

Annex 2. EJP SOIL call topics

Topic: Sustainable production (SP)

SP1 Alleviating soil compaction in a climate change context

Rationale/specific challenge: Soil compaction is considered a major European soil health challenge, and a threat for the soils' capacity to deal with climate mitigation and adaptation. The historical changes of compaction levels were shown to coincide with a stagnation in crop yields in the 1990s for cereals in many European countries (Keller et al. 2019)¹. Soil compaction restricts root growth and thereby the uptake of nutrients and water leading to yield losses and reduced carbon input to both top- and subsoil. Soil compaction also affects the timeliness of soil operations especially in a changing climate, which may also affect crop yields (Kolberg et al. 2020)². Thus, alleviation of soil compaction is critical for sustained or increased soil carbon storage and accounting for soil compaction effects may be necessary in forecasting the evolution of SOC stocks in European soils. Climate change is also expected to strongly worsen the soil compaction problem. Impeded root growth due to soil compaction will aggravate effects of more frequent droughts with detrimental effects on yields and carbon input. Soil compaction-induced restricted water transport will also exacerbate problems with flooding in a future climate with more extreme rainfall events (Keller et al. 2019). There is a strong need for an analysis of the impact of climate change on the extent and the effects of soil compaction. The extent and severity of the soil compaction challenge is strongly related to soil management in terms of field traffic with heavy machinery and livestock trampling. The extent of the soil compaction and the impacts on climate change adaptation, soil carbon storage and soil health in general needs to be quantified at EU scale for different pedo-climatic conditions and cropping systems. Strategies to limit the risk of soil compaction in a climate change context need to be developed with focus on traffic intensity, weight of machinery and timing of operations. Novel advanced technologies in the field of digital farming and robotisation may be applied to significantly reduce the soil compaction problem, but this has been scarcely researched. There is also a need for better knowledge on the recovery of compacted soil and the development of bio-based strategies to stimulate recovery.

Scope: The scope of project is to analyze how climate change affects the extent of soil compaction and how soil compaction affects the capacity of soils to adapt to climate change and mitigate it. For this the project will quantify the extent and severity of the soil compaction problem at EU scale for different pedo-climatic conditions and cropping systems considering both topsoil and subsoil compaction. The project will analyze and develop management strategies that reduce risk of compaction and stimulate the recovery of compacted soil. Management strategies will be developed and tested in collaboration with farmers. The project will gather knowledge from past and current EU and national activities and initiate targeted measurements and modelling activities to fill in significant knowledge gaps.

¹ Keller, T., Sandin, M., Colombi, T., Horn, R., Or, D., 2019. Historical increase in agricultural machinery weights enhanced soil stress levels and adversely affected soil functioning. *Soil and Tillage Research* 194.

² Kolberg, D., Riley, H., Børresen, T., 2020. Timeliness and traffic intensity in spring fieldwork in Norway: Importance of soil physical properties, persistence of soil degradation, and consequences for cereal yield. *AGRICULTURAL AND FOOD SCIENCE* 29, 154–165.

Expected outcomes:

- Analysis of the impact of soil compaction in a changing climate.
- Quantifying the extent and severity of the soil compaction problem for different pedo-climatic conditions and cropping systems under climate change.
- Improved knowledge of management strategies and technologies to reduce risk of soil compaction and the recovery of compacted soil in a climate change context.

Expected Impacts:

- EJP SOIL EI1: Fostering understanding of soil management and its influence on climate mitigation and adaptation, sustainable agricultural production and environment.

Project Type: Medium size research project (up to 2M€).