



Assessing irrigation modernization effects with agro-hydrological modelling. A case study in Spanish traditional agriculture.

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During last decades, the promotion of water use efficiency in irrigation has been a key adaptation strategy to water scarcity scenarios, mainly through infrastructures modernization and pressurized irrigation transition. However, many case studies worldwide evidence that this transition may not be effective to reduce pressure under natural water resources, and even it might generate socioeconomic and environmental negative impacts.

To improve knowledge about irrigation modernization implications, a comparative analysis of water balance and yield between gravity-fed and drip irrigated citrus orchards is developed. These orchards belong to the “Acequia Real del Júcar” irrigation district (ARJ), located in the Valencia province (Spain). The ARJ, with more than 750 years of history and 22.000 hectares of irrigated land, is one of the most important irrigation district in the Júcar River Basin but also in Spain.

To perform this analysis, an agro-hydrological model has been developed, which has been calibrated and validated with daily soil moisture values registered in a control drip irrigated citrus orchard. The model is applied to this case study together with the use of remote-sensing tools, field data collection and interviews with implied users. Finally, an upscaling is performed by extrapolation of average results obtained at plot scale. The aim is to achieve a first estimation of global implications that modernization of total citrus area in the ARJ will have.

As results, applied irrigation decreases around 22% at modernized orchards, which will generate a reduction in ARJ demand of 30 Mm³/year when modernization process is completed. However, this lower use of water produces a practically equivalent decrease on return flows. For this reason, net water savings at basin scale will be approximately 7 Mm³/year, while remaining 23 Mm³/year will actually correspond to a reduction on inflows to water bodies with certain economic use or environmental value, such as the aquifer “la Plana de Valencia Sur”, the Júcar river lower reach or “la Albufera de Valencia” which is a wetland included in Natura 2000 network. On the other hand, yield per hectare in modernized orchards is on average 27% higher than in gravity-fed orchards. The increase on farms yield will suppose a growth of 59 thousand tons in citrus annual production of the ARJ after modernization project, which is valued at 9 million € per year. This increment on yield is produced because higher transpiration is observed in drip irrigated orchards, due to less water stress in the crops. However, the effect on water consumption at plot scale is practically null, because the higher consumption by crops transpiration is compensated by a reduction on evaporation losses. Furthermore, neither expansion on irrigated land nor crop changes associated to modernization actions are observed, so the modernization of the ARJ is not generating a “rebound effect”.

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