With the contribution of LIFE Programme 2014-2020 of the EU
LIFE AGROWETLANDS II
LIFE15 ENV/IT/000423

AGROWETLANDS
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LIFE AGROWETLANDS II

After-LIFE Plan 2020-2025

Deliverable 2 of the Action E.1

AGROWETLANDS II

Progetto LIFE AGROWETLANDS II
Smart Water and Soil Salinity Management in Agro-wetlands
LIFE15 ENV/IT/000423

DATI DI PROGETTO

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Finanziamento
LIFE Programme 2014-2020 Environment and Resource Efficiency - Call 2015 (LIFE15 ENV/IT/000423)

Budget di progetto
939.431 € (finanziamento EU 559.591 €)

Durata
45 mesi (da 1 settembre 2016 a 30 giugno 2020)

Area di realizzazione
Emilia-Romagna (Ravenna) - Italia
Comunidad Valenciana (Elche - Comunidad de Regantes de Carrizales) - Spagna

PROJECT DATA

Coordinating Beneficiary
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Comunidad Valenciana (Elche - Comunidad de Regantes de Carrizales) - Spain

OVERVIEW ON THE PROJECT - The LIFE AGROWETLANDS II - LIFE15 ENV/IT/000423 project, funded under the LIFE 2014/2020 Programme - Environment, aims to improve the management of two resources essential for life and strategic for agriculture: water and soil.

Water is commonly considered a renewable resource, but if this is true in a wide context, it is not so at a local scale regarding quality, or through centuries. The soil, on the other hand, is anyways considered a non-renewable resource. The soil-water interaction is particularly important, also in the agricultural field. Soil salinization is often a consequence of negative interactions, which can occur in particular environmental contexts, even quite different from each other.

Concerning the agricultural practices, in particular irrigation, that can affect the conservation of water and soil resources, the project developed the SMART AGROWETLANDS System, broadly applicable to support irrigation management on saline soils. The project also identifies precision agriculture and its developments as a crucial tool for the sustainability of agriculture itself, in the coming years.

THE PROJECT EXPERIMENTAL AREA - The LIFE AGROWETLANDS II project was carried out in a large agricultural area, in the province of Ravenna (Emilia-Romagna Region), which includes the eastern part, close to the Adriatic coast, of the properties of the Agrisfera cooperative, partner of the Project. The area, surrounded by other cultivated properties and protected areas of the Natura 2000 Ecological Network and the Po Delta regional park, falls within the territory delimited to the North by the terminal section of the Reno river and the Comacchio valleys, to the South by the terminal section of the Lamone river and the "pialasse" system, to the East from the Adriatic sea, to the West from the inhabited area of S. Alberto (RA) and is crossed, approximately in the mid of its extension, by the terminal section of the Canal in Destra Reno (Figure 1).

Figure 1 – The project area

HOW DO THE SMART AGROWETLANDS SYSTEM WORK - SMART AGROWETLANDS promotes an efficient use of water for irrigation purposes, balancing the need to optimize the quantity of water used, with the need to safeguard the productivity of crops, maintaining the quality of environmental resources such as soil and water.

To achieve these results, **SMART AGROWETLANDS integrates** (Figure 2):

- **a Wireless Sensor Network - WSN** (Figure 3 and 4);
- **a Decision Support System – DSS**;
- **a Web Portal for the communication with farmers, to whom the irrigation advice produced by the DSS is addressed** (figure 5).

