Background

In Greece and adjacent Mediterranean countries, conventional agricultural practices are affected by water scarcity due to the great demands for water for irrigating crops, the intensive use of pesticides and chemical fertilisers and the depletion and contamination of ground water. Consequently, there is an increased interest in crop production systems that optimise yields while conserving soil, water and energy as well as protecting the environment.

The Thessaly Plain is one of Greece's main agricultural production areas. The Pinios river drainage basin occupies most of the Thessaly Plain region, and the proposed demonstration area, the Gonni-Sikourion-Platikambos basin, is part of the Pinios watershed. Significant water-bearing geologic formations are few and are located close to the alluvial deposits of the Pinios and its tributaries. The water resources (surface and groundwater) are minimal, and support the irrigation of limited areas. Irrigation is mainly based on pumping water from groundwater aquifers using private boreholes and pumping units, and such practices have resulted in continuously declining aquifer depths. Water pricing could help tackle this major environmental problem. Intensive agriculture has also led to excessive fertiliser and pesticide inputs, resulting in soil and water nitrate concentrations that often exceed EU limits. Overuse of water for irrigation accelerates the leaching of agrichemicals into groundwater.

Objectives

The HydroSense project aimed to improve efficiency in the use of water, fertilisers and pesticides for the production of a major Mediterranean agricultural crop (cotton). It would achieve this aim by employing site-specific.
management and advanced technologies in proximal remote sensing, such as the employment of advanced canopy sensors. The project would also produce data and tools to evaluate the project’s economic effectiveness and the potential to scale it up to the regional level, or transfer the methodology to other regions and other agricultural crops. Training and dissemination activities were also planned to reach these objectives.

Results

The HydroSense project applied precision agriculture methods to achieve the integrated crop management of combined inputs in three pilot cotton fields in the Pinios watershed, in order to reduce irrigation and the use of chemicals (fertilisers, herbicides and pesticides). The innovative use of system demonstrated the benefit of site-specific management for only single inputs such as fertilisers. Innovative technologies for targeted and variable-rate application of irrigation water, fertilisers and herbicides were also employed. Infrared thermocouple sensors were used to measure canopy temperatures in order to regulate variable-rate irrigation; multispectral proximal sensors were used to measure chlorophyll content for the estimation of the segmented fertiliser requirements, and the WeedSeeker was used for the detection of weeds and the targeted use of herbicides.

The application of precision farming technologies in the three pilot fields (each one 3 ha in size) resulted in a substantial reduction in the use of irrigation water and agri-chemicals as well as an impressive improvement in environmental performance. On average, precision farming reduced irrigation water by 18%, nitrogen fertilisers by 35% and total herbicides by 62% in comparison to conventional farming practice. These figures translate to an increase in water, nitrogen and herbicide use efficiency by 26%, 60% and 168%, respectively, while a 20% increase in energy use efficiency was also achieved. In spite of the reductions in water and chemicals, an average 10% increase in cotton yield was obtained.

Moreover, in spite of the high costs of the innovative technologies, the minimum dataset guidelines produced by the project show that the partial adoption of the demonstrated methods is feasible for farmers in the region at no or minimal extra cost with expected significant reductions in water needs and chemical use. Considering the excessive and unguided use of these inputs by farmers in the area, a substantial reduction of fertiliser and water can be achieved by the adoption of multispectral sensors, soil moisture sensors and evapo-transpiration devices for uniform application of entire fields before considering spatially-variable inputs. Most farmers in the area already possess the equipment needed to uniformly apply fertiliser and irrigation water at recommended rates without additional costs. For the full adoption of the project's methods and consequently more efficient management of inputs within single fields, delineation of management zones and a spatially-variable application system are needed. These requirements are associated with purchasing costs, the training of farmers, the creation of farmer networks and the provision of services by agricultural unions and companies ('agribusiness'). Greater incentives for the adoption of the proposed technologies could be provided through subsidies and the adoption of water pricing policies by local authorities.
Nevertheless, the project produced high-resolution maps of soil organic matter distribution across the Pinios watershed. A decision-support tool was also produced to offer advice to farmers on the delineation of simple management zones within their fields and, thus, reduce farmer costs associated with setting-up differential fertigation systems. This tool is already being used by the associated beneficiary, DEMETER, for the provision of field-specific advice to farmers in the region.

