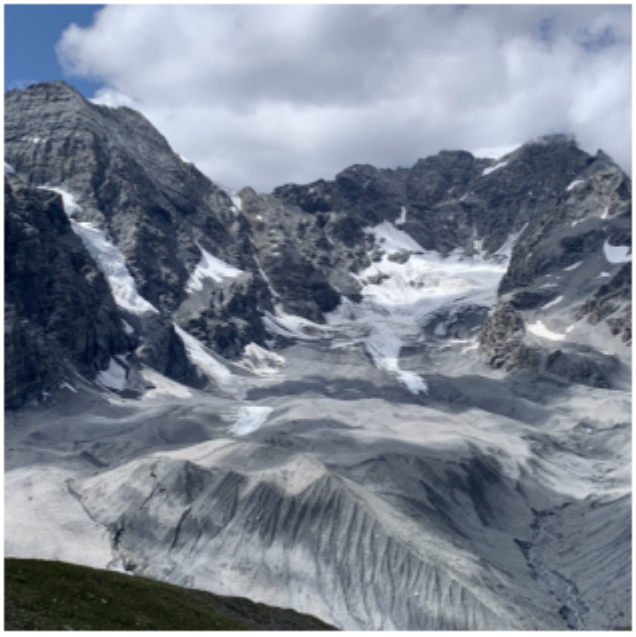
Project SUSTGREENHOUSE

The sustainable greenhouse: demonstrative action for zero emission intensive greenhouse agriculture

climate change | carbon foot print | carbon emissions | mitigation

PROJECT DESCRIPTION



The **climate change** imposes the implementation of **adaptation and mitigation strategies** in many sectors of the human activities which cause the emission of huge quantities of greenhouse gases.

As for agriculture this need is especially felt in the case of **greenhouse horticulture** , as far as the traditional practices request the use of a lot of chemicals, energy and water which produces large quantities of greenhouse gases and polluting effluents.

This situation is even more problematic when the 85 hectares of greenhouses (on a total land area of 600 hectares) are located in nature reserves or protected areas as in the case of the Special Protected Area of the **Fondi Lake in the Regional Park of the Ausoni Mountains**, area of implementation of the **Sustgreenhouse** project's activities. This area is at risk and environmentally fragile due to its geologic and hydrologic conformation, especially because of the extensive pumping of its groundwater for agricultural use.

OBJECTIVES

The overall objective of the project was **to demonstrate, through** the construction of a sustainable greenhouse model put in comparison with a traditional one, **that farming can be conducted by more environmentally friendly ways in terms of**:

- Direct and indirect emission of greenhouse gases;
- Extraction of water from the ground;
- Percolation to the soil and diffusion in the air of nutrients and chemical pollutants.

In the project area from several years is in use a technique for the winter heating of the greenhouses which is based on the so called defrosting irrigation. The technique consists in the spilling of water on the roof of the greenhouse when the external temperature lowers below 5 °C. The water is drawn from the ground and it is estimated that in the whole area the total annual consumption of the water used for defrosting is on average of 15.7 million liters/ hectare of greenhouse, that is much higher than the quantity of water needed for the irrigation of the plants. It 'clear that this involves the dispersion of thousands of cubic meters of fresh water per year and the depletion of groundwater what becomes even more relevant in a territory highly exposed to:

- land subsidence,
- saline intrusion with progressive salinisation of the wells,
- depletion of the groundwater,
- surface runoff and risks of pollutants infiltration,

- soil erosion.

The new greenhouse structure was made with technical features geared to sustainability by optimizing the production, and at the same time, the economic management, through:

- **rationalization of the irrigation and the defrosting systems** and use of **thermal screens on the greenhouse**;
- use of **compost** to be added to the ground;
- use of **zeolites**, minerals capable of capturing water and elements and release them to the roots slowly;
- use of **mycorrhiza**, symbiotic structure formed by the association between soil fungi and plant roots, which brings benefits in terms of root growth, increased resistance to water stress and drought and increased resistance to diseases;
- use of innovative irrigation and fertilization systems (**precision farming**).