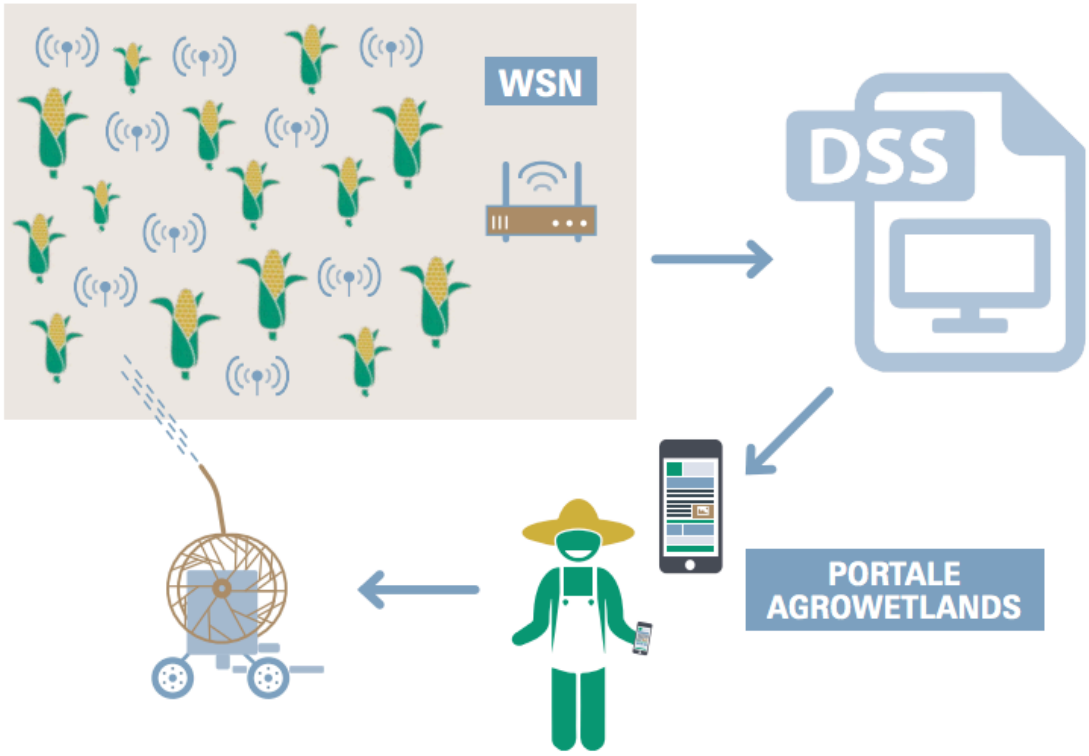

Figure 2 - The structure of the SMART AGROWETLANDS System, consisting of a Wireless Sensor Network (WSN), a Decision Support System (DSS), a Portal that allows farmers to receive the irrigation recommendations issued by the DSS.

Figure 3 *- The 23 nodes of the WSN AGROWETLANDS in the project area.* ***Each of the 9 P-type nodes****, light blue color, integrate a groundwater sensor and a soil sensor.* ***Each of the 11 I-type nodes****, blue color, integrate a sensor for the channel water****. Each of the 3 S-type nodes****, red color, integrate a soil sensor. The nodes P02 and P07 integrated each, in addition, a meteorological station equipped with a radiometer.*

Figure 4 *- The transmission station of the I07 node (hydrometer) on the Rivalone channel.*

