Project Name: WaterCAP

Within the WaterCAP project certain techniques have been developed. These technical tools all improve the fresh water balance if used in the right manner. Further the responses will reduce the vulnerability and improve flexibility to adapt to climate change. The techniques are listed below:

- Mapping the soil, locating aquifers and level of salinisation. Leading to better management to prevent exploitation and salinisation.
- Water sensing decision system. Monitor the soil moisture in advance of irrigation
- Combining the methods and implementation of the response. This includes the understanding of the importance of the lack of water in the Mediterranean area.

The tools and methods developed support the implementation of the Water Framework Directive and the EU white paper 'Adapting to climate change: Towards a European framework for action'.

Mapping the soil (sub surface), locating aquifers and salinisation

Sea levels are rising and threatening the freshwater lens, the beating heart of freshwater supplies and dependent ecosystems in coastal regions. New innovative airborne mapping, online monitoring and coupled groundwater-surface water modelling are offering society new ways of managing these challenges. The solutions are cost-effective on a regional scale, transferable to other EU regions and exportable worldwide.
Within the WaterCAP cluster project, smarter and faster data acquisition techniques have been developed. New airborne systems, for example, enable the collection of huge datasets in just a week, without disturbing ground activities, whilst online monitoring enables long distance access to large amounts of field data.
Models tested on the Wadden islands (The Netherlands, Germany and Denmark), are used to forecast hydrological conditions and the ability to extract groundwater. In this way, money can be saved and sustainable ecosystem services can be safeguarded.
Additionally, saltwater intrusion in aquifers will be clearly mapped by the SkyTEM method, which is crucial information since by knowing the exact location of the saltwater-freshwater boundary, the effects of water extraction in drought periods can be preciously modeled to prevent up coning of saline water and hence salinisation of the aquifers (In Australia they are currently struggling with salinisation of the coastal aquifers due to extensive water extraction in drought periods, and here the SkyTEM system is currently used to improve the water management).

- The modeling will lower the uncertainty within water management and secure resilient decisions since the long term effects of extraction can be predicted (even by taking different drought scenarios into account).
- Better information on the availability of water.
- Predictions of the effects of different drought scenarios through hydrological modeling
- An instrument that improves the ability to manage groundwater in a sustainable way and reduce energy consumption.
- Better water management since water can be defined between the users.

Water Sensing

With a sensor the soil moisture is measured in the top soil on different depths. The data is then transferred online and visualized for the farmer. Now he knows exactly how much moisture is available for the crops in the field on different depths in the soil. The knowledge is combined with the weather station information which is collected about the precipitation and the evaporation. Further the data is combined with the geological characterization and soil types in the fields. At this stage it is visible for the farmer how the weather has an impact on the soil moisture. The crops have different water demands

related to specie, season and growth stage of the crop. In combination with the information about the crops, the farmer will know if his crops need water at each dry period. When this information is combined with the weather forecast the farmer is able to decide if he has to irrigate today or if he can wait for a few more days. The system has been tested within the WaterCAP cluster project in an area with starch potatoes, sandy soils and a shortage of water in summer (North Eastern part of The Netherlands). About 40 farmers have used the system. The system has also been used outside Europe (Egypt, Tunisia, Saudi-Arabia, South Africa). Further on a small scale in an EU project in Spain and Cyprus (DESIRAS)
Advantages of the system:
The introduction of water sensing systems at farm level can target irrigation in space and time, guided by crop requirements.

- It saves the farmers money because he will only irrigate when it is needed.
- It also saves energy
- Efficient irrigation results in less pressure on the freshwater supply (15-20% on water savings).
- In the pilot in Spain and Cyprus water saving are up till 50%.
- Farmers are more aware of water management and the way they (can) influence water system
- Knowledge about the soil moisture is also important in combination with more efficient use of fertilizers.

Integration of the methods

By combining the two methods described above we are able to improve the output and use of data for society:With the SkyTEM system, one gets a detailed mapping of the near-surface geology - that is the distribution of clay and sand in the top 10 m of the soil. This information is crucial with regards to how the farmers irrigate (and fertilize) cost-effectively and is valuable information for deciding the placement of the water sensors, and hence gaining the full benefit of the water sensoring systems

- By knowing the heterogeneity of the top soil the amount of sensors for water sensing can be lowered
- Better use of the water (by the farmers) in combination with information of the availability of water, hopefully this will trigger other users to look for more efficient water use on the long term.

The methods reduce vulnerability, increase the water ability and safes energy consumption

Implementation

The implementation of the systems needs to follow a certain strategy and plan the diagram below shows how the systems are integrated in the in an area/country :

1. **Mapping** of groundwater aquifer and soil layer and **Analysis** of current water irrigation system
2. Stakeholder analysis and Force field analysis
3. **Workshop: *Kick-off and start-up***
   - *Visualisation of the Status-quo upper soil layer and water management system*
   - *Joint and integrated problem definition and analysis*
   - *Presentation of the WaterCAP methods: SkyTEM and Water Sensing Decision System (WSDS)*
   - *Identification of urgent water management problems and regions (pilot areas)*
   - *Developing an experimental set-up for identified pilot areas*
   - *Jointly developing an observation and monitoring system*
4. **Monitoring** by SkyTEM and data collection for the WSDS
5. **Stakeholder dialogue**

6. for identifying pros and cons, improvements
7. **Workshop: *Evaluation and Transfer***
    - *Presentation of monitoring results*
    - *Presentation of experiences (pros and cons of the relevant stakeholders)*
    - *Joint evaluation step: How to proceed? What has to be improved (communication process,*
      methods, experimental set-up, etc.)? What has been the benefit?
    - *Joint discussion: Transferable to other Mediterranean regions?*

Key success factors: The farmers take responsibility and ownership of the system. The local water companies and community uses the modelling in the management and regulation.
Threats: The system is too technical and will not be functioning and used.

Cost: Sensor and equipment €2000 euro and yearly costs for data analyses €550 euro.
Cost Mapping sub surface and locating aquifers and salinisation pr. Km^2 €5000
Time spend to implement mapping, install sensors involving stakeholder ~1 year.