# Thematic Piece: Climate adaptation & farm management

## Joint Programming Initiative on Agriculture, Food Security and Climate Change FACCEJPI.NET

*This series of thematic pieces spotlight FACCE-JPI projects on a specific theme. This piece will centre on projects with the theme of food security and climate change.*

### How does farm management relate to climate adaptation?

Adapting to climate change means seeking to reduce both the current and projected impacts of climate change, to limit the associated risks, and to benefit from any opportunities when possible. It is one of two main responses to climate change, the other being mitigation – reducing greenhouse gas emissions ~~to~~ by addressing ~~the~~ root causes. Climate adaptation represents a major challenge for food security and sustainability in Europe. At the farm level, a transition is needed to prepare for and adjust to climate change.

Various farm management systems that manage ecosystem services sustainably have been studied or are studied in FACCE-JPI research projects. These farming systems range from organic, to climate-smart, circular, agroforesty, and conservationist. These projects make clear that:

1. Alternative farm systems have clear benefits for soils, biodiversity and agricultural production, but still face difficulties in adoption.
2. There are regional variations in conditions (arid, wet, soil type) and farm management seeks directions which need to be taken into account, also outside of the European Union as the EU imports food from neighbouring regions
3. Water management (e.g. irrigation and coping with salinisation) is key to the implementation of novel farm management systems.

*Short description of the projects*

**WaterFARMING: Improvement of water and nutrient retention and use efficiency in arable farming systems from field to catchment scale in Europe and North Africa**

ERA-NET Cofund WaterWorks2015 Joint Call. Together with JPI Water

Duration: March 1, 2017 - December 31, 2020

*Short description of the project*

The objective of WaterFARMING was to enhance water and nutrient retention capacity and improve use efficiency in diverse arable production systems **across Europe and North Africa** to reduce soil and water pollution for sustainable management of water resources. In WaterFARMING:

- the potential to enhance retention and use efficiencies of water and nutrients at field, farm and catchment scale through water and soil conserving practices were quantified in a selected network of production systems.
- innovative practices and sustainable water and nutrient use production systems were designed, such as **agroforestry and conservation agriculture**.
- A web-based decision support tool for informed decision-making by farmers, advisory services and policy-makers was developed.

*Key insights related to food security and climate change:*

- Farm management can maximise Soil Organic Carbon (SOC) benefits and maintain Nitrogen (N) rates to reduce the off-farm N losses depending on the environmental zones, land use and the production system.
- Agroforestry systems were more productive by 36–100% compared to monocultures.
- Adoption of water and soil conserving practices in Europe and North Africa will contribute to the retention of water and nutrients at source and produce more with the same input. Adoption of water and nutrient-efficient production systems will also reduce the outflow of contaminated water.
- Despite reported benefits, such as improved soil fertility, crop growth, better water infiltration, increased biological activity, decreased soil erosion and reduced labour, machinery use and fuel costs, conservation agriculture is practised only in 25.8% of European agricultural lands.
- There is a need for **field-based investigations, policies and subsidies to support** conservation agriculture adoption for enhanced soil functions.

*Major publications*

Ghaley, B.B.; Rusu, T.; Sandén, T.; et al. 2018. Assessment of 21 benefits of conservation agroculture on soil functions in arable production systems in Europe. *Sustainability*, 10 (794). https://doi.org/10.3390/su10030794

Ghaley, B.B; Wösten, H.; Olesen, J.E.; et al. 2018. Simulation of soil organic carbon effects on long-term winter wheat (triticum aestivum) production under varying fertilizer inputs. *Frontiers in Plant Science* (Open access), 9 (1158). https://doi.org/10.3389/fpls.2018.01158

Lehmann, L.M.; Smith, J.; Westaway, S.; et al. 2020. Productivity and Economic Evaluation of Agroforestry Systems for Sustainable Production of Food and Non-Food Products. *Sustainability* 2020, 12(13), 5429. https://doi.org/10.3390/su12135429

## CINDERELLA: Comparative analysis, INtegration anD ExemplaRy implEmentation of cLimate smart LAnd use practices on organic soils

FACCE ERA-NET+

Duration: February 1, 2015 — March 31, 2018

*Short description of the project*

After centuries of peatland destruction and neglect, CINDERELLA aimed to advance **paludiculture** (agriculture on wet or rewetted peatlands) through field and lab investigations, desk studies and activities for dissemination and awareness. It relied on comparative analysis, integration and exemplary implementation of climate-smart land use practices on organic soils (peatlands). CINDERELLA developed **management strategies** for minimising greenhouse gas emissions and nutrient release from **organic soils**, incorporating ecosystem services. CINDERELLA focused primarily on climate mitigation, but its farm management around paludiculture is also highly relevant to climate adaptation.

*Key insights*

- Comparable biomass yields and revenues to conventional agriculture are potentially achievable under optimal conditions with currently available techniques and tools.
- Using wetland plants as renewable bioenergy crops instead of fossil fuels has the ecological benefit of reducing greenhouse gas (GHG) emissions, improving water quality and conserving peat soils.
- The main challenges to changing management practices include the profitability of the current land use, the difficult economic environment of farmers, the cultural background of the region, and the absence of systematic data on soil properties.
- A **long-term vision** for farm management on these soils and for eliciting society's willingness to invest in preserving organic soils is required to compensate for the cost of not farming on these soils.

