EXPERIMENTATION 4

The LIFE+ PROJECT WSTORE2 (LIFE11 ENV/IT/035): reconciling agriculture with environment through a new water governance in coastal and saline areas

THE CONTEXT

Scenarios of climate change

The latest studies on the subject of climate change show that, very likely, the area of the northern Adriatic sea will be characterized by an increase of the average air and water temperatures, by a rainfall reduction, and by a greater frequency and intensity of extreme events, and finally by a rise of the average sea level.

The most vulnerable areas to these events will be the low coastal areas and the reclaimed lands, which are particularly sensitive to rising sea level. In addition to the direct risks from rising sea we have to add secondary ones, as the infiltration of salt water into coastal aquifers, the intrusion of the salt wedge, loss of wetlands and marine and coastal biodiversity.

Territory and environment in coastal areas: the salinity problem

As said above it is likely that, without targeted interventions, the areas most at risk will be subjected to a decrease in the amount of fresh water and its quality decline for the accentuation of the phenomena of salinization with negative consequences both to natural environments and cultivated areas. In coastal areas, the main component of salt in the soil is the result of marine deposits. To this, in case of low rainfall, it could be added an insufficient fresh water flow from the layer under-surface to counteract the ascent of salt water in the zone explored by the roots. In inland reclaimed land salinization commonly occurs as an outcome of agricultural practices, either associated with irrigation or due to reduced

Wetland "Falconera" located in the western part of the site Vallevecchia and Caorle lagoon. In the upper left side the sea.

water flow in the landscape or changed water management. Ultimately, if the climate change scenarios described above will occur, it will go inexorably to face phenomena of excessive salinity. This would result in the loss of valuable natural areas and the environmental benefits associated with them, an impoverishment of agricultural activity, the loss of economic activity and, ultimately, the abandonment of man from coastal areas.

The site of Vallevecchia

Vallevecchia is a farm used by Veneto Agricoltura as pilot and demonstrative center. It is located along the coast between the seaside resorts of Caorle and Bibione, and is characterized as being the last great, not urbanized, coastal site of the northern Adriatic.

The site is the last reclamation of the Veneto and it has maintained relevant natural and environment features, especially for the presence between the beach and the pine forest of one of the largest coastal dune systems of the Veneto. Because of the presence of this particular habitat, Vallevecchia has been recognized as a Special Protection Area and Site of Community Importance in the Natura 2000 Network of the European Community.

More recently environmental restoration have reshaped wetlands, rebuilding habitat that once were reclaimed land. Today, on a total of nearly 800 ha almost half are occupied by areas of great natural value: 63 ha of coastal pine forest, 100 hectares of coastal lowland forests, 24 km of hedgerows, 7 large wetlands totaling 68 ha, 14 small wetlands including a phytoremediation basin.

Drain and rural landscape.

Phenomena related to climate change and salinity they were studied in the territory of Vallevecchia during extensive research conducted by the University of Padua. The analysis of research data shows the recurrence of more or less important intrusion events of sea water along the canals and groundwater. Some soils show also signs of heightened salinity. This is partly justified by the fact that the contributions in the coastal zone of meteoric fresh water are lower by about 40% compared to the inland areas only 15 kilometers away, because of the influence of the sea to weather conditions. Fresh water is scarce and therefore has a weak opposition (especially when no hydraulic management is performed) against saline intrusion, which is also favored by the position of the area, located slightly below the mean sea level and bordering the sea.

The territory of Vallevecchia, in the context of climate change mitigation, is therefore an ideal laboratory to test the effectiveness of solutions to the problems mentioned above.

Effects of salinity in one of the plots: failed areas and stunted growth in a soybean crop.

The site Vallevecchia in a satellite image. The areas outlined in yellow are those directly affected by the project.

