DESSIN

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DESSIN

DEMONSTRATE ECOSYSTEM
SERVICES ENABLING INNOVATION
IN THE WATER SECTOR

01 DESSIN Project: a last year of challenges ahead

The main objectives of DESSIN are to demonstrate and promote innovative solutions to water-related challenges with a focus on water quality issues and water scarcity, as well as to develop and demonstrate a methodology for the valuation of ecosystem services (ESS) as catalyzer for innovation in water management. To this purpose, DESSIN has launched demonstration projects of innovative solutions that are integrating technological, monitoring, modeling and management approaches for a more resource-efficient and competitive water sector in Europe. Moreover, an evaluation framework has been developed and is currently being applied, to valuate changes in ecosystem services of water bodies that result from implementation of these solutions. The framework also assesses the sustainability of these solutions.

By adopting this twofold approach, it will be demonstrated how innovative solutions integrated in the water cycle can increase the value of the services provided by freshwater ecosystems while assuring sustainability, thus generating additional incentives and arguments for their market uptake and practical implementation. This will support innovation and competitiveness in water management by enabling a more informed selection of the most promising solutions, in regards to their impact on the water body and their economic implications.

DESSIN faces the last year of work with plenty of confidence after a successful project meeting celebrated in Barcelona late January

01 DESSIN Project: a last year of challenges ahead

The DESSIN consortium visited the Llobregat Demo Site

The whole project is centered around a suite of carefully selected demonstration sites across Europe, (Emscher - Germany, Hoffselva – Norway, Westland – Netherlands, Athens – Greece, Llobregat – Spain), representative of global major water challenges, where public and private water management organizations and end-users, technology providers (SMEs), supporting researchers, technical development experts and relevant public authorities were brought together to demonstrate this approach.

Main achievements for the third year of the project were to finalize the overarching project features, such as the ESS Evaluation Framework, to finalize initial research and technical development work that is needed to actually start the demonstrations, and to continue with activities needed as constant support to those demonstration case studies. Another important activity within this period has been to disseminate and exploit first DESSIN results and to support the SMEs with regard to the market uptake of DESSIN solutions, once they are ready and fully demonstrated or validated.

The second periodic meeting took place in month 37 of the project (25-27 January 2017) in Barcelona, hosted by Cetaqua in the headquarters of Aigües de Barcelona, where issues related to the general progress of the project were discussed. In the meeting the different partners presented the innovations implementation success and came to the conclusion that the most important challenge for the final year of the project is to bring the demonstrated innovations to the market.

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02 | Interview with Koen Zuurbier

DESSIN scientist Dr. Koen Zuurbier (KWR) graduated at TU Delft on findings from the Westland demo site

Koen Zuurbier is a scientific researcher in the Geohydrology team of KWR Watercycle Research Institute, holds a master's degree in applied environmental geosciences and is specialized in groundwater monitoring and modelling. On May 10th 2016, Koen Zuurbier obtained his doctoral degree at the TU Delft on his findings during his research related to the DESSIN project.

What does your PhD consist in?

The PhD-thesis is titled 'Increasing freshwater recovery upon aquifer storage' and is on aquifer storage and recovery (ASR) using groundwater wells, which can provide a robust, cost-effective, and sustainable freshwater supply. It gives a broadened scientific understanding of the performance of ASR in brackish-saline aquifers. For instance, it describes how one could map the a priori indication of ASR performance in coastal areas. It also shows that a potential increase in freshwater recovery can be attained by implementing dedicated well configurations at ASR-systems in brackish-saline aquifers.

How did you confirm this thesis?

This was confirmed during field pilots using multiple partially penetrating wells (MPPW) and horizontal directional drilled wells (HDDWs). These dedicated well configurations are primarily based on an increased vertical control on freshwater injection and recovery, optionally complemented by interception of deeper brackish or saline groundwater.

What can be achieved by this approach?

The findings in this thesis provide important means to achieve a local, self-reliant freshwater supply especially in coastal areas using temporally available freshwater sources via ASR. In these areas, which suffer most from decreasing freshwater availabilities and growing demands, ASR can now become a viable cost-effective freshwater management option, whereas it was previously neglected due to the limited success of conventional ASR systems.

What regions did you focus your research on and why?

The main focus was on the Dutch delta, where the research was part of the Knowledge for Climate programme. This may sound surprising, since it is blessed with regular rainfall and inflow of freshwater from major rivers. However, even here we are experiencing more-and-more longer droughts, which leads to shortage of especially high-quality irrigation water in the horticultural sector. As we allow an immense volume of high-quality rainwater to be discharged to sea in the winter season, we wanted to find out how storage of this rainwater in brackish aquifers could bridge the mismatch between water availability and demand. Looking abroad, however, this mismatch is a common phenomenon, so the outcomes are applicable worldwide.

Koen Zuurbier in front of the crowd at the Westland Demo Site

02 | Interview with Koen Zuurbier

What are the immediate and future applications of your research?