The project furthermore assessed the full cost of irrigation at watershed level and subsequently used this assessment as a basis to design appropriate water pricing in line with the objectives of the Water Framework Directive (2000/60/EC). The first assessment study concluded that on the assumption that the Pinios Regional Organisation of Land Reclamation (TOEB) has a balanced account (i.e. the prevailing land-based pricing system is able to recover its financial outlay) the existing pricing system achieves a cost recovery ratio of 70.5% under the best-case scenario, and only 54.1% under the worst-case scenario. Such figures should thus result in the radical reform of water-pricing policy in order to restore efficient water use in the region. Typical pricing reforms could include volumetric charges on monitored or estimated water use, and pumping taxes for private wells. A second study showed that the average cost pricing outperforms all other pricing alternatives on economic and environmental grounds. This result has clear implications for policy directed towards more effective water management regimes.

The success of the precision technologies – as demonstrated by the HydroSense project and the evident environmental and financial benefits – support their wider adoption at local, regional, national and EU levels. Though specific to the pilot areas, the project results merit a broader dissemination among relevant policy makers including the Pinios Regional Organisation of Land Reclamation, national ministries of agriculture and environment, energy and climate change, other units of DG Environment (such as the water, resource efficiency, and agriculture, forests and soil) and DG Agriculture and DG Research and Innovation. It is likely that Piraeus Bank (the beneficiary of three LIFE projects) may also be interested in the project results given the range of green products it has developed for financing green business that covers water management, farming and energy saving.

Further information on the project can be found in the project's layman report and After-LIFE Communication Plan (see "Read more" section).

Environmental issues addressed:

Themes

Industry-Production - Agriculture - Forestry
Land-use & Planning - Soil and landscape protection
Water - Water resources protection
Keywords

fertiliser, agricultural method, soil degradation, water quality improvement, remote sensing, water resources management, irrigation

Target EU Legislation

- Water
- Directive 91/676 - Protection of waters against pollution caused by nitrates from agricultural so ...

Natura 2000 sites

Not applicable

Beneficiaries:

Coordinator: The Goulandris Natural History Museum
Type of organisation: NGO-Foundation
Description: The Goulandris Natural History Museum was founded in 1964, and is a private non-profit organisation devoted to the study, conservation and protection of the natural environment. The project will be implemented by the museum's GAIA Environmental Research and Education Centre.

Partners: Benaki Phytopathological Organization, Greece
Hellenic Agricultural Organisation DEMETER, Greece
University of Thessaly, Greece
Benaki Phytopathological Institute, Greece
Agricultural University of Athens, Greece

Administrative data:

Project reference: LIFE08 ENV/GR/000570
Duration: 01-JAN-2010 to 31-DEC -2012
Total budget: 1,747,825.00 €
EU contribution: 846,787.00 €
Project location: Thessalia (Ellas)

Read more:

- **Newsletter:** Article-Paper
  - Title: Project's Newsletter N°1 (3 MB)
  - Year: 2010
  - No of pages: 2

- **Press article**
  - Title: Project's Newsletter N°2 (1.88 MB)
  - Year: 2011
  - No of pages: 2

- **Project web site**
  - Project's website

- **Publication:** After-LIFE
  - Title: After-LIFE Communication Plan
  - Year: 2012
  - No of pages: 6

- **Publication:** Layman report
  - Title: Layman report
  - Year: 2010
  - No of pages: 16

- **Publication:** Layman report (Greek version)
  - Title: Layman report
  - Year: 2010
  - No of pages: 16

- **Publication:** Technical report
  - Title: Project's Final technical report (2.86 MB)
  - Year: 2013
  - No of pages: 47