

SUSCROP





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ERA-NET Cofund on Sustainable Crop Production

About

SusCrop was an ERA-Net Cofund Action under H2020, which aimed to strengthen the European Research Area (ERA) in the field of Sustainable Crop Production through enhanced cooperation and coordination of different national and regional research programmes. In this regard, SusCrop brought together 34 owners and managers from 19 different countries from national and regional R&D&I programmes of EU Member States, EU-associated States and Third countries with significant experience in research funding and coordination.

Aim and objectives

SusCrop had four major strategic objectives:

- Enhancement of predictive breeding technologies and development of new genotypes leading to new phenotypes and crop varieties
- Development and exploitation of novel integrated pest and crop management methods and practices
- Improvement of resource-use efficiency of crops and cropping systems
- Systemic research on agricultural crops as part of an ecosystem ("plant as a meta-organism")

Challenges

One of the Grand Societal Challenges of the 21st century is to ensure food and nutrient security for a growing population under climate change and pressure on natural resources.

To do this, sustainable crop production needs to be secured and enhanced. Current food production methods utilise excess energy, water, pesticides and chemicals. New ways of sustainable crop production are necessary to increase productivity, reduce the amount of chemical inputs and/or improve the quality of the crops. This will be crucial to maintain access to affordable, safe and nutritious food for a healthy life, and to serve the increasing demand for industrially used biomass whilst keeping and improving a healthy environment, natural habitats and increasing biodiversity. Modern crop production must be addressed by taking into account the whole food value chain, crop diversity and resilience, resource use efficiency, nutrient recycling, ecosystem services, environmental impacts, integrated pest management and waste reduction and use in order to achieve food and nutrition security.

Widespread use of simplified cropping systems with large fields cultivated in standardized operations with large-scale machinery strongly influence agricultural habitats, soil structure and soil organisms. Monocultures tend to reduce the variety of cultivated species, contribute to overexploiting soils and also render crops more vulnerable to pests and climate extremes. Wild habitats disappear when field margins and hedges are cleared to combine smaller fields, fertilisation modifies plant community composition in field margins and pesticides have direct and indirect lethal or sublethal effects on survival or reproduction of plants, invertebrates, mammals, and birds. The simplification of cropping systems leads to erosion of the heritage of species and varietal diversity from European farmland and the ability



to adjust crops and cultivation practices to differences in soil quality and other landscape characteristics. Thus, reduced biodiversity will eventually result in a decrease of agricultural productivity.

With the Green Deal, the European Union has pledged to foster the ecological transition and has set stringent goals for reduction of chemical pesticides, fertilisers and antibiotics, and has pledged to reverse the trend of biodiversity degradation by 2030. According to the European Environment Agency, compared to 2015, agricultural habitats show an overall deterioration in conservation status: good status decreased from 14% to 12% and bad status increased from 39% to 45%. Only 8% of agricultural habitats show an improving trend, whereas 45% are deteriorating.

The EU biodiversity strategy for 2030 pledges to "Bringing nature back to agricultural land" and demands solutions to substantially improve agrobiodiversity in European agricultural systems, including innovative agro-ecological practices building on knowledge of beneficial and manageable variation in species and varieties within and between fields. In its 2020 Strategic Research Agenda (SRA), FACCE-JPI has stated the need to adopt research and farming approaches such as agro-ecology, agrobiodiversity, conservation farming/regenerative agriculture, circular farming, organic farming... that can have a transformative role at the farming system level but also at the level of the broader bioeconomy, as they can inspire new products, new business models, supply chain configurations, cooperation among firms, trade relations, responsible business and marketing conduct. Moreover, the SRA notes the importance of improving and adapting these practices to the specific contexts, particularly in relation to weather volatility due to climate change.

The SusCrop ERA-NET has also flagged sustainable crop production, particularly (agro-)biodiversity as a key topic. Therefore, research is needed that:

- (a) leads to the production of new and/or improved crop varieties to cope with the consequences of climate change,
- (b) enhances biodiversity of crops and in cropping systems contributing to nutritional and food security for a balanced and diverse human diet.

Scope, goals and research topics

SusCrop focuses on the core research theme "Environmentally sustainable intensification of agricultural systems." The network contributes to sustainable crop production, particularly agro-diversification strategies tailored to different European agricultural systems, and targeting landscapes and cropping systems with low and/or moderate agro-biodiversity, higher negative impact on agrobiodiversity, or most at risk due to low resilience. In this context, SusCrop and FACCE-JPI have joint forces and launched a Joint Call on Agrobiodiversity in 2022.

During the final period of the ERA-Net Cofund action, SusCrop published in August 2023 a White Pater on 'Future Research Needs in Sustainable Crop Production'. In this document, the four most relevant research needs are presented. Work in SusCrop highlighted both research needs and a methodology for working. The initial focus concerned protein crops, primarily for food but also including feed. Here the term protein refers to proteins coming from plants (but not algae) and therefore including e.g. grasses. Further, the focus was on production (crop improvement and cultivation) but taking into account the value chain. More generally, there was a focus on "niche crops", which have huge potential in the future, given that there is sufficient investment in research and a step-by-step approach to developing and



sharing knowledge on such crops. In this context, the following four relevant research areas/topics in the field of sustainable crop production were elaborated and are defined as:

Topic 1. Knowledge generation in relation to nutritional value and health benefits of protein/niche crops

This gap concerns the nutritional quality of protein/niche crop species for human health by increasing micronutrients (phytochemicals,(pro)-vitamins, trace minerals), decreasing anti-nutrients, optimising bioavailability, improving amino acids as well as the associated processing techniques to safeguard the beneficial plant compounds.

Topic 2. Knowledge generation and transfer on multi-stress resistance for stable yield

Further research is needed on the links between yield and biotic (pests, diseases etc.) and abiotic stress (drought, salinity due to climate change, CO2, temperature). In addition to investigation of resistance to individual and combined stresses, better linking genetics and genomics, and making more use of bridge species.

Topics 1 and 2 should be supported by the following items:

- A toolbox for researchers investigating protein/nice crops, including:
 - Development of fundamental tools at the research level for protein/niche crops: genomes, markers + mapping populations + seeds/seedbanks especially with vouchers of sequenced accessions as well as transformation methods;
 - Efficient pathways to move from lab models to real life production (including microbiome);
 - Understanding the value chain for protein/niche crops beyond the farm gate, including policy and society (feeding back into a and b).
- Concrete information for farmers on a particular species for decision-making on cultivation practices
 - o Better understanding of growth and biology/genetics;
 - Better understanding of crop management.

Topic 3. Innovation pipeline: Protein/niche crops for food and feed value chains: How to build up a value chain for uncultivated protein/niche crops

To support the development of the protein/niche crop food value chain, research is needed as efforts so far have supported mainly the feed value chain.





Topic 4. Impact assessment and trade-offs

Research needs concern the impacts of switching our current land use and production to protein/niche crops with emphasis on the shift to systemic approaches and on resulting consequences with regard to climate change. Socio-economic research is also needed to identify and demonstrate the value of protein/niche crops and to develop better understanding of both global environmental impact and of the potential for protein/niche crop value chains for food at local, national and international levels.