PROJECT PHASES

The project was implemented through 4 principal actions aimed at demonstrating that with a balanced supply of water and mineral nutrition it is possible to have quality production in agriculture which can be, at the same time, of low environmental impact:

- **preparatory activities**. After studying the territory and identifying the site where to build the demonstration model, the functional parameters of the facility were defined, and the facility was set up. **Two greenhouses were compared** for three years, **a more sustainable one**, realized by adopting the best technologies on the market for the emission reduction, **and a traditional one**;
- management of the **model greenhouse** with "precision farming" techniques foreseeing a reduced input of irrigation and fertilization on the basis of calculations obtained from instrumental monitoring of the crops, and the realization of **four crop cycles** of two typical local crops, zucchini and tomatoes. This reduction of input was compared to the conventional inputs based on the regional regulations for the agricultural practices governed by integrated pest management;
- **overall analysis** of the agronomic and productive results, and calculation of the economic and environmental balance of the four crop cycles also through **an LCA (Life Cycle Assessment)**;
- **information, dissemination and training activities** through guided visits for students, training courses for technicians of the field and provision of information materials.

PROJECT RESULTS

The proposed greenhouse model showed that through the use of specific technical arrangements it is possible to reach substantial **benefits both in environmental** (saving water, reducing chemical inputs and greenhouse gas emissions) **and in economic terms**, related this latter to the savings of the farmers.

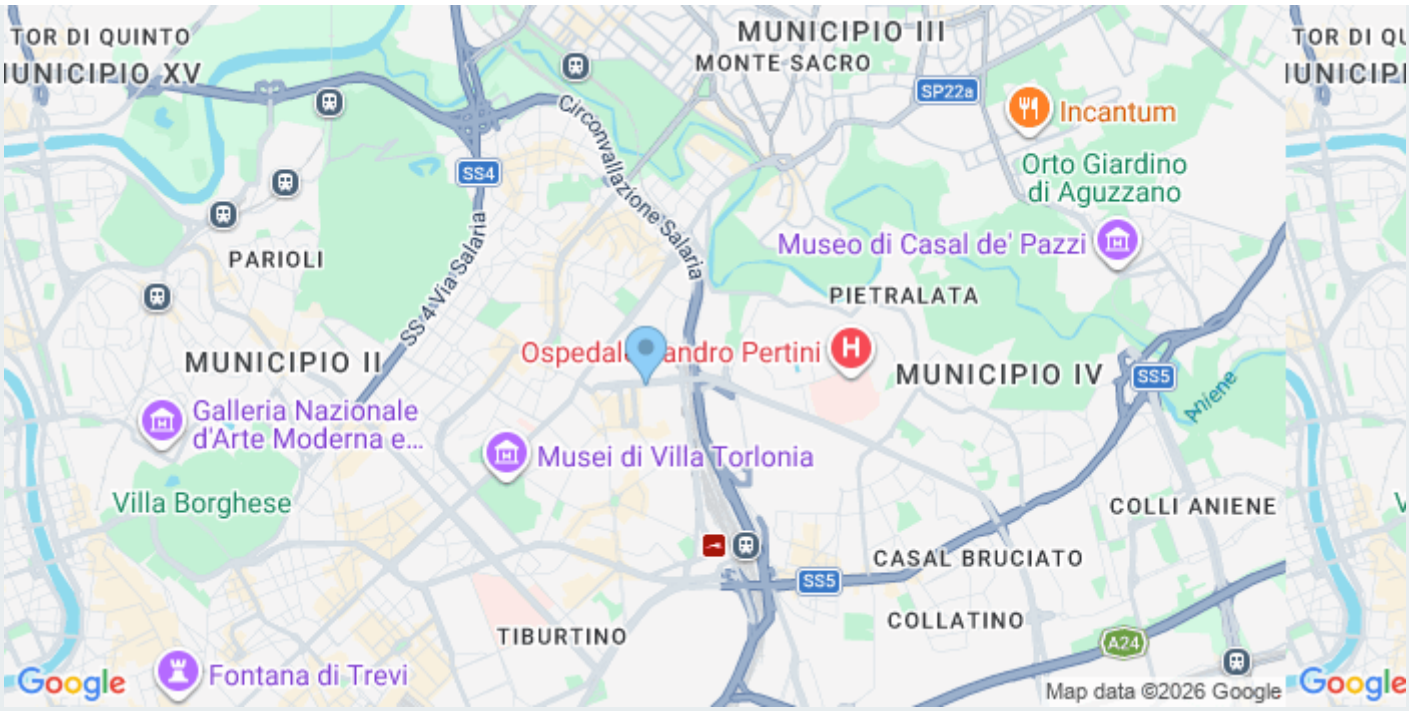
From the point of view of farmers the interest for this technique lies in the fact that the simultaneous adoption of two or more innovative methods amplifies the results. For example, the parallel use of precision farming, compost and mycorrhiza allowed to save up to 29% of nitrogen, over 20% of irrigation water and to reduce by 4% the unit cost of production per hectare. For local authorities, instead, the attractiveness of the model is represented by the advantages of its possible application on a larger scale. In fact, if only half of the 85 hectares of greenhouses present in the Plain of Fondi adopted these innovative methods, with only two crops a year, it would lead to a reduction in the annual average of the groundwater consumption of over 500,000 cubic meters for the defrosting system and of 150,000 cubic meters for the plant watering. It would be also possible to have a **reduction of** about 3 tons of **chemicals**, of 364 kg of CO2 release into the atmosphere and of 620 kg of non-renewable resources. All this with an **increase of** the average **productivity** of between 5 - 10% and a reduction of the production costs of between 2 - 4%.