THE PROJECT

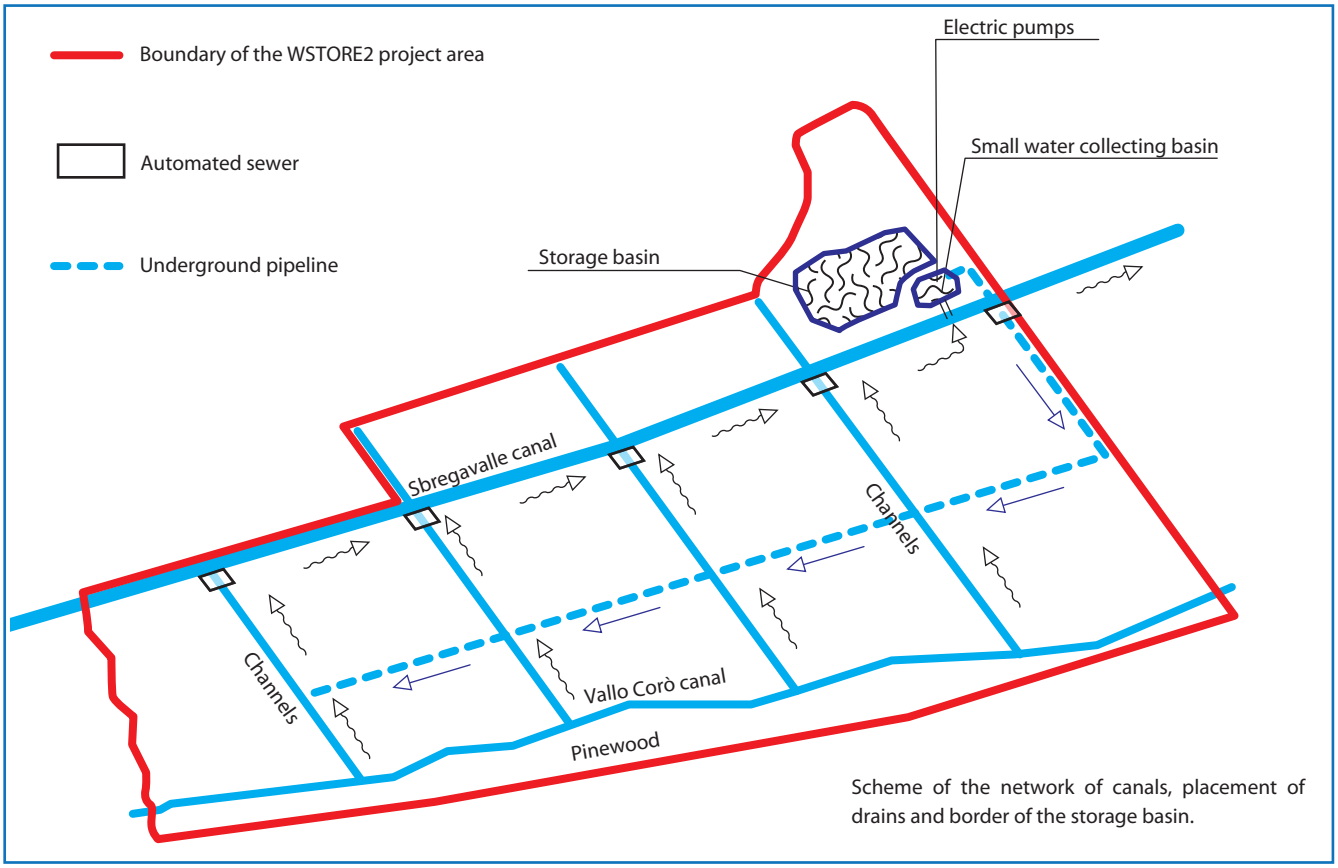
Main objectives

The project, through an innovative rainwater management system, aims to ensure the conservation of the environment and economic activities in coastal areas threatened by climate change.

