Farm Level Optimal Water Management: Assistant for Irrigation under Deficit (FLOW-AID)

J. Balendonck

Objectives
- Sustainable irrigated agriculture for low water availability and quality
- New, simple and affordable sensor technologies
- Decision Support System for deficit irrigation
- Evaluation in semi-arid Mediterranean countries

FLOW-AID system
In view of the expected water availability (amount and quality) the system allocates available water among several farm zones and schedules irrigation for each individual zone. The following tools are being developed by partners from the Netherlands, United Kingdom, Spain, Italy and Greece:

- An expert system to assist farm zoning and crop planning
- A short-term irrigation scheduling module
- A crop response model for deficit irrigation
- A low-power wireless sensor network
- A maintenance free tensiometer
- Smart real-time and remote irrigation controllers

These tools are evaluated at test-sites in 4 Mediterranean countries: Italy, Turkey, Lebanon and Jordan, as well as in the Netherlands which are chosen in such a way that they differ in the type of constraints, irrigation structures, crop types, local water supplies, availability of water and water sources, in amount and quality, the local goals, and their complexity.

The work was carried out between 2006 and 2009 as a 6th Framework European project (no. 036958) under the call for water in agriculture, new systems and technologies for irrigation and drainage (FP6-2005-Global-4, PRIORITY II.3.5).

Benefits
- Maximum crop yield and economic profit under given constraints
- Optimal water gift when marginal water resources are being used
- Generic tools, adaptable to local situations
- For open field, as well as protected crop production systems
More Crop per Drop
Technology supports growers to cope with water shortage challenges

Water shortage forces growers to adopt deficit irrigation practices. They tend to irrigate with less water at a lower quality. To avoid crop damages and income losses, they need to manage their water and nutrients more precisely. New technology based tools might help them by making the most optimal operational decisions. The extra income, due to slightly higher yields and use of less fertilizers, might help to invest in these new technologies.

The Problem
Agriculture is the largest user of water, making it a big competitor for domestic and industrial users. To secure our food production for future generations, the irrigation water use efficiency must be increased drastically, in other words: we need “more crop per drop”. Generally the way to go is to avoid spilling of water, and to ensure that all the irrigation water is being used by the crop. Over-irrigation invokes leaching of water and fertilizers affecting the environment. This can be ensured by optimizing irrigation equipment and irrigation management.

However, in many cases this step is not enough, and currently growers need to adopt a deficit irrigation strategy in which they supply water under the advised FAO amount or even use non-fresh water resources. Crop yield is closely related to water and fertilizer use. Limiting water supply or using marginal water resources might result in yield and quality losses. Working under deficit conditions means that the grower needs to operate his water management more precisely to prevent income losses. He cannot longer rely on his common sense, but needs help from technology.

Objectives
FLOW-AID contributes to sustainable irrigated agriculture by developing a deficit irrigation management system for farm-level crop production in cases with limited water supply and marginal water quality. It integrates innovative sensor technologies into a decision support system, taking into consideration boundary conditions and constraints for a number of practical growing systems in the Mediterranean. It focuses on innovative, simple and affordable, hard- and software concepts; particularly a maintenance free tensiometer, a wireless and low-power sensor network; an expert system for farm zoning and crop planning in view of expected water availability and quality; and an irrigation scheduler for allocation of multiple water sources. The system is being evaluated at five sites located in Italy, Turkey, Lebanon, Jordan and the Netherlands, which differ in the type of local constraints, irrigation structures, crop types, local water supplies, availability of water and water sources in amount and quality, the local goals, and their complexity.

Methodology
The FLOW-AID system consists of irrigation controllers, distributed over the irrigated farm zones. They are connected via a wireless link to a local computer that regularly reads out sensor data and updates the scheduling programs running autonomously in the controllers. A Decision Support System containing an expert system with “best practice irrigation rules”, running either on the local or remote (connected via internet) computer helps growers to optimise their scheduler programs in view of the expected water availability and climatic conditions on a long-term as well as short-term basis. During three growing seasons, the system components are mainly being evaluated at Mediterranean test-sites. Over the years, the system is enhanced and the final system was shown to farmers during the 3rd year at the test-sites. The FLOW-AID system is being developed through a close partnership between research institutes, universities and SME’s.

Results
Case studies have shown that compared to current practices, by using innovative technologies, the water use efficiency can be raised up to 10% while maintaining the existing crop yields. Application of new technologies cost money. Some case studies have shown that by using technology and adapting strategies one could even raise the productivity up to 10%, while the amounts of water and nutrients being used were less than current practices. By using treated waste water resources farmers could benefit from the already available nutrients in these water sources. Farmers might use this extra income for investing in new technologies.