In detail, the main results achieved by the project were:

- **LCA assessment**, performed for the first time in Italy with reference to a greenhouse cultivation, showed how the use of compost can help **to reduce CO2 emissions;**
- **use of dynamic spreader of 360 °,** instead of the Sbrinex perforated pipe, for the spreading of water in the defrosting irrigation system, enabled a greater coverage of the greenhouse surfaces and therefore a greater efficiency, **reducing water volumes (from 8, 15 to 5,10 cubic meters / hour)** and obtaining a **saving of the water volume up to 23%;**
- **use of a thermal screen** which allowed to produce, thanks to the more temperate climate in the sustainable greenhouse, **a harvest of about 16% greater than that conventional.** In addition, thanks to the drier climate, there were less diseases which made necessary to have **only 8 chemical treatments (1,9 kg x 1000 m2)** compared to the 11 treatments (5,3 kg x 1000 m2) of the conventional greenhouses subject to fungi attacks. Moreover it was avoided the summer practice of "liming" (smearing the roof with lime) to shade the plants. But the thermal screen, combined with the defrosting irrigation system, was crucial especially in terms of water saving, allowing to **save up to 86% of groundwater**.

From an overall balance it can be deduced that the rather substantial costs of the thermal screen can be **amortized** through the saved costs and the gained benefits.

- **adoption of precision farming techniques**, which allow to dose water and nutrients to the plants according to their needs, helped to improve the physiological state and the quality of the crop and allowed to avoid waste with **savings up to 24% of water and 27% of nitrogen**.
- **addition of substrates in the soil** resulted in benefits in both environmental and economic terms. In particular the addition of compost in the ground led to the improvement of the crop and the decrease of the production costs. The most important results were achieved, however, in terms of environmental protection as fertilization could be accomplished by using organic waste, avoiding landfilling.
- **reduction of CO2 emissions by about 10% and reduction of effluents** to groundwater and in the Fondi Lake **amounting to around 20%.**
- **greater awareness** of farmers and agronomist students on sustainable agricultural practices through specialized training courses for technicians of the sector (**29 subscriptions**); **guided study visits** to the sustainable greenhouse model with the overall participation of **994 students and 63 teachers and accompanying persons belonging to 7 different educational institutions**; realization of an educational game on sustainable greenhouse agriculture and development of an animated slideshow on the project for the younger students.
- **issue of a** Study report on the territorial situation that illustrates the natural environment with elements related to climate, hydrogeology, flora and fauna and in particular the state of the local agriculture in its environmental, economic and technical aspects.
- **issue of a** Manual of horticulture: the sustainable greenhouse, which is an important tool of capitalization and educational dissemination of the knowledge gained by the proposed model.



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Acronym
SUSTGREENHOUSE

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LIFE07 /ENV/IT/000516

Reference Programme
LIFE

Beneficiary Coordinator
ARSIAL (Agenzia Regionale per lo Sviluppo e l'Innovazione dell'Agricoltura

del Lazio)

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440.883,00

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2007

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2009

End Year
2012

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Region
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