The specific objectives of the project:

- provide an automatic decision-making system for the management of rainwater that in real time, reacting to the change of physical-chemical parameters of the water of the drainage network and the soil (in particular the electrical conductivity of which is related to the content of the salts) allowing the accumulation in a basin of quality water (reduced content of salts);
- develop a water distribution system allowing the distribution of the stored freshwater to the noncultivated areas and the efficient irrigation of significant portion of cultivated land;
- develop an optimized cultivation system suitable for the qualitative and quantitative characteristics of the water stored in the basin;
- promote participatory management of water management and the direct involvement of local stakeholders;
- evaluate the overall performances of the proposed project's model from both environmental and economic point of view and share the achievements with local stakeholders;
- demonstrate the validity of the proposed model, in its complexity, and to encourage replication in other European contexts.

Automated weir remotely controlled.



Scheme of the network of canals, placement of drains and border of the storage basin.

Methodology

The most relevant and innovative methodological aspect of the WSTORE2 project is the fully automatic management of rainwater. This is analyzed directly in the drainage channels of the parcels by a network of sensors of electrical conductivity and, if deemed appropriate, that is, less than or equal to a critical threshold of salt content, is pumped and stored in a collecting basin (artificial lake) to be subsequently reused. The availability of fresh water reserve of the basin is the key technical element of the whole system as it allows the maintenance of natural areas and the use of fresh water for agronomic purposes of the entire farm. The effects of the system on natural areas and the different activities connected with the territory, and the economic sustainability (a full cost - benefit analysis) are an integral part of the project. The development of the project was organized with the involvement of key local stakeholders by organizing specific information sessions and sharing of design choices.

Technical elements of automation

The flow of rainwater is collected from the water mains and regulated by 5 automated weirs, equipped with sensors for

Loading basin.

Main storage basin of fresh water (160,000 m^3).

salinity and devices for sending and receiving data via a Wi-Fi network. At regular intervals the data are sent to a central computerized system that elaborates the information through tested algorithms.

The system remotely controls the automated weirs, and in summary, it decided to:

- Allow the flow of water in the catchment area (160,000 m^3) when this has the minimum requirements;
- Remove the water from the hydraulic grid through lifting water-pumps when the salt concentration is too high.

The fresh water stored in the basin can then be reallocated in the opposite direction via an additional pump to the cultivated parcels and natural and semi-natural areas.

Uses of fresh water reserves in the farm

Depending on climate and soils conditions the fresh water of good quality of the storage basin can be used for washing the soils (and thus reduce the salinity of the soil layer explored by the roots), to create and consolidate a water-table of fresh water above the deeper salt water-table, for the revitalization of the water in the drainage network, water restoration of wetlands and for crop irrigation.

Sunset on the storage basin with various typologies of birds.

RESULTS

Effectiveness of the technique

In two years of operation (2014-2015) the automatic selection of the water has allowed the accumulation of water with quality from good to fair, with an electrical conductivity between 1000 and 2000 µS/cm (it is recalled that a water of excellent quality has conductivity <1000 µS/cm). The system has also demonstrated excellent reactivity of response in intercepting 24 hours 24 all the opportunities to store water derived from rainfall events, event of short duration but of great intensity (eg. Summer storms) which, in the absence of the automatic system made in the project, would be lost.

Agronomic benefits

The results collected during the project highlighted the effectiveness and benefits of the system of water management in improving soil fertility for crops. In 2015, thanks to good quality water in the storage basin was possible to irrigate an area of over 59 ha with irrigation systems at low pressure (drip irrigation and micro-irrigation).

Irrigated crops in the experimental trials.

Both crops traditionally grown in Vallevecchia, (such as corn and soybeans) and more difficult as some horticultural crops have benefited of the new system. In fact, in recent experiments, vegetable crops sensitive to salinity have been successfully cultivated. In addition, the availability of water for irrigation purposes, beside improving productivity of demanding crops as maize, has made possible the exploration of cultivation scenarios previously unthinkable as the realization of after crops. Overall it was recorded an increase of both quantity and quality of yields of crops already in the rotations before the completion of the new water management system.