Right now we are making important steps to bring the outcomes of the pilots into practice at replication sites. Most often, these are large greenhouse clusters (100 – 500 hectares) which are newly developed and want to integrate a robust and reliable freshwater supply, without claiming a large area aboveground. However, we are also exploring the potential for urban areas. We already see that ASR can also add a very important component in the urban water cycle (retention, storage, recovery), a cycle which is now cut off by rapid rainwater run-off.

In what way is your approach innovative?

Although attempts to store and recover freshwater surpluses on a small-scale were made in the eighties already, the design of the groundwater wells was too rigid for successful recovery in brackish aquifers. Injected freshwater moved to the top of the aquifer due to its lower density and it was hard to recover. The approach we developed and studied was based on an increased control on the points of infiltration and recovery, which was hardly applied or studied before. So, we piloted more dedicated and flexible configurations to recover significantly more freshwater upon aquifer storage.

Koen Zuurbier received his doctoral degree on May 10th, 2016

How does it link with the DESSIN research and investigations?

In the PhD-research, we came up with the hypothesis that interception of the brackish water below the injected freshwater would be beneficial for the (shallow) recovery of freshwater. At the same time, this intercepted brackish water could be used to produce additional freshwater via reverse osmosis (RO). We call this ASRO (combination of ASR and RO). This way, the robustness of the ASR-system would increase significantly, while this form of brackish water reverse osmosis (including re-injection of the removed salts into a deeper aquifer) does not lead to salinization of the groundwater system. The latter is due to the infiltration of the freshwater surplus, which generally equals the net abstraction of freshwater during droughts. The system is in 'balance' while providing an ecosystem service. Therefore, it fits nicely in the DESSIN project, where we closely evaluate the hypothesis.

> "We are making important steps to bring the outcomes of the pilots into practice at replication sites"

Your PhD was related to an alimentary business. How will your improvements affect the market? Do they have immediate impact?

Yes, we see a rapid uptake of the concept on the national market, where new greenhouse areas at least consider the technique, and often decide to implement it, too. Another main driver for market uptake is a future ban on brackish water reverse osmosis in the current form (without infiltration of freshwater in winters), which often does induce salinization of the groundwater system. ASRO provides an elegant and sustainable alternative, with limited impact on the companies' operations.

03 | How to invest in the water sector?

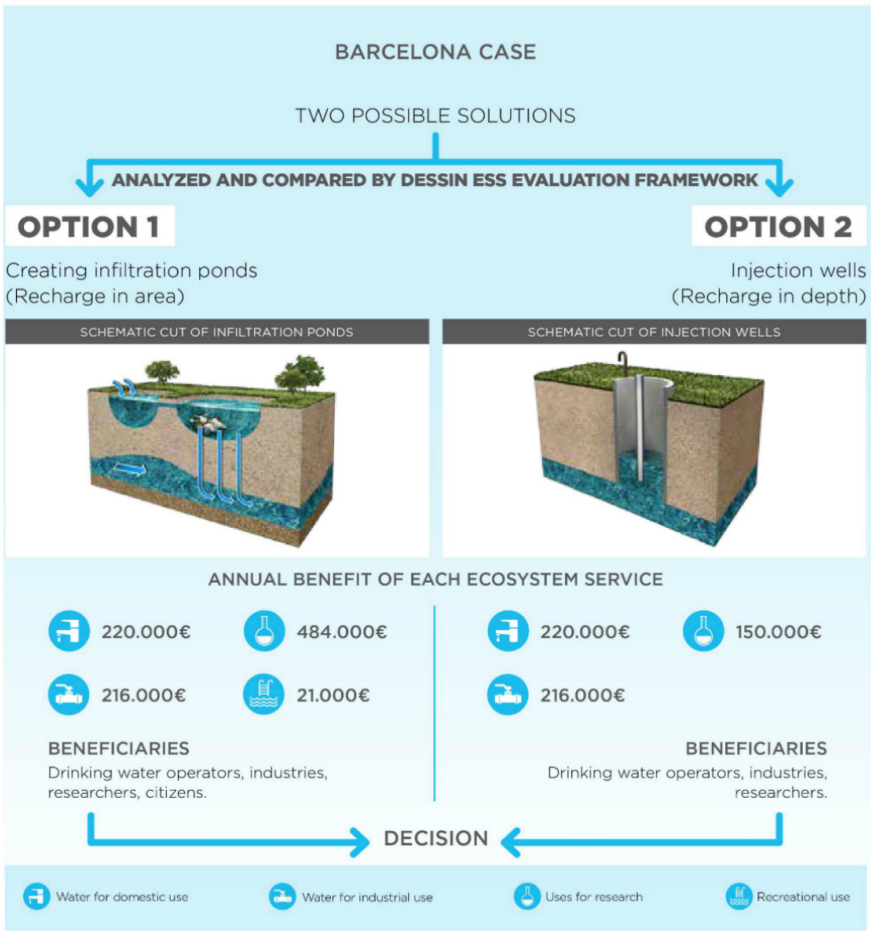
The ESS DESSIN Framework approach

In September 2016, the DESSIN project released the ESS Evaluation Framework, a methodology that assesses and analyses ecosystem services changes once a measure/solution is implemented and provides the necessary data for the decision-makers (administrations, companies...) to choose the best option when investing in projects. One of the core aims of the methodology is to make decisions more transparent and easier to communicate.