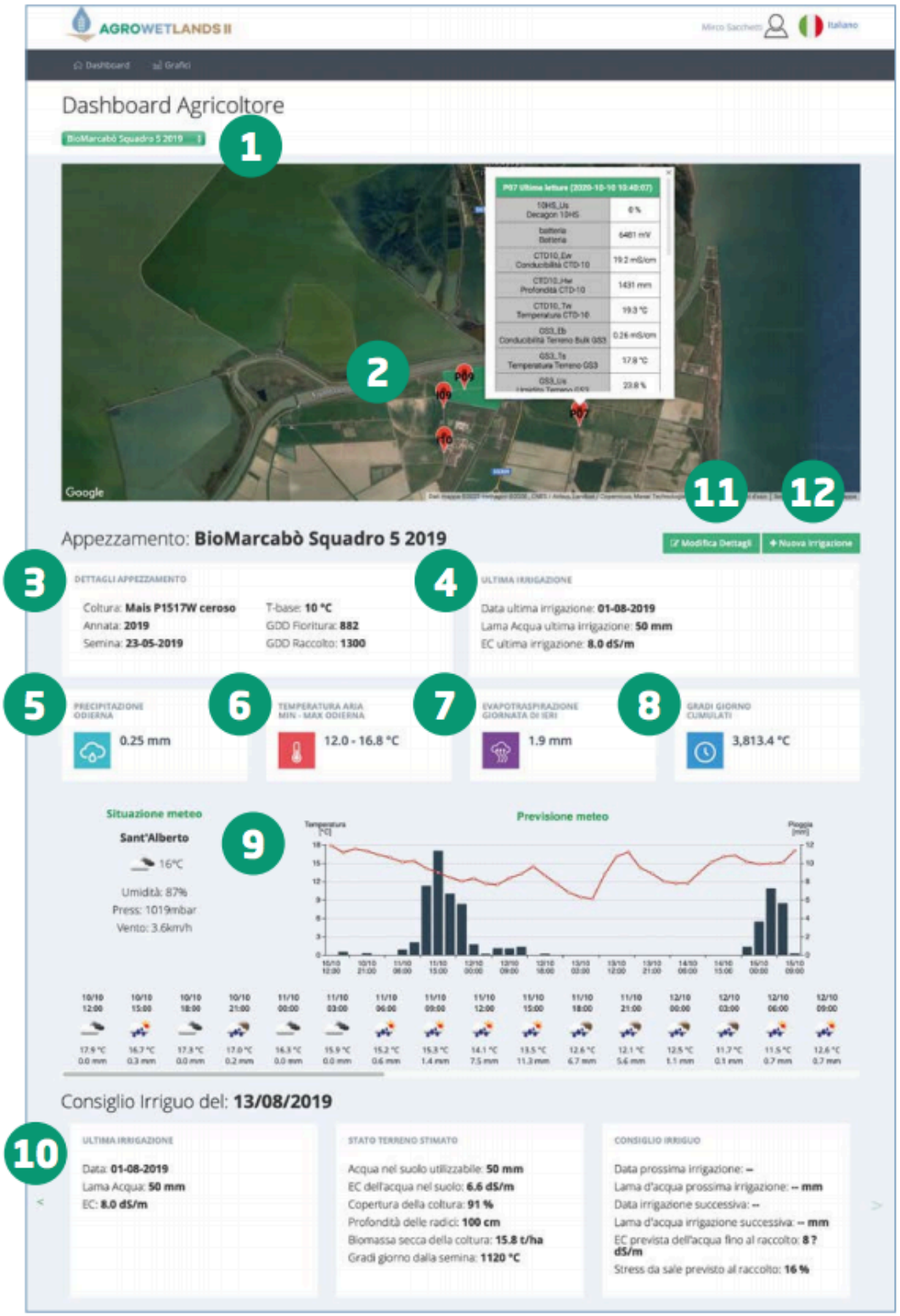

Figure 5 *- The farmer's dashboard of the AGROWETLANDS Portal. 10: Area dedicated to the description of the irrigation advice; 11: "Modify details" button, used by the farmer to provide data in fields 3, 4; 12: "New Irrigation" button, to be used by the farmer to provide parameters of a new irrigation, see field 10.1. By clicking on the red markers, which represent the nodes of the WSN, a drop-down menu opens, which shows the values of the last records registered by the sensors present in that node (image top). Data in fields 5-9 are updated in real time by the system and refer to the time of the query (9 July 2020, in the presented case).*

The irrigation advices provided by SMART AGROWETLANDS are based on an accurate knowledge of the environmental conditions that define the water needs of the crop in the different stages of its development, from sowing to harvest, as required by the Aquacrop model (Raes et al., 2009; Steduto et al., 2009; Steduto et al., 2012; Foster et al., 2017), used by the Decision Support System (DSS) adopted.

Agronomic information are provided to the DSS by the farmer; meteo-climatic information and groundwater information are instead provided to DSS in real time by the nodes of the WSN (Figure 3 and Figure 4). **The WSN is a fundamental tool of the quantitative approach adopted to define time and quantity of irrigation interventions.**

The Decision Support System (DSS) developed by the project allows to describe the development of the main open field crops, from sowing to harvest, to evaluate the water needs, according to the development achieved, once the parameters that define the water balance are known, and to predict the possible accumulation of salts in the soil.

The DSS can therefore be used for irrigation suggestions in the plots registered in the SMART AGROWETLANDS System. The irrigation advice, beside suggesting the date and quantity of the next irrigation and the following one, also provides an assessment of the water content of the soil and its salinity (therefore of the urgency to irrigate with water of adequate quality), the degree of development of the crop, the harvest date and the expected yield, including the reducing effect of salinity and other stresses, thus providing forecast of the final harvest (dry biomass, stresses effects), during the development of the crop.