Environmental observations and wildlife

After the introduction of the new water management system the first environmental observations showed important changes in Vallevecchia. Within plant species it is consolidating the presence of species that, before the interventions, only sporadically were detected. This helps to characterize even more the specificity of coastal wetland ecosystem. In addition, a notable presence of green and diversified areas, even in periods of rainfall absence, is observable in the natural areas of the site.

At the level of birdlife results are also already tangible. In the period between March 2014 and May 2015 in the course of numerous control outputs were observed 113 species of birds, 19 of which are included in Annex I of Directive 2009/147 "Birds".

The largest number of species linked to wetlands ecosystems was observed from points located nearby the storage basin and the one located close the eastern basin wetlands where, consistent bands of reeds, have definitely helped increase the number of aquatic species. As regards the presence of birds of particular interest we remember the Savi's Warbler

Detail of a body of freshwater characterized by typical plant species of wetlands.

Two specimens of Ferruginous spotted in the storage basin.

detected in the spring of 2015, uncommon specie, appearing occasionally during migration. In other points, placed at the areas of phytoremediation a substantial homogeneity, with a percentage of aquatic species between 35% and 38% has been recorded. The basin of accumulation has proved important for different species of Anatidae, both surface (Mallard, Wigeon, Shoveler and Garganey Teal) and depth (Ferruginous Duck and Common Pochard). In January 2015 two males of Scaup were also observed. The observation of these species, typically linked to aquatic ecosystems of fresh water, coincided with the start of the automated water accumulation in the basin.

Grey Heron.

Drainage canal and lowland forest in the Eastern area of the site.

THE PROJECT WSTORE2 IN A LONG-TERM PERSPECTIVE

The project was conceived in self-contained modules; each of them can be chosen individually to address and resolve specific aspects of water management in coastal areas. The implementation of each module took place with the involvement and contribution of stakeholders that, together with the project partners have contributed to the various operations in a shared process and participated. Then, the cultural and technical elements were been discussed and defined through the contribution of the actors who, in the years ahead, will have to deal in various contexts, with water management for environmental and agricultural purpose.

With WSTORE2 it has been demonstrated that a dual use of water resources is possible. Improve farm incomes and, at the same time, counteract land degradation with benefits to natural ecosystems is the most important message arising from the realization of the project in the Vallevecchia farm.

THE WORKING GROUP AND THE MAIN ROLE OF EACH PARTNER IN THE PROJECT

Coordination

Veneto Agricoltura – Legnaro (PD), project leader: dr Lorenzo Furlan

Most important activities carried out (role) in the project

Management, coordination and monitoring of the project; realization of technical part of water management; environmental monitoring; monitoring the impact towards stakeholders; creation of documents and reports; project web-site realization; contacts with other projects.

Partner

Consorzio di bonifica di secondo grado per il Canale Emiliano Romagnolo CER – Bologna

Most important activities carried out (role) in the project

Contribution to the realization of the technical part of water management; monitoring impact on environmental problem; creation of documents and reports; information and involvement of policy makers; contribution to the realization of the project web-site; results communication to technical experts.

GAL Venezia Orientale – Portogruaro (VE)

Most important activities carried out (role) in the project

Contribution to the realization of the technical part of water management; environmental monitoring; documents realization and reporting; information and engagement with policy makers; actions targeted to undifferentiated public.

Dipartimento Ingegneria Industriale – Università degli Studi di Padova

Most important activities carried out (role) in the project

Contribution to the realization of the technical part of water management; monitoring impact on environmental problem; preparation of documents and reporting; information and involvement of policy makers; contribution to the realization of the project site; results communication to technical experts; technical part of the web-site.

Workshop and visit to the experimental trial conducted in 2014.

VENETO AGRICOLTURA

Canale Emiliano Romagnolo

VENEZIA ORIENTALE VeGAL Venezia Orientale

DIPARTIMENTO DI INGEGNERIA INDUSTRIALE DELL'UNIVERSITÀ DI PADOVA