



Ecohydrology of managed ecosystems: Linking rainfall unpredictability, agronomic performance, and sustainable water use

Giulia Vico (1) and Amilcare Porporato (2)

(1) Swedish University of Agricultural Sciences (SLU), Department of Crop Production Ecology, Uppsala, Sweden (giulia.vico@slu.se), (2) Duke University, Department of Civil and Environmental Engineering, Durham, NC, USA (amilcare@duke.edu)

The field of ecohydrology, traditionally focusing on natural ecosystems, can offer the necessary quantitative tools to assess and compare the sustainability of agriculture across climates, soil types, crops, and irrigation strategies, including rainfall unpredictability. In particular, irrigation is one of the main strategies to enhance and stabilize agricultural productivity, but represents a cost in terms of often scarce water resources. Here, the sustainability of irrigated and rainfed agriculture is assessed by means of water productivity (defined as the ratio between yield and total supplied water), yields, water requirements, and their variability. These indicators are quantified using a probabilistic description of the soil water balance and crop development. Employing this framework, we interpret changes in water productivity as total water input is altered, in two staple crops (maize and wheat) grown under different soils, climates, and irrigation strategies. Climate change scenarios are explored by using the same approach and altering the rainfall statistics. For a given irrigation strategy, intermediate rainfall inputs leads to the highest variability in yield and irrigation water requirement - it is under these conditions that water management is most problematic. When considering the contrasting needs of limiting water requirements while ensuring adequate yields, micro-irrigation emerges as the most sustainable strategy at the field level, although consideration should be given to its profitability and long-term environmental implications.