding of the issues involved.

Project list

The table below provides the complete list of LIFE projects related to the Water Blueprint mentioned in this publication. For more information on individual projects, visit the online database at: http://ec.europa.eu/environment/life/project/projects/index.cfm

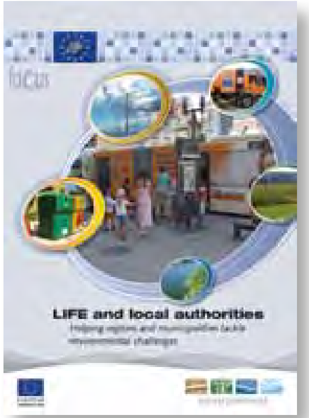
PROJECT REFERENCE	ACRONYM	TITLE	PAGE
WATER QUALITY AND QUANTITY			
LIFE04 ENV/IT/000500	CAMI	Water-bearing characterization with integrated methodologies	9
LIFE06 ENV/IT/000255	A.S.A.P.	Actions for systemic aquifer protection: implementation and demonstration of a Protocol to scale down groundwater vulnerability to pollution due to overexploitation	9, 51, 66
LIFE10 ENV/IT/000394	WARBO	Water re-born - artificial recharge: innovative technologies for the sustainable management of water resources	10
LIFE10 ENV/IT/000380	AQUOR	Implementation of a water saving and artificial recharging participated strategy for the quantitative groundwater layer rebalance of the upper Vicenza's plain	10
LIFE08 ENV/E/000117	ENSAT	Enhancement of Soil Aquifer Treatment to Improve the Quality of Recharge Water in the Llobregat River Delta Aquifer	11
LIFE07 ENV/IT/000497	SALT	Sustainable management of the Esino river basin to prevent saline intrusion in the coastal aquifer in consideration of climate change	11, 17
LIFE07 ENV/E/000845	WATER CHANGE	Medium and long term water resources modelling as a tool for planning and global change adaptation. Application to the Llobregat Basin.	13-15
LIFE07 ENV/IT/000475	TRUST	Tool for regional - scale assessment of groundwater storage improvement in adaptation to climate change (TRUST)	16
LIFE05 ENV/E/000288	ALMOND PRO-SOIL	Soil protection in Mediterraanean areas through cultivation of new varieties of almond tree	17
LIFE07 ENV/FIN/000141	VACCIA	Vulnerability assessment of ecosystem services for climate change impacts and adaptation	17
LIFE05 ENV/H/000418	SUMANAS	Sustainable management and treatment of arsenic bearing groundwater in Southern Hungary	18
LIFE05 ENV/B/000517	INSIMEP	In Situ Metal Precipitation for remediation of groundwater contaminated with non ferrous metals	19
LIFE06 ENV/B/000359	MULTIBARDEM	Demonstration of a MULTIBARRIER as a sustainable approach for the prevention of groundwater contamination by leaking landfills and multipollutant contaminated sites: a cheap alternative to landfill reinstallation and/or leachate treatment	19
LIFE04 ENV/IT/000503	SERIAL-WELLFIR	Serchio River alimented well-fields integrated rehabilitation	20
LIFE08 ENV/FIN/000609	CATERMASS	Climate Change Adaptation Tools for Environmental Risk Mitigation of Acid Sulphate Soils	20
LIFE10 ENV/GR/000601	CHARM	Chromium in asopos groundwater system: remediation technologies and measures	20
LIFE06 ENV/F/000158	ISONITRATE	Improved management of nitrate pollution in water using isotopic monitoring	20
LIFE08 ENV/PL/000519	EKOROB	ECOtones for Reducing Diffusion Pollution	20
LIFE04 ENV/HU/000374	RETOXMET	Removal of toxic heavy metals from waste water by special yeast produced by bioconversion on food byproducts - an integrated solution for wastewater treatment	20
LIFE03 ENV/NL/000467	VERBAL	The Vertical Flow Reed Bed at Leidsche Rijn. A natural way to filter urban water.	21
LIFE04 ENV/FR/000320	WILWATER	To demonstrate the effectiveness as well as the environmental and economic interest to promote in Europe the culture of short rotation coppices of willow accordingly to the Breton context of reconquest the water quality	21
LIFE08 ENV/CY/000460	WATER	Strengthening the scientific foundation of water quality programs	21
LIFE02 ENV/LV/000481	Ziemelsuseja	Elaboration of a new comprehensive Ziemelsuseja River Basin Management System based on ecosystem approach and wide stakeholders involvement into decision-making process at local level	21, 71
LIFE07 ENV/L/000540	M^3	Application of integrative modelling and monitoring approaches for river basin management evaluation	23-26

