

## Session 3: Land use / cropping systems

# Challenges and opportunities for sustaining crop production under future climates

*Dr. Giulia Vico, SLU*

Crop production is heavily affected by climatic conditions. Currently, a large fraction of crop yield variability can be explained by climatic conditions and, in particular, climatic extremes, in both temperature and precipitation. Moreover, the yields of several crops and regions are already exhibiting some declines, which have been attributed to recent changes in climate. Further declines in yields and increases in their variability are expected under future conditions. Adaptations can at least partially mitigate these changes, by sustaining high and stable yields under current and future, more extreme conditions.

Three types of management strategies towards more climate resilient agriculture are reviewed: i) inputs; ii) crop choice; and iii) diversification.

Among the inputs, irrigation can stave off the effects of dry spell but also reduce the occurrence and severity of crop heat stress; soil amendments, like the use of organic fertilizers and biochar addition, can improve the soil water retention capacity and, as such, often lead to more stable yields in the face of climatic variability. Yet, some contrasting results emerge regarding the effects of soil amendments.

Crop choice for resilient agriculture requires selecting crops or crop varieties that can withstand and thrive under a wide variety of climatic conditions. Nevertheless, traits may have interactive effects, so that it is difficult to know *a priori* their net effect. A case in point is that of perennial grain crops: despite their larger transpiring biomass, their deeper roots can help in stabilizing yields under drier conditions, although on lower levels than those common in annual grain crops.

Finally, diversification practices offer a number of opportunities for more climate resilient agriculture, although mechanisms are often still unclear. Diversification in space can be achieved within field via crop mixtures, but also in the landscape, promoting a portfolio effect and supporting landscape-scale ecosystem services. Crop rotations are an example of diversification in time. Long-term experiments show that diverse rotations confer an advantage in terms of yields over monocultures, in particular under drier conditions, i.e. conditions that are expected to become more common in the future. Nevertheless, the mechanism behind this response are still unknown.

This review of potential adaptation strategies shows that, while the potential benefits of some management strategies are known, the mechanisms explaining these benefits and the inherent trade-offs are not always completely understood. A combination of approaches is needed to identify the most promising set of adaptations towards a more climate resilient agriculture: on the one hand, *ad hoc* experiments can inform the development process-based models, which in turn are powerful tools to effectively explore a large number of climatic, crop and management scenarios. On the other hand, long-term experiments provide data on the actual response of crops when confronted with a variety of climatic conditions, including extremes.