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Combining integrated models and participatory methods to quantify water and agricultural trade-offs linked to different rural development scenarios

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This study explores the water and agricultural tradeoffs linked to three different rural development scenarios in the Cega-Eresma-Adaja basin (CEA) in Central Spain. Agriculture is a key socioeconomic activity in CEA, and nearly 44% of the basin is devoted to croplands and pastures. Irrigated agriculture accounts for 12% of the cropland area and is currently using over 84% of available water resources.

To define the three scenarios for CEA, we conducted a workshop with local stakeholders to infer how contrasting evolutions of EU agricultural, water and environmental policies could affect the local land use and agricultural management using participatory mapping techniques. The three scenarios reflect 1) a business as usual (BAU) rural development; 2) a land sharing strategy (LSH); and 3) a land sparing (LSP) situation.

The integrated Soil Water Assessment Tool (SWAT) was used to model the changes in water use (hm3/year) and agricultural productivity (ton/year) under each scenario. To account for changes in agricultural land use and management, the model integrates a large set of agricultural patterns obtained from combining high resolution remote sensing images (20m x 20m) for the years 2011-2015, agricultural productivity from survey by municipality and land use information obtained from the national map SIOSE2011 (1:50.000). Model calibration and sensitivity analysis were performed using SWAT-CUP/SUFI2 The period of the years 2005 to 2008 were used for parameter calibration and validation period extending between 2009 and 2014. The predicted daily streamflow presents a correlation coefficient of 0.76 and a NS coefficient of 0.81.

The preliminary results reveal that under a BAU and a LSP scenario agricultural production and water demand will increase significantly (>25%) despite the improvements in water use efficiency and agricultural productivity. Under these scenarios, allocated water is likely to exceed the natural renewable water resources compromising the hydrological and natural balance of the basin. Under a LSH scenario, water use will decrease (10%) from the current situation, but it will entail a loss of agricultural productivity that depends of crop rotations. The results of this study exemplify how participatory approaches and stakeholder knowledge can be incorporated into modeling exercises to address complex water-agriculture problems, as well as the high data requirements needed to provide robust results that can support better decision making.