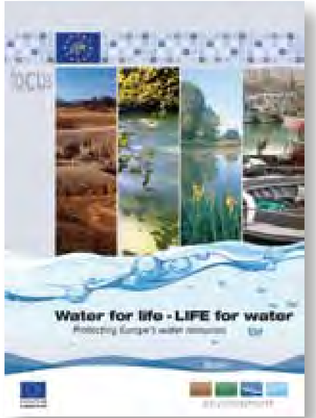
PROJECT REFERENCE	ACRONYM	TITLE	PAGE
WATER-RELATED GREEN INFRASTRUCTURE			
LIFE10 ENV/IT/000347	UNIZEO	Urea-based nitrogenous fertilizers coated with zeolite : reducing drastically pollution due to nitrogen	29
LIFE10 ENV/IT/000321	ZeoLIFE	Water Pollution Reduction and Water Saving Using a Natural Zeolite Cycle	29
LIFE05 ENV/E/000289	FERTIGREEN	Sustainable management of water reducing environmental impact using new fertirrigation methods	29
LIFE06 ENV/F/000133	ArtWET	Mitigation of agricultural nonpoint-source pesticide pollution and phytoremediation in artificial wetland ecosystems	30
LIFE06 ENV/E/000044	ES-WAMAR	Environmentally-friendly management of swine waste based on innovative thechnology: a demonstration project set in Aragón (Spain)	31
LIFE04 ENV/IT/000454	OptiMa-N	Optimisation of nitrogen management for groundwater quality improvement and conservation	31
LIFE04 ENV/FR/000350	SWAP-CPP	Surface Water Protection Against Diffuse Crop Protection Products Release	31
LIFE05 ENV/DK/000145	Odense PRB -AgriPoM	Odense Pilot River Basin - Agricultural Programme of Measures	31
LIFE05 ENV/NL/000021	CEPE	Reduction of pest control impact of horticulture on ground and surface water through a system of constant crop monitoring, early diagnoses, prevention and early treatment	32
LIFE05 ENV/D/000182	WAgriCo	Water Resources Management in Cooperation with Agriculture. Compilation and Implementation of Integrative Programmes of Measures According to the WFD to Reduce Diffuse Pollution from Agriculture.	32
LIFE05 ENV/B/000510	TOPPS	Train the operators to prevent pollution from point sources	32
LIFE00 ENV/IT/000019	Petrignano	Integrated management systems of the Petrignano area : new models against the nitrates pollution	32
LIFE03 ENV/GR/000217	STRYMON	Ecosystem Based Water Resources Management to Minimize Environmental Impacts from Agriculture Using State of the Art Modelling Tools in Strymonas Basin	33, 56
LIFE05 ENV/DK/000155	AGWAPLAN	Integrated Protection of Surface and Groundwater in Agricultural Regions	33
LIFE06 ENV/F/000132	CONCERT'EAU	Collaborative Technological Plateform for implementation for WDF within agricultural context	34-36
LIFE08 ENV/E/000099	AQUAVAL	Sustainable Urban Water Management Plans, promoting SUDS and considering Climate Change, in the Province of Valencia	37
LIFE07 ENV/UK/000936	GRACC	Green roofs against climate change. To establish a UK green roof code to support climate change mitigation and adaptation.	38
LIFE06 ENV/DK/000229	TREASURE	Treatment and re-use of urban stormwater runoff by innovative technologies for removal of pollutants	38
LIFE08 ENV/PL/000517	EH-REK	Ecohydrologic rehabilitation of recreational reservoirs "Arturówek" in Łódź; as a model approach to rehabilitation of urban reservoirs	38
LIFE00 ENV/IT/000080	IMOS	Integrated Multi-Objective System for optimal management of urban drainage	38
LIFE02 ENV/UK/000144	Smurf	Sustainable Management of Urban Rivers & Foodplains	39
LIFE05 ENV/UK/000127	QUERCUS	Maintaining quality urban environments for river corridors users and stakeholders	39
LIFE05 NAT/UK/000143	STREAM	River Avon cSAC: demonstrating strategic restoration and management	39
LIFE09 INF/UK/000032	RESTORE	Rivers: Engaging, Supporting and Transferring knOwledge for Restoration in Europe	39, 65
LIFE99 ENV/DK/000619	ECRR	European Centre for River Restoration	40
LIFE00 NAT/DK/007116	Skjern River	Restoration of habitats and wildlife of the Skjern River	40
LIFE03 ENV/H/000291	FOK WATMAN	Integrated (Multi-level inundation) water management system solving flood-protection, nature conservation and rural employment challenges	40
LIFE03 ENV/S/000601	ForestForWater	Demonstration of opportunities on forest land to support the implementation of the Water Framework Directive	41
LIFE00 NAT/A/007051	Theiss	Management of floodplains on the Tisza	41

