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A Network of Farms to Develop and Test Innovations for Climate-Smart Cropping Systems

Elisa Marraccini¹, Vittoria Giannini², Gabriela Alandia¹, Giorgio Borreani³, Mirco Corazzin¹, Gemini Delle Vedove¹, Francesco Ferrero³, Stefano Grigolato⁴, Carmelo Maucieri², Tanja Mimmo⁵, Carlo Nicoletto², Silvia Panozzo⁶, Gaetano R. Pesce², Gabriele Rolando³, Luigi Sartori, Paolo Sivilotti¹, Enrico Sturaro², Ernesto Tabacco³, Massimo Tagliavini⁵, Eren Taskin⁵, Damiano Zanotelli⁵, Maurizio Borin²

¹ DI4A, Univ. Udine, IT, elisa.marraccini@uniud.it

² DAFNAE, Univ. Padova, IT, vittoria.giannini@unipd.it

³ DISAFA, Univ. Torino, IT, giorgio.borreani@unito.it

⁴ TESAF, Univ. Padova, IT, stefano.grigolato@unipd.it

⁵ Faculty of Agricultural, Environmental and Food Sciences, Univ. Bolzano, IT, tanja.mimmo@unibz.it

⁶ IPSP-CNR, IT, silvia.panozzo@cnr.it

Introduction

Digital technologies are essential to achieve a carbon-neutral Europe by 2050. In the farming sector, technologies such as precision farming, artificial intelligence, prediction systems, or green data spaces will help analysis and decision-making, and are expected to reduce global emissions by 15% (European Commission, 2020). Moreover, for a green, digital and resilient economy the direct involvement and engagement of stakeholders is fundamental to empower them and let them lead the digital green transition (Muench et al., 2022). Nowadays, several approaches are applied according to stakeholders' interests and needs to conduct participatory planning and on-farm experimentation; co-develop and explore solutions; monitor and assess systems and processes; and/or disseminate and promote production practices (Bouma, 2021; Lacoste et al., 2021; Toffolini and Jeuffroy, 2022). In this context, the main goal of Task 4.2.1 of the Italian Agritech National Center is to set up a network of farms composed of several units in forms of living labs in order to test in real conditions innovative approaches and climate-smart agricultural practices.

Material and Methods

The methodology used to set-up a farm network can be summarized in three steps. The first regards an overall discussion among research groups involved on the: a) definition of the main issues of investigation/demonstration according to the general objectives of the Spoke 4 within the Agritech National Center, b) identification of potential farms that could contribute to co-develop innovation according to the defined objectives. The second step will be operative, based on the interaction and collaboration among researchers, farmers and stakeholders to build the farm network. This activity is based on: a) field visits and involvement of the farms; b) initial on-farm assessments; c) identification of individual farmer preferences for the issues of investigation and the type of involvement in the network.

Once the network will be established, the third step will start. In that last phase, individual farmer-researcher-farmer and farmers-researchers-farmers/stakeholders contacts will take place to test and demonstrate in real conditions innovative climate-smart agricultural practices.

Preliminary results and discussion

The preliminary results include the farm network design. The network will involve farms mainly located in Northern Italy and particularly the Po valley, which is one of the most productive Italian agricultural areas, which is particularly affected by climate change (flooding, salinity, drought).

Considering the framework in which the research activity is set, a series of indicators dealing with water, carbon and energy management will be co-constructed and analysed. Moreover, we will build water and carbon-related scenarios starting from the farm business as usual and then taking into account the effectiveness of innovation on both carbon and water footprints for a subset of farms aiming at co-

developing and testing innovation. Examples of innovations include the implementation of drought resistant summer crop genotypes, cover crops, innovative irrigation systems or weed management.

The design of the network considered the expected activities in the farms belonging to the network, the type of farms involved and the structure of the network. The network is composed of some farms collaborating in the project with different research units. These farms could be differently involved according to their features: 1) *commercial farms* providing data and feedbacks to the network, participating to the demonstration activities taking place in other farms of the network; 2) *demonstration farms* providing data and feedback to the network and wishing to host demonstration or on-farm experiments in their farm; 3) *lighthouse farms* already having an outstanding performance in terms of resilience to climate change on their farm and wishing to participate to demonstration actions. These lighthouse farms can be part of the network either from the beginning or can be recognized as such according to the performance results measured during the project.

A group of farms within the network having the same farming system and collaborating with a research group involved in the project will create a living lab. Therefore, there will be 14 living labs in the farm network as summarised in Table 1. Within the network, four living labs of arable farms are expected, followed by three living labs of orchard and vineyard farms.

Table 1. Farming systems involved in the farm network

Research group involved	Arable farms	Mixed farms	Orchard farms	Vineyard farms	Vegetable farms	Forestry systems
CNR	X		X	X		
University of Bolzano			X			
University of Padova	X			X	X	X
University of Torino	X	X	X			
University of Udine	X	X		X		

Conclusions

The set-up of a farm network within the Spoke 4 of the Italian Agritech National Center is expected to generate several types of outcomes: 1) establishing a medium-term agricultural monitoring network able to provide multiannual data about cropping system resilience to climate change; 2) enabling peer-to-peer and researcher-farmers learning to generate innovative knowledge on climate-smart cropping systems; 3) testing different cropping systems and technological solutions.

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