The Agrowetlands Portal performs various functions, including that of interface between farmers and the SMART AGROWETLANDS System. The farmer, by connecting to the portal domain via a traditional PC, or even with his smartphone, accesses the functions of the farmer dashboard (figure 6), and can interact with the SMART AGROWETLANDS System, updating the agronomic information concerning his plots, receiving irrigation advice, and consulting the WSN records.

MAIN RESULTS **One of the main quantitative result obtained by LIFE Agrowetlands ii, is the demonstration that an appropriate water management, through SMART AGROWETLANDS, can increase the crop final production, obtaining water saving, even on saline soil**.
In particular, one of the 2018 experiments on maize demonstrates the possibility of obtaining an increase in the final production of biomass and grains, equal to 1.8 t/ha and 0.80 t/ha, respectively, **if the internal Aquacrop criterion is used for irrigation, combined with good quality water, rather than the traditional system based on IRRINET**. This increase in biomass, which corresponds to a greater fixation of CO2 by the crop, can compensate emissions due to the creation of SMART AGROWETLANDS System, estimated by LCA at 6743 kg CO2e (relatively limited impact) to be distributed over the infrastructure lifetime (5 years).
The total volume of water, used in 2018 experiment, was 135 mm with the traditional system based on IRRINET and 142 mm according to the AquaCrop internal advice, with a different distribution during the development period of the crop. The greater quantity of water used (+7 mm), should have corresponded to an increase in biomass of 0.5 t/ha according to maize water productivity (0,34 t/ha) and typical summer ET0 (4.7 mm/day). There was instead an increase of 1.8 t/ha, an increase more than 3 times greater than expected, corresponding to more efficient utilisation of water resource. This advantage, due to the greater water volume delivered in the initial growth period, is also accompanied by a lower accumulation of salts in the soil surface layers, an important fact for the development of plants in the juvenile phase.

Assuming that SMART AGROWETLANDS system can be applied to 200 yearly irrigated ha served by the WSN, and assuming: 1) the production increment is 1 t/ha/year, 2) carbon content in dry biomass is 50%, since the conversion factor from Ce to CO2e is 44/12, the incremental CO2 removed from the atmosphere amounts to 360 t/year, compared to 1.4 t/year produced by the system. It is therefore sufficient that a minimal fraction of the biomass remains in the soil or returns there through fertilisation, for the balance to be positive.

THE AFTER-LIFE PLAN 2021-2025

OBJECTIVES OF THE AFTER-LIFE PLAN – The After-LIFE Plan of the LIFE AGROWETLANDS II aims to ensure the dissemination of the SMART AGROWETLANDS System. SMART AGROWETLANDS System is the tool through which the results that LIFE AGROWETLANDS II set out to achieve, were achieved: "save irrigation water, maintaining agricultural productivity, minimize soil and water quality degradation by salinization and allow the sustainable development of agriculture, particularly in the surrounding of valuable wetland habitats".

METHODOLOGY OF THE AFTER-LIFE PLAN

The positive results obtained through the adoption of the SMART AGROWETLANDS for irrigation recommendations, concerning both productive and environmental aspects, will be verified through further experiments in the first two crop seasons (2021 and 2022) of the After-LIFE. The existing WSN, the DSS, the web Agrowetlands portal, and the maize cultivated fields of the Agrisfera farm will be used. Farmers other than farmers of Agrisfera will be involved/informed on the irrigation management during the two growing seasons.

It is likely that in the first two years of After-LIFE, some farmers involved in the demonstration activities previously mentioned, will want to adopt the SMART AGROWETLANDS System on their farm. In this phase the LIFE AGROWETLANDS II Consortium, in particular Winet and UNIBO, can offer the skills acquired during the Project to new farmers who want to equip themselves with a WSN. Farmers will be invited to use the facilities already available on the website of LIFE AGROWETLANDS II, to familiarize themselves with the use of the Smart AGROWETLANDS system ("Guida all'utilizzo del Sistema SMART AGROWETLANDS per gli agricoltori"; ppt presentations in Italian language, on the functioning of the AquaCrop model).