PROJECT REFERENCE	ACRONYM	TITLE	PAGE
LIFE08 ENV/IT/000413	INHABIT	Local hydro-morphology, habitat and RBMPs: new measures to improve ecological quality in South European rivers and lakes	41
LIFE07 ENV/B/000038	WALPHY	Design of a decision tool for hydromorphological restoration of water bodies in Walloon Region	41
LIFE06 ENV/D/000485	Moveable HEPP	Demonstration Plant in the Kinzig River: Moveable Hydroelectric Power Plant for Ecological River Improvements and Fish Migration Reestablishment	41
LIFE98 NAT/A/005422	Donauauen	Restoration and management of the alluvial flood plain of the River Danube (Alluvial Zone National Park)	42
LIFE03 NAT/A/000009	WACHAU	WACHAU	42
LIFE02 ENV/A/000282	LiRiLi	Living River Liesing - Demonstrative Ecological Reconstruction of a Heavily Modified Waterbody in an Urban Environment	42
LIFE06 NAT/A/000127	LIFE Obere Drau II	Life in Upper Drau River	43
LIFE99 NAT/A/006055	Obere Drau	Combine of the flood plain-forests of the Upper Drau-river valley (Kärnten)	43
LIFE06 NAT/RO/000177	GREENDANUBE	Conservation and integrated management of Danube islands Romania	43
LIFE02 NAT/A/008518	Donauufer	Restoration of Danube river banks	43
LIFE03 NAT/E/000067	Lago Bañolas	Recuperation of the aquatic environment of Porqueres and the lake of Banyoles	45
LIFE03 NAT/E/000055	Humedales andaluces	Conservation and restoration of wetlands in Andalucia	45
LIFE00 ENV/GR/000685	Reservwet	Mediterranean reservoirs and wetlands. A demonstration of multiple - objective management in the island of Crete	45
LIFE08 ENV/IT/000406	REWETLAND	Widespread introduction of constructed wetlands for a wastewater treatment of Agro Pontino	45
LIFE02 NAT/UK/008544	New Forest	Sustainable Wetland Restoration in the New Forest	46
LIFE00 NAT/D/007038	Galenbecker See	Restoration project 'Galenbecker See' for priority species	46
LIFE02 NAT/D/008456	Westliche Dümmerniederung	Re-wetting of the Western Dümmer fen area	46
LIFE02 NAT/H/008638	Habitats-Birds	Habitat management of Hortóbagy eco-region for bird protection	46
LIFE03 ENV/UK/000617	Sowap	Soil and Surface water protection using conservation tillage in northern and central europe	47
LIFE00 ENV/E/000547	DOÑANA SOSTENIBLE	Design and Application of a Sustainable Soil Management Model for Orchard Crops in the Doñana National Park Area	48
LIFE04 ENV/ES/000269	Humedales Sostenibles	Integrated management of agriculture in the surroundings of community importance wetlands (sustainable wetlands)	48
LIFE07 ENV/GR/000278	Soil Sustainability (So.S)	Soil Sustainable Management in a Mediterranean River basin based on the European Soil Thematic Strategy	48
INCREASING WATER EFFICIENCY			
LIFE02 ENV/E/000183	DROPAWATER	Durable Regions On Peripheal Areas for Water Reduction	51
LIFE09 ENV/IT/000136	PALM	Pump And Leakage Management	51
LIFE08 ENV/E/000114	POWER	Project for Optimisation of Water and Emissions Reduction	51, 72
LIFE09 ENV/ES/000456	AG_UAS	Sustainable water management at regional scale through Airborne Remote Sensing based on Unmanned Aerial Systems (UAS)	51
LIFE00 ENV/EE/000922	RAKWANET	Demonstration Activities for the Reduction of Water Losses and Preservation of Water Quality in Over-dimensioned Water Distribution Network in Rakvere Town, Estonia	51
LIFE00 ENV/NL/000791	RAS	Smart Flow in Reiderland	51
LIFE05 ENV/GR/000235	SUSCON	Sustainable Construction in Public and Private Works through IPP approach	52
LIFE00 ENV/NL/000808	EQuation	Demonstration and dissmeination project for stimulating architects and local governments to build sustainable with help of innovative design tools	53
LIFE07 ENV/E/000805	EDEA	Efficient Development of Eco-Architecture: Methods and Technologies for Public Social Housing Building in Extremadura	53