The DESSIN ESS EVALUATION FRAMEWORK will support evaluation, planning, design and development of new solutions before being implemented in water management. The methodology incorporates elements of main ecosystem services typologies (CICES and FEGS-CS) and integrates existing schemes like the concept of Drivers-Pressures-State-Impact-Response (DPSIR) to improve the DESSIN method.

The case of Barcelona

Barcelona was taken as one of the case studies to develop the DESSIN ESS Evaluation Framework. The city is in need of an alternative to the main sources of water: the rivers Llobregat and Ter. For this reason, the aquifers of the Llobregat deltas were selected. However, the aquifers of the Llobregat deltas are a limited source. The DESSIN framework enabled to identify and compare both options with regard to the beneficiaries and actual monetary benefits of the ecosystem services.



04 Demonstration, documentation and evaluation at the Westland demonstration site

The DESSIN Westland demosite for aquifer storage and recovery in combination with reverse osmosis (ASRO) is a unique site to demonstrate, document and evaluate this water innovation.

Demonstration

Plenty of scientists, policy makers and water users find their way to the Westland site. For instance, a meeting was organised together with the Rabobank (financing most Dutch horticulturists) at September 16th in 2016. During this meeting interested agriculturists from the area visited the site for presentations on the technique, but also on interesting ways to finance this type of sustainable innovation. A delegation from Vietnam was welcomed on October 13th, while on October 24th delegates from the Gulf Cooperation Council visited the site to explore its potential for the Gulf States. Both regions suffer from saline groundwater and a lack of storage opportunities aboveground. These latter visits were arranged together with the Netherlands Enterprise Agency (RvO).

Documentation

Having a demosite also enables a realistic documentation of the functioning of innovations. For instance, the contribution of the ASRO to the additional water supply of the greenhouses (on top of the rainwater stored in aboveground reservoirs) was examined. In 2016, most of the required high-quality irrigation water was supplied by ASR, which means it was rainwater that could be directly used for irrigation after aquifer storage. Around 25% of the irrigation water was produced by desalinating the mixed brackish water/rainwater, abstracted from the Freshkeeper well. During longer droughts, additional freshwater was produced with the RO-system that formerly provided all of the additional water by desalinating brackish water. This system also uses a mixture of rainwater and brackish water for RO now.

Over the timespan of the DESSIN project so far (2014-2016), more than 168.000 m^3 were collected from 270.000 m^2 of greenhouses (i.e. 623 mm of rainfall). Almost 87.000 m^3 were produced from the aquifer, either by direct recovery or via RO, meaning that 52% of the injected water at the site is recovered.

Visitors during the official opening of the showcase in August 2015

Evaluation

Since a viable and apparently sustainable technique seems to be at hand, careful evaluation of its impact on the groundwater system is required before further upscaling. Therefore, the local groundwater system and the regional Westland groundwater system was modelled. Three different solutions were evaluated: the autonomous one (no use of groundwater), the current one (desalination of brackish groundwater, deeper disposal of the brine) and ASRO. This study is currently under review, but the results suggest that ASRO can bring a clear improvement for the local groundwater quality as compared to the current practice: salinization of the groundwater is counteracted and stratification of groundwater qualities may be the only noticeable and generally positive effect.

05 | A green business award for DESSIN and EYDAP

The NTUA and EYDAP team together at the PASEPPE awards ceremony

On October 19th, one of the partners of the consortium, the Greek Athens Water Supply and Sewerage Company (EYDAP) won a prestigious award for DESSIN, increasing the value of the sewer mining pilot as a high profile showcase. EYDAP participated in the European Business Awards for the Environment (EBAE) and excelled at the national level.

The Panhellenic Association of Environmental Protection Enterprises (PASEPPE) together with the European Union Representation in Greece awarded EYDAP with two prizes for the Athens sewer mining pilot in the categories **Products & Services Award** and **Business & Biodiversity Award.**

EYDAP, alongside with DESSIN partners NTUA, CHEMITECH and TELINT promoted the idea of an innovative small footprint sewer mining packaged treatment unit for urban reuse, enabled by Advanced Monitoring Infrastructure (AMI) and Decision Support System (DSS)[1].

The ceremony took place at the Eugenides Foundation on the 19th of October 2016 in the presence of the Greek Minister of Interior & Administrative Reconstruction, Mr. Panagiotis Kouroublis and the Minister of Environment, Mr. Yannis Tsironis.

1. To see how the innovation works, you can find a video about it on the DESSIN website: https://dessin-project.eu/?p=2232

06 | Partners

DESSIN is formed by 21 partners from seven European countries and coordinated by IWW Water Centre.

IWW

eco logic

UFT
Umwelt- und Fluid-Technik
Dr. H. Brombach GmbH

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