However, in the perspective over several years (5 years or more) and with a greater number of farmers interested, the After-LIFE Plan foresees to improve the actual organization. Funding will be necessary to organize a more diffuse support to the farmers, willing to install the SMART AGROWETLANDS System in their farms.
In addition, LIFE AGROWETLANDS has outlined the benefits of jointly using SMART AGROWETLANDS irrigation advice together with high-resolution satellite images. This is to develop differentiated irrigation at variable rates that better take into account environmental and pedological heterogeneity. The use of relatively complex technologies generates the need to make a qualitative leap in order to provide a more advanced technical support to farmers. In this regard, it is possible to hypothesize the creation of services, involving qualified and specialized personnel to the extent of 1-2 FTE every 4-5000 ha of agricultural land and, similarly, 3 FTE with lower qualifications, in direct contact with farmers, for assistance and field maintenance etc.
All these aspects concern complex organizational processes, which will be addressed in the After-LIFE, but which could take longer than five years, to reach completion. Stakeholders participating in the virtual Final Conference of the LIFE AGROWETLANDS II, will be involved to sustain these more challenging aspects of the After-LIFE Plan.

REPLICABILITY AND COOPERATION and THE AFTER-LIFE PLAN - To complete the After-LIFE PLAN, attention is given to the positive results as well as the collaboration experienced during the replicability in the South of Spain. In the framework of climate change, rising temperatures and reduction of precipitations, SMART AGROWETLAND System has wide possibility of applications in other Mediterranean Countries (Europe and North Africa) with semi-arid or arid climate, where salty soils are frequently present. The preparation of a project proposal, Involving UNIBO, another Italian University, IVIA (Spain), a Tunisian (and/or other North Africa) University or Research centre, one

European and one North Africa farm, one or two SMEs is foreseen for submission to the 2022 PRIMA (Partnership for Research and Innovation in the Mediterranean Area) call, in the Section "Water and Sustainable Agriculture".

FUNDING NEED AND SOURCE OF FUNDING – The table below summarizes the costs of the After-LIFE PLAN. Funding for activities 1 to 8 (210 k euro) are particularly important to manage the After-LIFE Plan.

WHAT	WHEN	FUNDING FORESEEN/NECESSARY
1 - Application of SMART AGROWETLANDS on maize fields in Agrisfera Farm, to verify the results already obtained during the LIFE AGROWETLANDS II Project.	2021 and 2022	**FORESEEN**: **15 k euro** by 2014-2020 Rural Development Programme (CALL of September 2020- Deadline 25 November 2020)
2 – WSN and Website maintenance	2021 to 2025	**NECESSARY: 25 k euro**
2 - Involvement of farmers other than those of Agrisfera, in demonstration activities on irrigation management during the experiments at point 1	2021 and 2022	**NECESSARY**: **10 k euro**, for dissemination activities with farmers (2021-2022)
3 - Installation of new WSN modules in other farms with salinity problems	2021 to 2025	Costs borne by farmers
4 – Assistance to farmers (new installations, point 3)	2021 and 2022	UNIBO and WINET assist the farmers
5 – Organization of a more diffuse support to the farmers	2023 to 2025	**NECESSARY**: 40 k euro
6 – Training of a researcher for 2 years on the joint utilization of high-resolution satellite images and SMART AGROWETLANDS System	2022 and 2023	**NECESSARY**: 80 k euro
7 - Encouraging the organization of regional specialized irrigation service for farms on saline soils. Involvement of the LIFE AGROWETLANDS II Stakeholders	2021, 2022 and 2023	**NECESSARY**: 40 k euro
WHAT	**WHEN**	**FUNDING FORESEEN/NECESSARY**
8 – Preparation of a project proposal to submit to the 2022 PRIMA Call	2021 and 2022	**CONTRIBUTION REQUESTED:** 650 k euro

TOTAL FUNDING: 860 k euro (210 + 650 k euro)

AVAILABLE FUNDING: 0 euro

FORESEEN FUNDING: 15 k eur

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