PROJECT REFERENCE	ACRONYM	TITLE	PAGE
LIFE09 ENV/ES/000466	EDEA-RENOV	Development of Energy Efficiency in Architecture: Energy Renovation, Innovation and ICTs	53
LIFE10 ENV/DE/000158	HWC - Jenfelder Au	Hamburg Water Cycle - Jenfelder Au	53
LIFE04 ENV/FR/000321	ECO-CAMPS	Eco-design and eco-engineering of buildings, amenities and accommodations in campsites	54
LIFE02 ENV/E/000210	HAGAR	Tools of self-management for water irrigable in the overused hydric systems	55
LIFE08 ENV/GR/000570	HydroSense	Innovative precision technologies for optimised irrigation and integrated crop management in a water-limited agrosystem	56, 66
LIFE03 ENV/E/000164	OPTIMIZAGUA	Demonstration of water saving for watering uses through the experimentation of artificial intelligence integrated in traditional systems of water control	56, 66
LIFE05 ENV/E/000313	gEa	Excellence in irrigation water management	56
LIFE08 ENV/GR/000551	PURE	From Treated Wastewater to Alternative Water Resources in Semi-Arid Regions	56
WATER RE-USE			
LIFE00 ENV/GR/000671	Minos	Process development for an integrated olive oil mill waste management recovering natural antioxidants and producing organic fertilizer	59
LIFE07 ENV/IT/000421	RE-WASTE	Recovery, recycling, resource. Valorisation of olive mill effluents by recovering high added value bio-products.	59
LIFE03 ENV/GR/000223	DIONYSOS	Development of an economically viable process for the integrated management via utilization of winemaking industry waste; production of high added value natural products and organic fertilizer	59
LIFE04 ENV/DK/000067	New potatopro	Novel energy efficient process for potato protein extraction	59
LIFE05 ENV/NL/000035	CLB	Demonstration of a closed loop blanching system for the potato processing industry	60
LIFE03 ENV/NL/000488	Dairy, no water !	A dairy industry which is self-supporting in water	60
LIFE00 ENV/NL/000790	Maastricht water	Demonstration of integrated total water management for a cluster of 8 industries, implementing a centralised water supply and a semi collective WWTS and resulting in substantial ground water and energy savings	60
LIFE03 ENV/E/000166	Dyeing bath reuse	Direct reutilization of dye baths and self-monitoring of the process “on line”	61
LIFE05 ENV/IT/000846	BATTLE	Best Available Technique for water reuse in TextiLE SMEs	61
LIFE08 ENV/CY/000455	WINEC	Advanced systems for the enhancement of the environmental performance of WINEries in Cyprus	62
MANAGEMENT TOOLS FOR EFFICIENT WATER USE			
LIFE08 INF/IT/000308	WATACLIC	Water against climate change. Sustainable water management in urban areas	65
LIFE03 ENV/RO/000539	DIMINISH	Development of an Integrated Basin Management System in order to correlate water quality and quantity analysis with socio-economical analysis, using Open-GIS technology	65
LIFE09 ENV/FR/000593	WaterRtoM	Water Research to Market - to speed-up the transfer of water related research outputs to better implement the Water directives	65
LIFE07 ENV/PL/000605	Lake recultivation in Gniezno	Recultivation of Jelonek and Winiary lakes in Gniezno by inactivation of phosphorus in bottom sediments	66
LIFE04 ENV/GR/000099	Water Agenda	Development and implementation of integrated water resources management policy to a river basin, through the application of a social wide local agreement, based on the principles of Agenda 21	67-69
LIFE99 ENV/RO/006697	MOSYM	Modernisation of a system of measurement,storage,transmission and dissemination of hydrological data to decision makers at various levels.	71
LIFE04 ENV/HU/000382	Szigetkoz	Implementation of an innovative Decision Support Tool for the Sustainable water and land-use management planning and Flow Suppelmentation of the Hungarian-Slovakian Transboundary Danube Wetland Area (Szigetköz)	71
LIFE03 ENV/E/000149	LIFE-CORBONES	New public uses in management and planning of a basin resources	71
LIFE08 ENV/B/000042	WEISS	The Water Emissions Inventory, a planning Support System aimed at reducing the pollution of water bodies	72
LIFE09 ENV/IT/000056	WIZ	WaterIZe spatial planning: encompass future drinkwater management conditions to adapt to climate change	72

