Terrain and climate change impact on WUE of durum wheat in a semi-arid hilly catchment

Ferrara R.M., Introna M., Martinelli N., Rana G.
CRA- Research Unit for agriculture in dry environments, Via C. Ulpiani, 5, 70125 Bari (Italy), fax +39 080 5475023, email: rossana.ferrara@entecra.it

The effects of climate change on agriculture are widely investigated by means of the support of crop simulation models which can be useful to evaluate the efficacy of probable mitigation and adaptation strategies for improving the sustainability of crop growing in future scenarios. Even if wheat yield could benefit from increasing atmospheric CO$_2$ which could mitigate limited water availability in dry conditions, the interaction between climate, water and CO$_2$ concentration is still unclear with respect to its effect on crop yield. Moreover, any simulation model has investigated in detail the terrain effects (slope, elevation and azimuth effects) on the crop growth in function of climate changes. The focus of this paper is to relate predicted yields of wheat crops to topographic characteristics, analysing the vulnerability in future scenarios with respect to crop cultivated in plane in a semi-arid region in South Italy. The presented simulation has been based on the model STAMINA, which is the result of an European project (EU-QLK-5-CT-2002-01313) where a risk assessment for arable agriculture in hilly landscape has been done in detail in the final report of the project. This complex cropping system model, integrating spatial information, simulates agro-meteorology, hydrology, crop development and photosynthesis in hilly terrain, deriving, among others variables, Agro-Ecological Indicators (AEI) for aiding decision makers to improve sustainable farming at the catchment scale. Among the AEI indicators obtainable by STAMINA model, the WUE, defined by the ratio of yield and cumulative actual evapotranspiration, has been analysed to show how the spatial heterogeneity of the landscape affected its distribution in time and space. Moreover, a study on how management practices could mitigate negative impacts of climate change and topography has been done. Adaptation solutions are needed to counterbalance the warming effect and the shortage of water forecasted for semi-arid: changes in sowing dates, use of longer season cultivars and new genotypes can be possible solutions. In function of this consideration, simulations with an early sowing date have been done, obtaining a mitigation of the negative effect on crop yield of warmer temperature with a significant improvement in production stability. Moreover, an improvement of wheat cultivation in hilly landscape during future scenarios has been obtained using as adaptation solution the old usage to leave a field lying fallow for trying to handle the shortage of water in the dry environment.