*Major publications*

Ferré, M.; Muller; A.; Leifeld, J.; et al. (2019). Sustainable management of cultivated peatlands in Switzerland: Insights, challenges, and opportunities. *Land Use Policy* 87. https://doi.org/10.1016/j.landusepol.2019.05.038

Ren, L.; Eller, F.; Lambertini, C.; et al. (2019). Assessing nutrient responses and biomass quality for selection of appropriate paludiculture crops. *Science of The Total Environment*. https://doi.org/10.1016/j.scitotenv.2019.01.419

Geurts, J.; Duinen, G.A.; Belle, J.; et al. (2019). Recognize the high potential of paludiculture on rewetted peat soils to mitigate climate change. *Landbauforschung Volkenrode;* 69: 5-8. https://doi.org/10.3220/LBF1576769203000

## TRUSTFARM: Towards Resilient and sUStainable integrated agro-ecosystems Through appropriate climate-smart FARMing practices

FOSC

Duration: June 1, 2021 — May 1, 2024

*Short description of the project*

Agriculture in the **Mediterranean and Sub-Saharan Africa** is is increasingly challenged by climate change. TRUSTFARM designed two Climate-Smart Farm Practices (CSFPs) that cope with climate change that leads to variability in food security: 1) **Reduce Reuse Recycle** (RRR) to produce high-quality compost; and 2) **Dairy and meat products and wool from small ruminants**. These were selected through Multi-Stakeholder Innovation Platforms (MIPs). A toolbox of innovative pathways is being developed that contains the following:

- Identification and promotion of food crops with high-yielding germplasm that are resistant to heat and disease;
- Soil and water conservation to improve productive capacity;
- Adoption of best practices in ruminant husbandry.
- An assessment of the environmental and economic impacts of the designed systems using Life Cycle Analysis.
- A business model.

*Key insights related to food security and climate change*

- Improving crop productivity under water stress, rainfall variability, and soil salinisation is possible in Mediterranean cropping systems through intelligent climate farming practices (CSFP) that make use of the principles of the circular economy.
- Improvement of irrigation management is one of the main options in Mediterranean cropping systems to increase the efficiency of water use.
- Among the sustainable irrigation strategies, supplementary irrigation consists in the application of **small quantities** of irrigation water to crops that are normally grown in dry conditions.
- There are several promising species that can maintain the productivity levels of traditional crops under increasing climate stress. Examples are quinoa and grain amaranth.

*Major publications*

Pulvento, C.; Ahmed, O.; Sellami, M.H.; et al. Sustainable Irrigation and Abiotic Tolerant Crops in South Italy within TRUSTFARM Project. *Environ. Sci. Proc.* 2022, 16(8). https://doi.org/10.3390/environsciproc2022016008

## SALAD: Saline Agriculture as a Strategy to Adapt to Climate Change

FOSC

Duration: June 1, 2021 — May 31, 2024

*Short description of the project*

Salinisation is one of the main challenges of contemporary agriculture affecting food security and sustainability. Climate change impacts coastal areas by sea-level rise and more frequent droughts. These events increase the salinity in agricultural soils, affecting food systems overstretched by an increasing global population. Progressing salinisation is one of the major drivers of soil degradation in Europe and North Africa, exerting increasing pressure on conventional farming. Therefore, the inter- and transdisciplinary project SALAD aims at improving the resilience of food production in saline and potentially saline agricultural areas in the Mediterranean and the North Sea regions by:

- Supporting the development and sustainable use of innovative salt-tolerant crops;
- Identifying and further developing crop cultivation suited to saline conditions;
- Exploring and testing innovative market development techniques and instruments with the goal of upscaling crop/food chains across the regions;
- Exchanging knowledge and transferring practical and adaptive solutions among stakeholders.

*Key insights*

- Choice of well-adapted crop genotypes, seed treatments and farming practices enhance and sustain crop production in saline lands.
- Developing an integrated and long-term oriented policy on saline agriculture could bring benefits such as avoiding yield losses, safeguarding the income of farmer communities, protecting biodiversity and increasing water efficiency.
- There is a need for regional and international networks that serve as platforms for a science and policy interface.

*Major publications*

Bourhim, M.R.; Cheto, S.; Qaddoury, A.; Hirich, A.; Ghoulam, C., Chemical Seed Priming with Zinc Sulfate Improves Quinoa Tolerance to Salinity at Germination Stage. Environ. Sci. Proc. 2022, 16, 23. https://doi.org/10.3390/environsciproc2022016023

Holst, H., van; van Tongeren, P.; Velling, P.; Negacz, K. *Advancing towards a Climate-Resilient Future: Putting Saline Agriculture on the European Policy Agenda*. Policy Brief, 2023, Institute for Environmental Studies. https://doi.org/10.17605/OSF.IO/8BWT3

Negacz, K.; van Tongeren, P.; Ferrone, L.; et al. The Emergence of a Governance Landscape for Saline Agriculture in Europe, the Middle East and North Africa. *Environ. Sci. Proc.* 2022, 16, 33. https://doi.org/10.3390/environsciproc2022016033

K. Negacz; van Tongeren, P.; Ferrone, L.; Martellozzo, F.; Randeli. F. *Saline agriculture initiatives in Mediterranean and North Sea Region*. 2022. https://doi.org/10.17605/OSF.IO/RFSP3

El Mouttaqi A, Sabraoui T, Belcaid M. et al. and Hirich A, Agromorphological and biochemical responses of quinoa (Chenopodium quinoa Willd. var: ICBA-Q5) to organic amendments under various salinity conditions. *Front. Plant Sci*. 2023, 14.. https://doi:10.3389/fpls.2023.1143170

For an overview of all FACCE-JPI projects, check the project wheel which gathers information on the 170 projects funded by FACCE-JPI. Both past and currently running projects are included.

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