Available LIFE Environment publications





LIFE Environment brochures

LIFE and coastal management (2012, 96 pp. – ISBN 978-92-79-25091-0– ISSN 1725-5619)

LIFE and Resource Efficiency: Decoupling Growth from Resource Use (2011, 72 pp. – ISBN 978-92-79-19764-2 – ISSN 1725-5619)

LIFE and local authorities: Helping regions and municipalities tackle environmental challenges (2010, 60 pp.– ISBN 978-92-79-18643-1 – ISSN 1725-5619)

Water for life - LIFE for water: Protecting Europe's water resources (2010, 68 pp. – ISBN 978-92-79-15238-2 – ISSN 1725-5619)

LIFE among the olives: Good practice in improving environmental performance in the olive oil sector (2010, 56 pp. – ISBN 978-92-79-14154-6 – ISSN 1725-5619)

Getting more from less: LIFE and sustainable production in the EU (2009, 40 pp. – ISBN 978-92-79-12231-6 – ISSN 1725-5619)

Breathing LIFE into greener businesses: Demonstrating innovative approaches to improving the environmental performance of European businesses (2008, 60 pp. – ISBN 978-92-79-10656-9 – ISSN 1725-5619)

LIFE on the farm: Supporting environmentally sustainable agriculture in Europe (2008, 60 pp. – 978-92-79-08976-3 – ISSN 1725-5619)

LIFE and waste recycling: Innovative waste management options in Europe (2007, 60 pp. – ISBN 978-92-79-07397-7 – ISSN 1725-5619)

LIFE and Energy: Innovative solutions for sustainable and efficient energy in Europe (2007, 64 pp. ISBN 978 92-79-04969-9 – ISSN 1725-5619)

LIFE in the City: Innovative solutions for Europe's urban environment (2006, 64 pp. – ISBN 92-79-02254-7 – ISSN 1725-5619)

Other publications

Best LIFE Environment projects 2011 (2012, 24 pp. – ISBN 978-92-79-25967-8 – ISSN 1977-2734)

Environment Policy & Governance Projects 2011 compilation (2012, 122 pp. – ISBN 978-92-79-25247-1 – ISSN 1977-2319)

Information & Communications Projects 2011 compilation (2012, 17 pp. – ISBN 978-92-79-25248-8 – ISSN 1977-2297)

Best LIFE Environment projects 2010 (2011, 32 pp. – ISBN 978-92-79-21086-0)

Environment Policy & Governance Projects 2010 compilation (2011, 113 pp. – ISBN 978-92-79-20030-4 – ISSN 1977-2319)

Information & Communications Projects 2010 compilation (2011, 19 pp. – ISBN 978-92-79-20027-4 – ISSN 1977-2297)

Best LIFE Environment projects 2009 (2010, 46 pp. – ISBN 978-92-79-16577-1)

Environment Policy & Governance Projects 2009 compilation (2010, 125 pp. – ISBN 978-92-79-13884-3)

Information & Communications Projects 2009 compilation (2010, 14 pp. – ISBN 978-92-79-16138-4)

Environment Policy & Governance Projects 2008 compilation (2009, 107 pp. – ISBN 978-92-79-13424-1)

Information & Communications Projects 2008 compilation (2009, 21 pp. – ISBN 978-92-79-13425-8)

Best LIFE Environment projects 2008-2009 (2009, 32 pp. – ISBN 978-92-79-13108-0)

Environment Policy & Governance and Information & Communications Projects 2007 compilation (2009, 44 pp. – ISBN 978-92-79-12256-9)

A number of LIFE publications are available on the LIFE website:
http://ec.europa.eu/environment/life/publications/lifepublications/index.htm

A number of printed copies of certain LIFE publications are available and can be ordered free-of-charge at:
http://ec.europa.eu/environment/life/publications/order.htm

KH-AJ-12-004-EN-C

LIFE+ "L'Instrument Financier pour l'Environnement" / The financial instrument for the environment

Period covered (LIFE+) 2007-2013.

EU funding available approximately EUR 2 143 million

Type of intervention at least 78% of the budget is for co-financing actions in favour of the environment (LIFE+ projects) in the Member States of the European Union and in certain non-EU countries.

LIFE+ projects

> LIFE Nature projects improve the conservation status of endangered species and natural habitats. They support the implementation of the Birds and Habitats Directives and the Natura 2000 network.

> LIFE+ Biodiversity projects improve biodiversity in the EU. They contribute to the implementation of the objectives of the Commission Communication, "Halting the loss of Biodiversity by 2010 – and beyond" (COM (2006) 216 final).

> LIFE+ Environment Policy and Governance projects contribute to the development and demonstration of innovative policy approaches, technologies, methods and instruments in support of European environmental policy and legislation.

> LIFE+ Information and Communication projects are communication and awareness raising campaigns related to the implementation, updating and development of European environmental policy and legislation, including the prevention of forest fires and training for forest fire agents.

Further information further information on LIFE and LIFE+ is available at http://ec.europa.eu/life.

How to apply for LIFE+ funding The European Commission organises annual calls for proposals. Full details are available at http://ec.europa.eu/environment/life/funding/lifeplus.htm

Contact

European Commission – Directorate-General for the Environment LIFE Unit – BU-9 02/1 – B-1049 Brussels – Internet: http://ec.europa.eu/life

LIFE Publication / LIFE's Blueprint for water resources

Luxembourg: Office for Official Publications of the European Union

2012 - 80p - 21 x 29.7 cm
ISBN 978-92-79-27206-6
ISSN 1725-5619
doi:10.2779/39850

Publications Office

ISBN 978-92-79-27206-6
9 789279 272066
doi:10.2779/39850